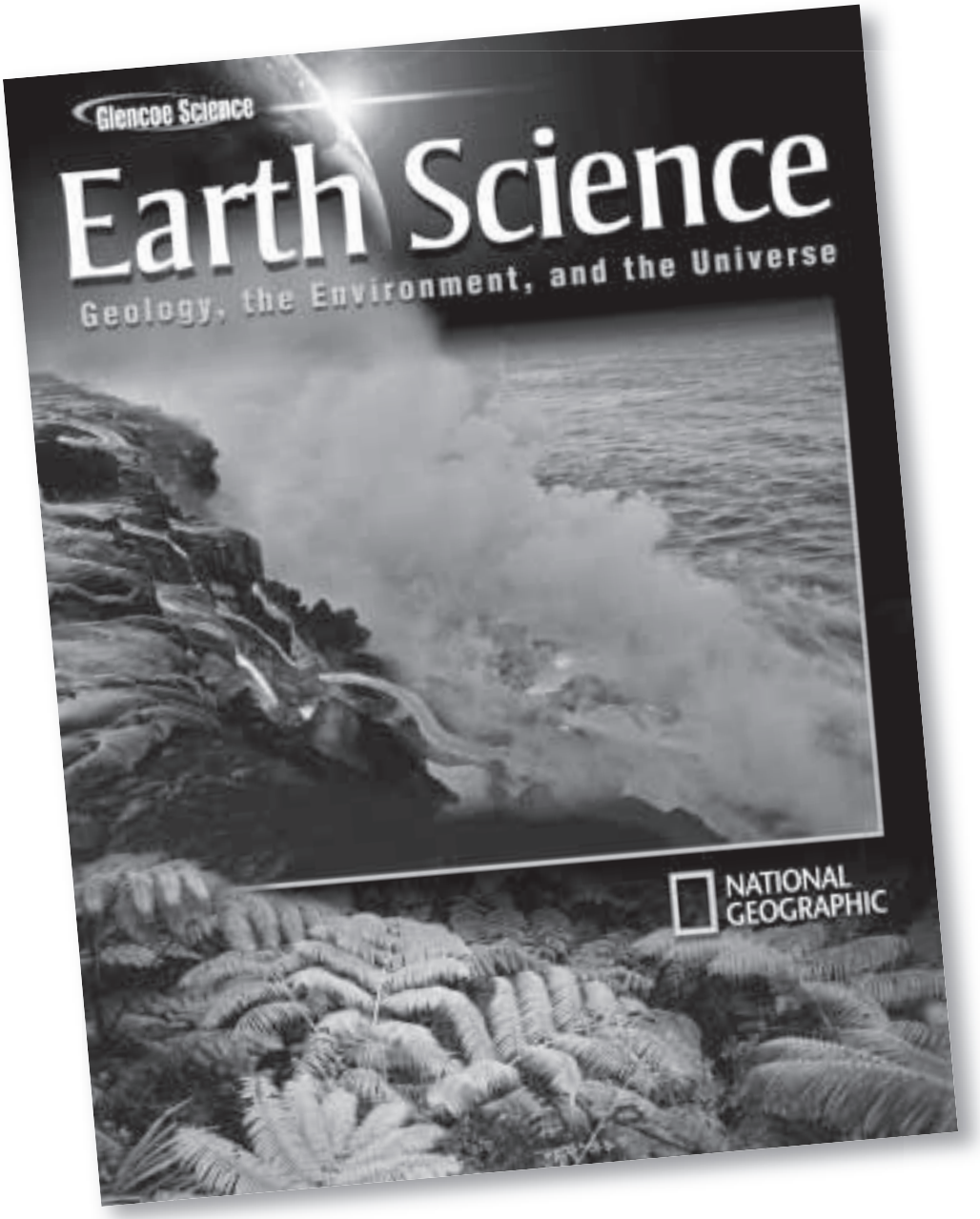
UNIT 3 RESOURCES

Surface Processes on Earth



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Teacher Approval Initials
Date of Approval

Lab Safety Form

Name: _____

Date: _____

Lab type (circle one) : Launch Lab, MiniLab, GeoLab

Lab Title: _____

Read carefully the entire lab and then answer the following questions. Your teacher must initial this form before you begin.

1. What is the purpose of the investigation?

_____

_____

_____

2. Will you be working with a partner or on a team? _____

3. Is this a design-your-own procedure? Circle: Yes No

4. Describe the safety procedures and additional warnings that you must follow as you perform this investigation.

_____

_____

_____

5. Are there any steps in the procedure or lab safety symbols that you do not understand? Explain.

_____

_____

_____

Table of Contents

Reproducible Pages

Chapter 7 Weathering, Erosion, and Soil

Name Class Date

MiniLab 7

Model Erosion

How do rocks erode? When rocks are weathered by their surrounding environment, perticles can be carried away by erosion.

Procedure 

1. Read and complete the lab safety form.
2. Carve your name deeply into a bar of soap with a toothpick. Measure the mass of the soap.

_____

3. Measure and record the depth of the letters carved into the soap.

_____

4. Place the bar of soap on its edge in a catch basin.
5. Slowly pour water over the bar of soap until a noticeable change occurs in the depth of the carved letters.
6. Measure and record the depth of the carved letters.

_____

Analysis

1. **Describe** how the depth of the letters carved into the bar of soap changed.

_____

_____

2. **Infer** whether the shape, size, or mass of the bar of soap changed.

_____

_____

_____

3. **Consider** what additional procedure you could follow to determine whether any soap wore away.

_____

_____

Name Class Date

GeoLab Model Mineral Weathering

Many factors affect the rate of weathering of Earth materials. Two major factors that affect the rate at which a rock weathers include the length of time it is exposed to a weathering agent and the composition of the rock.

PREPARATION

Problem

What is the relationship between exposure time and weathering?

Materials

plastic jar with lid
water (300 mL)
halite chips (100 g)
balance
timer
paper towels

Objectives

In this Geolab, you will:

- **Determine** the relationship between the length of time that rocks are exposed to running water and the degree of weathering of the rocks.
- **Describe** the appearance of weathered rocks.
- **Infer** what other factors may influence the rate of weathering.
- **Apply** your results to a real-world situation.

Safety Precautions

Wear splash-resistant safety goggles and an apron while you do this activity. Do not ingest the halite chips.

Weathering Data

Shaking Time (min)	Starting Mass of Chips (g)	Final Mass of Chips (g)	Change in Mass of Chips (g)
2			
4			
6			
8			

Name Class Date

GeoLab Model Mineral Weathering

PROCEDURE

1. Read and complete the lab safety form.
2. Soak 100 g of halite chips in water overnight.
3. As a class, decide on a uniform method of shaking the jars.
4. Pour off the water, and use paper towels to gently dry the halite chips. Divide them into four piles on the paper towel.
5. Use a balance to find the starting mass of one pile of the chips.
6. Place the halite chips in the plastic jar.
7. Add 300 mL of water to the jar.
8. Secure the lid on the jar, and shake the jar for the assigned period of time.
9. Pour the water from the jar.
10. Use paper towels to gently dry the halite chips.
11. Use a balance to find the final mass of the chips. Record your measurement in a data table similar to the one provided.
12. Subtract the final mass from the starting mass to calculate the change in mass of the halite chips.
13. Repeat Steps 4 to 12 using a fresh pile of halite chips for each period of time.

ANALYZE AND CONCLUDE

1. **State** What real-world process did you model in this investigation?

2. **Infer** Why did you need to soak the halite chips before conducting the expenment?

3. **Compare** the lab procedure with actual weathering processes. What did the halite represent? What process did shaking the jar represent?

Name Class Date

GeoLab Model Mineral Weathering

CONCLUDE AND APPLY

4. Deduce How would acid precipitation affect this process in the real world?

5. Conclude How would the results of your investigation be affected if you used pieces of quartz instead of halite?

INQUIRY EXTENSION

Design an Experiment This lab demonstrated the relationship between exposure time and weathering. Consider other factors that affect weathering. Design an experiment to measure the effects of those factors.

Chemical Weathering

Use with Chapter 7
Section 7.1

Hydrolysis

$$2KAlSi_3O_8 + 2(H^+ + HCO_3^-) + H_2O \rightarrow Al_2Si_2O_5(OH)_4 + 2K^+ + 2HCO_3^- + 4SiO_2$$

$2KAlSi_3O_8$	$2(H^+ + HCO_3^-)$	H_2O	$Al_2Si_2O_5(OH)_4$	$2K^+$	$2HCO_3^-$	$4SiO_2$
potassium feldspar	carbonic acid	water	kaolinite	potassium ion	bicarbonate ion	silica

potassium ion, bicarbonate ion, silica: in solution

Oxidation

$$4FeO_2 + O_2 \rightarrow 2Fe_2O_3$$

$4FeO_2$	O_2	$2Fe_2O_3$
ferrous oxide	oxygen gas	hematite

Carbonic Acid Formation

$$H_2O + CO_2 \rightarrow H_2CO_3$$

H_2O	CO_2	H_2CO_3
water	carbon dioxide	carbonic acid

Acid Precipitation Formation

$$SO_3 + H_2O \rightarrow H_2SO_4$$

SO_3	H_2O	H_2SO_4
sulfur trioxide	water	sulfuric acid

$$3NO_2 + H_2O \rightarrow NO + 2HNO_3$$

$3NO_2$	H_2O	NO	$2HNO_3$
nitrogen dioxide	water		nitric acid

Name Class Date

WORKSHEET 16 TEACHING TRANSPARENCY

Use with Chapter 7
Section 7.1

Chemical Weathering

1. What is chemical weathering?

2. What is hydrolysis?

3. According to the chemical equation, what happens to potassium feldspar during hydrolysis?

4. How is carbonic acid formed, and what is its role in chemical weathering?

5. What substances react and form during oxidation?

6. Which chemical processes shown involve carbon acid?

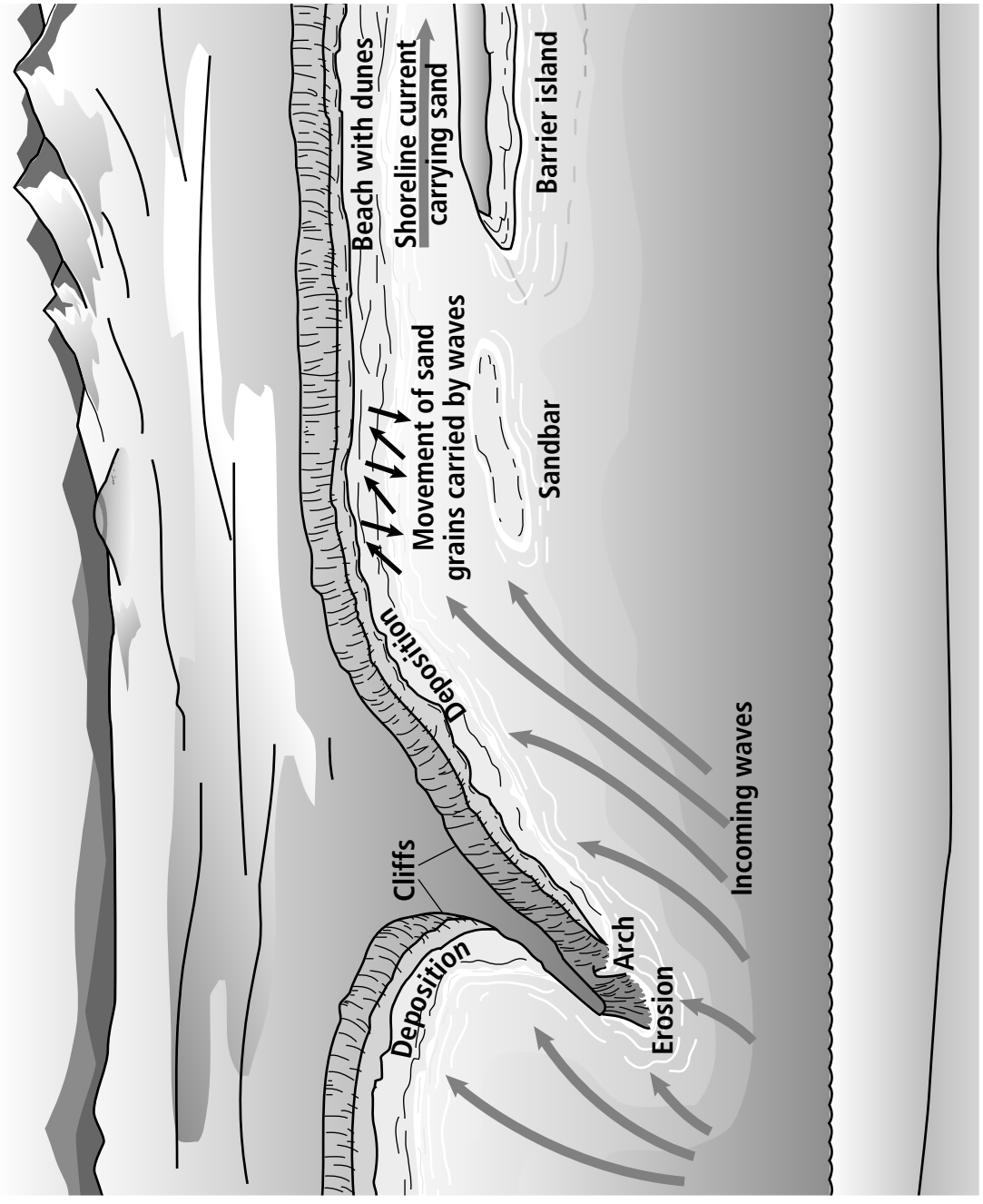
7. What substances react during the formation of acid precipitation?

8. What products result from acid precipitation formation?

9. Which chemical processes shown involve H_2O?

Use with Chapter 7
Section 7.2

Coastal Erosion and Deposition



Name Class Date

WORKSHEET 17 TEACHING TRANSPARENCY

Use with Chapter 7
Section 7.2

Coastal Erosion and Deposition

1. What causes coastal erosion?

2. Which coastal features shown were carved by erosion?

3. What is deposition?

4. What causes deposition to occur along a shoreline?

5. Which coastal features shown were created by deposition?

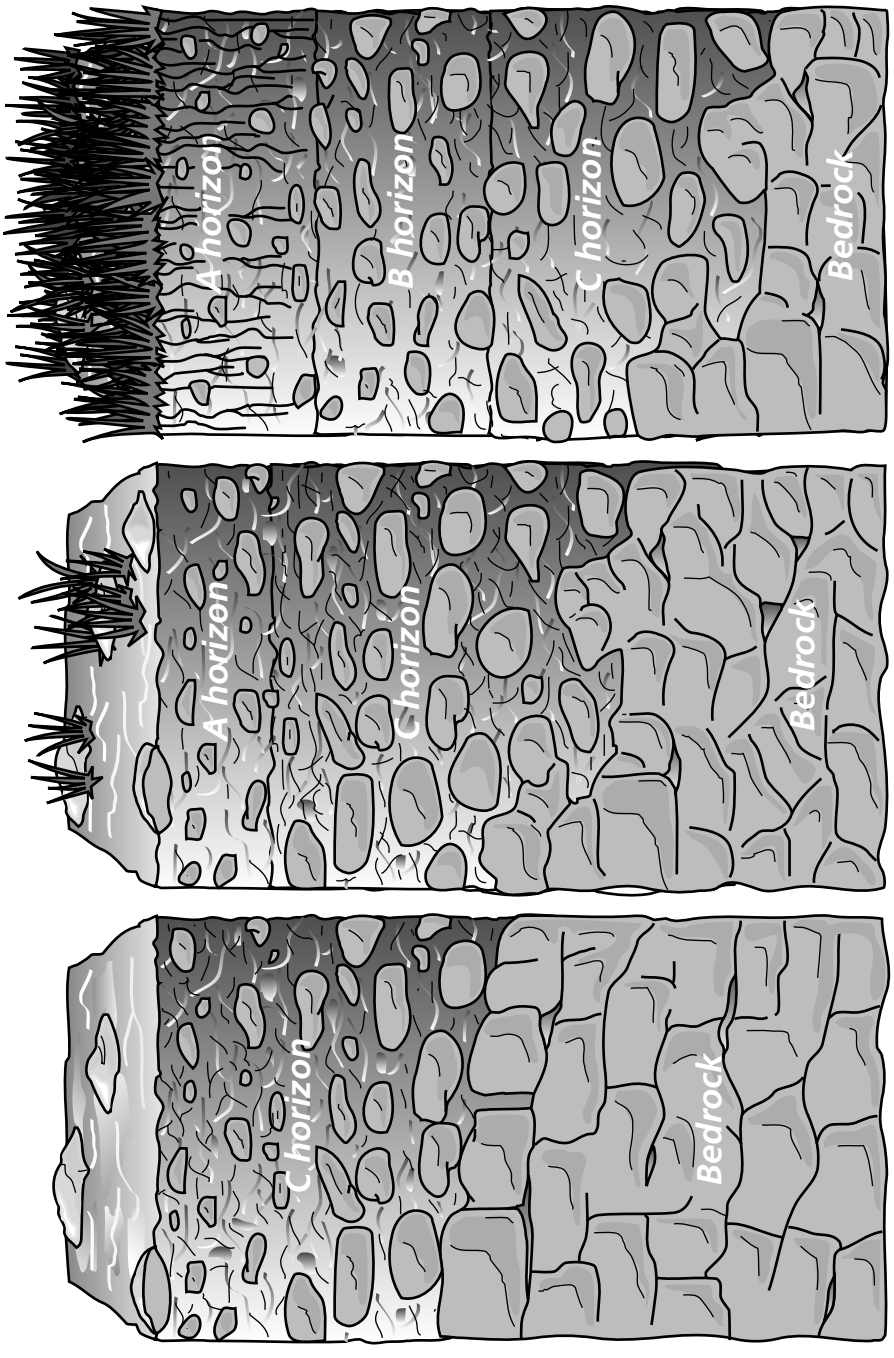
6. What is a sand bar, and how does it form?

7. How did the barrier island likely form?

8. Describe how sand grains carried by waves move.

Use with Chapter 7
Section 7.3

Soil Formation



Stage 3. Weathering and organic decay continue. Water leaches soluble minerals downward from the A horizon, and a mineral-rich B horizon forms.

Stage 2. Weathering of rock pieces continues. Organisms living in the weathered material die and decay, forming an organic-rich top layer, or A horizon.

Stage 1. Weathering breaks solid bedrock into smaller pieces, forming the C horizon.

Name Class Date

WORKSHEET 18 TEACHING TRANSPARENCY

Use with Chapter 7
Section 7.3

Soil Formation

1. What occurs at the beginning of the soil formation process?

2. Are weathered rocks the only components needed to form soil? Explain your answer.

3. Is the soil shown a residual soil or a transported soil? Explain your answer.

4. Which horizon contains the least-weathered parent material?

5. What occurs during the second stage of soil formation?

6. Which is the last horizon to form, and how does it form?

7. What process occurs during all three stages?

Name Class Date

CHAPTER 7 STUDY GUIDE

Weathering, Erosion, and Soil

SECTION 7.1 *Weathering*

In your textbook, read about weathering.
In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or phrase to make it true.

_____ **1.** *Weathering* is the process by which rocks on or near Earth's surface break down and change.

_____ **2.** *Mechanical weathering* changes the chemical composition of rocks.

_____ **3.** Weathering rate depends on *temperature*.

_____ **4.** Acid precipitation has a pH value *above* 5.6.

_____ **5.** The repeated thawing and freezing of water in the cracks of rocks is called *frost wedging*.

_____ **6.** Water, oxygen, carbon dioxide, and acids are significant agents of *mechanical* weathering.

_____ **7.** Oxidation occurs in the decomposition of *iron ore*.

_____ **8.** The chemical reaction of *carbon dioxide* with other substances is called oxidation.

Circle the letter of the choice that best completes the statement or answers the question.

9. The reaction below is an example of which of the following processes?

$$2FeO_4 + \tfrac{1}{2}O_2 \rightarrow 3Fe_2O_3$$

a. oxidation **b.** exfoliation **c.** freezing **d.** mechanical weathering

10. The pH scale is used to measurement which of the following?
a. oxidation **b.** exfoliation **c.** acidity **d.** precipitation

11. The process by which outer layers of rock are stripped away is called
a. chemical weathering. **b.** oxidation. **c.** exfoliation. **d.** frost wedging.

12. In which of the following climates would physical weathering most readily occur?
a. wet and warm **b.** dry and warm **c.** wet and hot **d.** dry and cool

13. Large amounts of carbonic acid are found in
a. the soil. **b.** acid precipitation. **c.** limestone. **d.** automobile exhaust.

14. Buildings and monuments that are made of limestone are greatly damaged by
a. freezing. **b.** acid precipitation. **c.** oxidation. **d.** frost wedging.

15. Which of the following factors does NOT exert pressure on rocks that leads to physical weathering?
a. plant roots **b.** overlying rocks **c.** freezing water **d.** carbonic acid

SECTION 7.1 *Weathering, continued*

In your textbook, read about weathering and what affects the rate at which weathering occurs.
Use the terms below just once to complete the passage.

water	**acid precipitation**	**carbonic acid**	**carbon dioxide**
temperature	**mechanical**	**composition**	**pressure**

The process by which rocks and minerals break down into smaller pieces is **(16)** _____ weathering, also called physical weathering. Two factors that play a significant role in this type of weathering are **(17)** _____ and **(18)** _____. To some extent, the **(19)** _____ of rocks determines the effects that chemical weathering will have on them. **(20)** _____ is an important agent in chemical weathering because it can dissolve many kinds of minerals. An atmospheric gas that contributes to the chemical weathering process is **(21)** _____, which is produced by living organisms. When this gas combines with water, it produces a weak acid called **(22)** _____. Another agent of chemical weathering is **(23)** _____, which is caused mainly by emissions of sulfur dioxide and nitrogen oxides.

Answer the following questions.

24. What climate conditions promote chemical weathering?

25. What rock type is most easily weathered? Why?

26. How is surface area related to weathering?

27. How does slope affect the rate of weathering?

SECTION 7.2 *Erosion and Deposition*

In your textbook, read about erosion and deposition.
For each item in Column A, write the letter of the matching item in Column B.

	Column A	Column B
_____	**1.** The final stage of the erosional process in which materials are dropped in another location	**a.** slope
_____	**2.** The force that tends to pull all materials downhill	**b.** ocean waves
_____	**3.** The steeper the _____, the greater the potential for flowing water to erode earth materials.	**c.** wind
_____	**4.** Coastal areas undergo erosion by _____ and wind.	**d.** glaciers
_____	**5.** Erode by scraping, gouging, and picking up large rocks and debris piles	**e.** gravity
_____	**6.** A major erosional agent in areas with limited precipitation and high temperatures	**f.** deposition

Answer the following questions.

7. Give two examples of how plants and animals move Earth's surface materials from one place to another as they carry on their life processes.

8. Explain rill erosion and how it differs from gully erosion.

9. Describe the formation of barrier islands.

SECTION 7.2 *Erosion and Deposition, continued*

The following statements list types of erosion. Using the numbers 1–4, label them by their ability to transport materials.

_____ **1.** wind erosion

_____ **2.** water erosion

_____ **3.** glacial erosion

_____ **4.** plant and animal erosion

For each statement below, write *true* or *false*.

_____ **5.** When a river enters a large body of water, the water generally slows down and deposits large amounts of sediments.

_____ **6.** The Nile Delta was formed from ocean waves and currents.

_____ **7.** The constant movement of water and the availability of accumulated weathered material creates continuous erosion.

_____ **8.** Unlike water, glaciers do not move material over a long distance.

_____ **9.** Wind is a major erosional agent in areas on Earth that have both limited precipitation and high temperatures.

_____ **10.** Wind barriers are trees and other vegetation planted perpendicular to the wind direction.

_____ **11.** The movement of soil and other Earth materials by humans as they build highways and bridges, is not considered erosion.

_____ **12.** Barrier islands, which form from offshore sand deposits, can continue to be built up from sediments and form sandbars.

_____ **13.** The continued erosion of rill channels can develop into gully erosion.

_____ **14.** Winds cannot blow against the force of gravity.

_____ **15.** Wind can always move more material than water.

_____ **16.** A U-shaped valley indicate that glacial erosion has taken place.

_____ **17.** Waves, tides, and currents are responsible for erosion of islands.

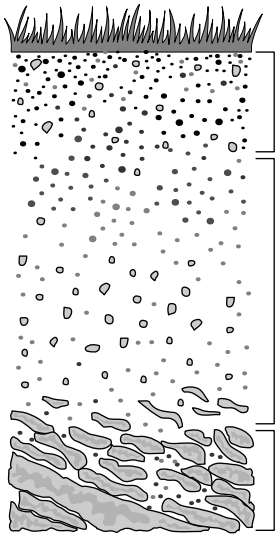
SECTION 7.3 *Soil*

In your textbook, read about soils and how they form.
Complete each statement.

1. _____ is the loose covering of weathered rock particles and decaying organic matter overlying the bedrock of Earth's surface.
2. Soil that is located above its parent material is known as _____.
3. Soil that has been moved away from its parent bedrock is called _____.
4. When heavy machinery digs out soil in the process of building a road, a vertical sequence layers of soil, called a(n) _____, will often be exposed.
5. A distinct layer, or zone, located within a soil profile is known as a(n) _____.
6. Soils formed in dry, hot areas with low rainfall are classified as _____.
7. A(n) _____ is a type of soil that forms in a prairie environment.
8. The layer of a soil which is composed of humus and leaf litter is called the _____ horizon.
9. Soil forms as a result of _____ and biological activity that breaks down and changes soil materials over long periods of time.
10. The relative proportions of particle sizes make up a soil's _____.
11. Soil _____ is the measure of how well a soil can support the growth of plants.

SECTION 7.3 *Soil, continued*

In your textbook, read about soil profiles.
Complete the soil profile by filling in the horizons. Then answer the questions.



12. _____

13. _____

14. _____

15. Which horizon is the surface layer? Describe it.

16. Which horizon is the subsoil? Describe it.

17. Which horizon occurs directly above bedrock? Describe it.

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Reproducible Pages

Chapter 8 Mass Movements, Wind, and Glaciers

Name Class Date

MiniLab 8

Model Glacia l Deposition

How do glaciers deposit different types of rocks and sediments?
Glaciers are powerful forces of erosion. As they move across the land they pick up rocks and sediments, and carry left behind and deposits form in different shapes.

Procedure

1. Read and complete the lab safety form.
2. Work with a group of 2 to 3 other students. One student should obtain four glaciers from your teacher.
3. Place the glaciers on a baking pan. In front of each glacier, place a popsicle stick (to prevent the glacier from sliding down the pan).
4. Place a textbook under one end of the baking pan (your glaciers should be toward the elevated end of the pan).
5. Observe what happens as the glaciers melt. Record your observations in your science journal.
6. Dispose of your materials as your teacher instructs.

Analysis

1. **Discuss** Did the materials differ in the way they were deposited by the melting ice cubes? Were your results similar to those of your classmates? Explain.

2. **Explain** how this activity modeled the formation of meltwater.

3. **Apply** Which materials in this activity modeled glacial till?

4. **Apply** How did this activity model glacial deposition and the formation of a moraine?

Name Class Date

Mapping GeoLab

Map a Landslide

Around midday on April 27, 1993, in a normally quiet, rural area of New York, the landscape dramatically changed. Unexpectedly, almost 1 million m^3 of earth debris slid 300 m down the lower slope of Bare Mountain and into Tully Valley. The debris flowed over the road and buried nearby homes. The people who lived there had no knowledge of any prior landslides occurring in the area, yet this landslide was the largest to occur in New York in more than 75 years.

PREPARATION

Problem

How can you use a drawing based on a topographic map to infer how the Tully Valley Landslide occurred?

Materials

metric ruler

PROCEDURE

Imagine that you work for the United States Geological Survey (USGS) specializing in mass movements. You have just been asked to evaluate the Tully Valley Landslide.

1. Read and complete the lab safety form.
2. Check the map's scale.
3. Measure the length and width of the Tully Valley in kilometers. Double-check your results.

ANALYZE AND CONCLUDE

1. **Interpret Data** What does the shape of the valley tell you about how it formed?

2. **Determine** In what direction did the landslide flow?

3. **Determine** In what direction does the Onondaga Creek flow?

4. **Infer** from the map which side of Tully Valley has the steepest valley walls.

Name Class Date

Mapping GeoLab

Map a Landslide

ANALYZE AND CONCLUDE

5. Deduce What conditions must have been present for the landslide to occur?

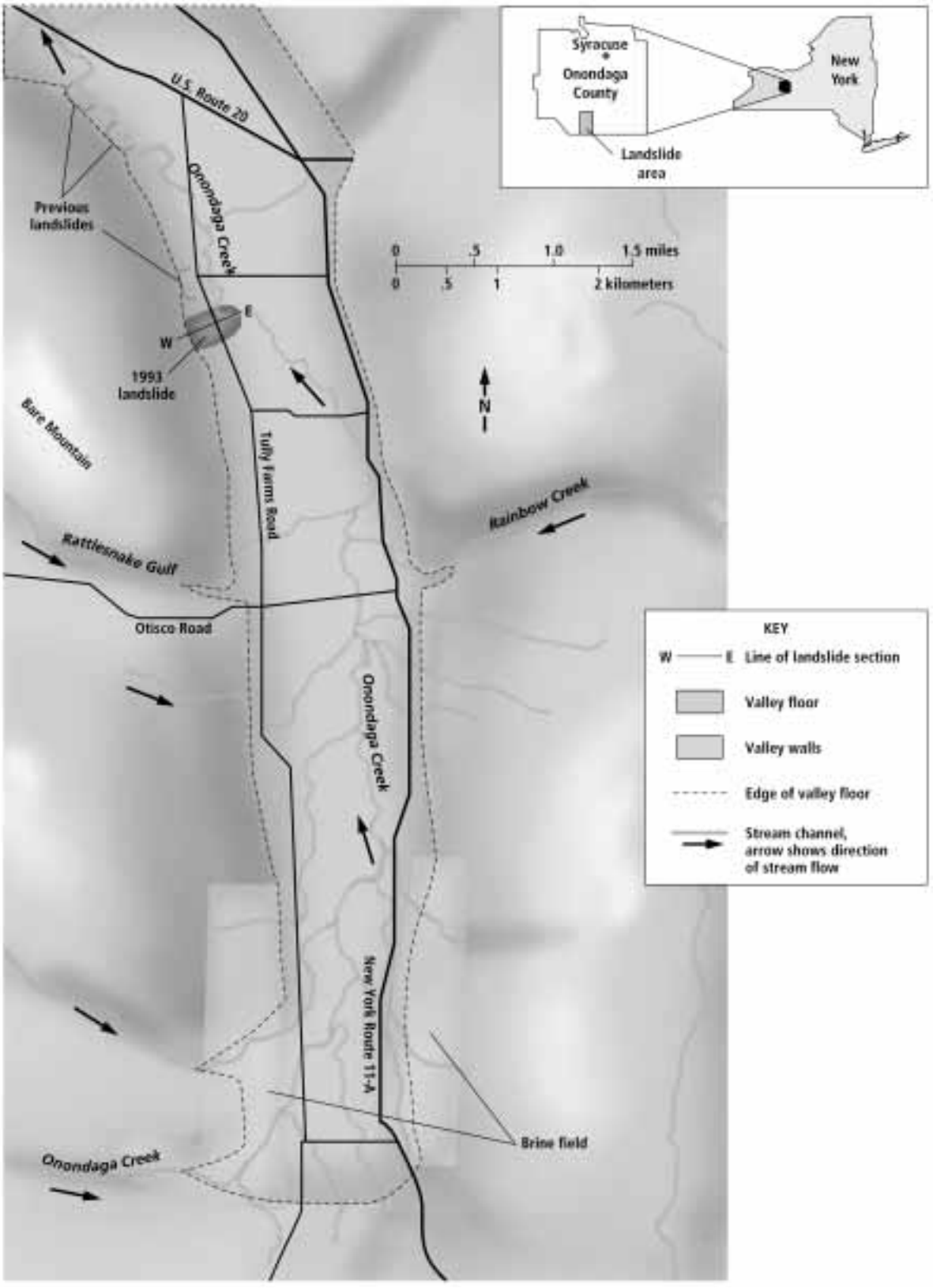
6. Infer At the time of the Tully Valley Landslide, the trees were bare. How could this have affected the conditions that caused the landslide?

WRITING IN EARTH SCIENCE

Explain why the mass movement event you examined in this GeoLab is classified as a landslide. Differentiate a landslide from a creep, slump. flow, avalanche, and rockfall.

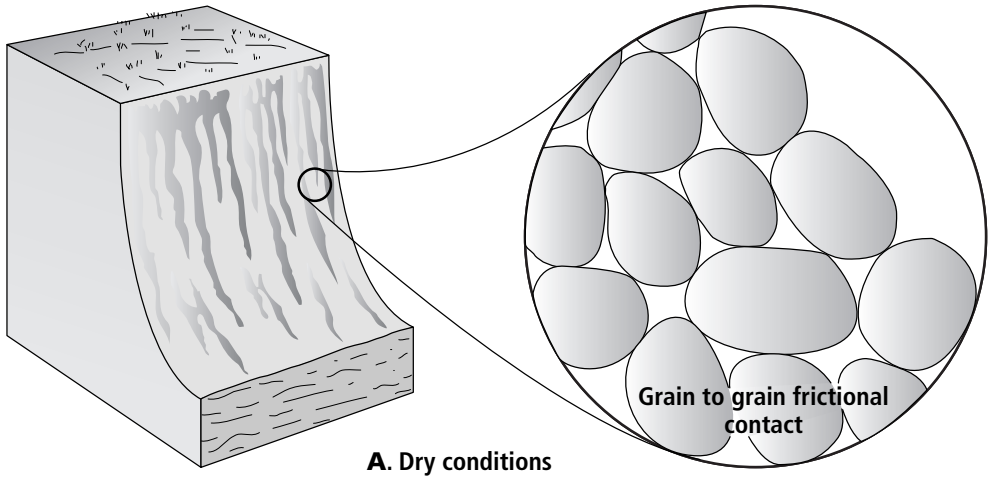
Name Class Date

Mapping GeoLab: Map a Landslide

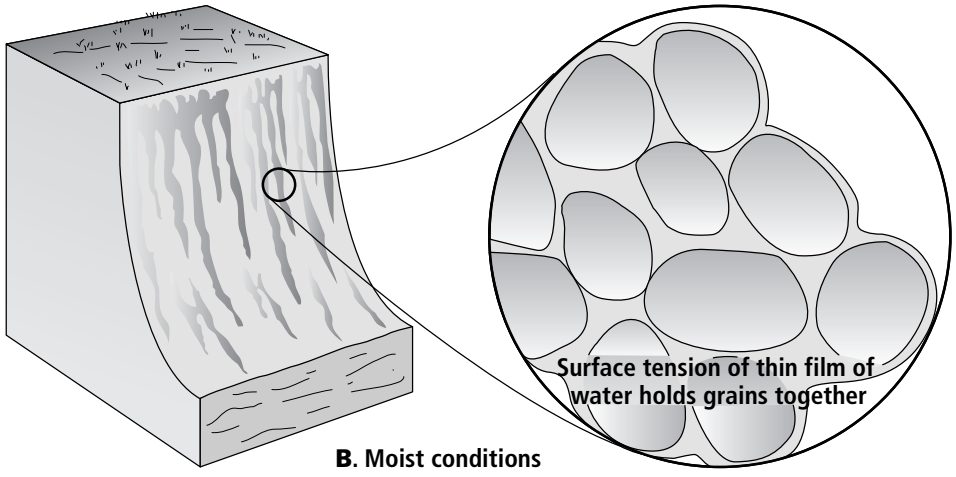


Use with Chapter 8
Section 8.1

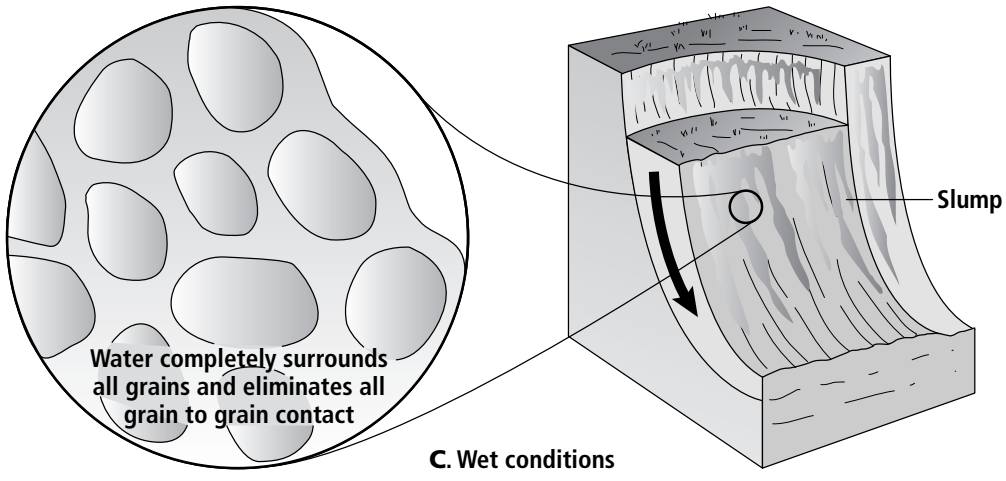
Water and Mass Movement



A. Dry conditions



B. Moist conditions



C. Wet conditions

Name Class Date

WORKSHEET 19 TEACHING TRANSPARENCY

Use with Chapter 8
Section 8.1

Water and Mass Movement

1. What is mass movement?

2. What role does gravity play in mass movement?

3. What is slump?

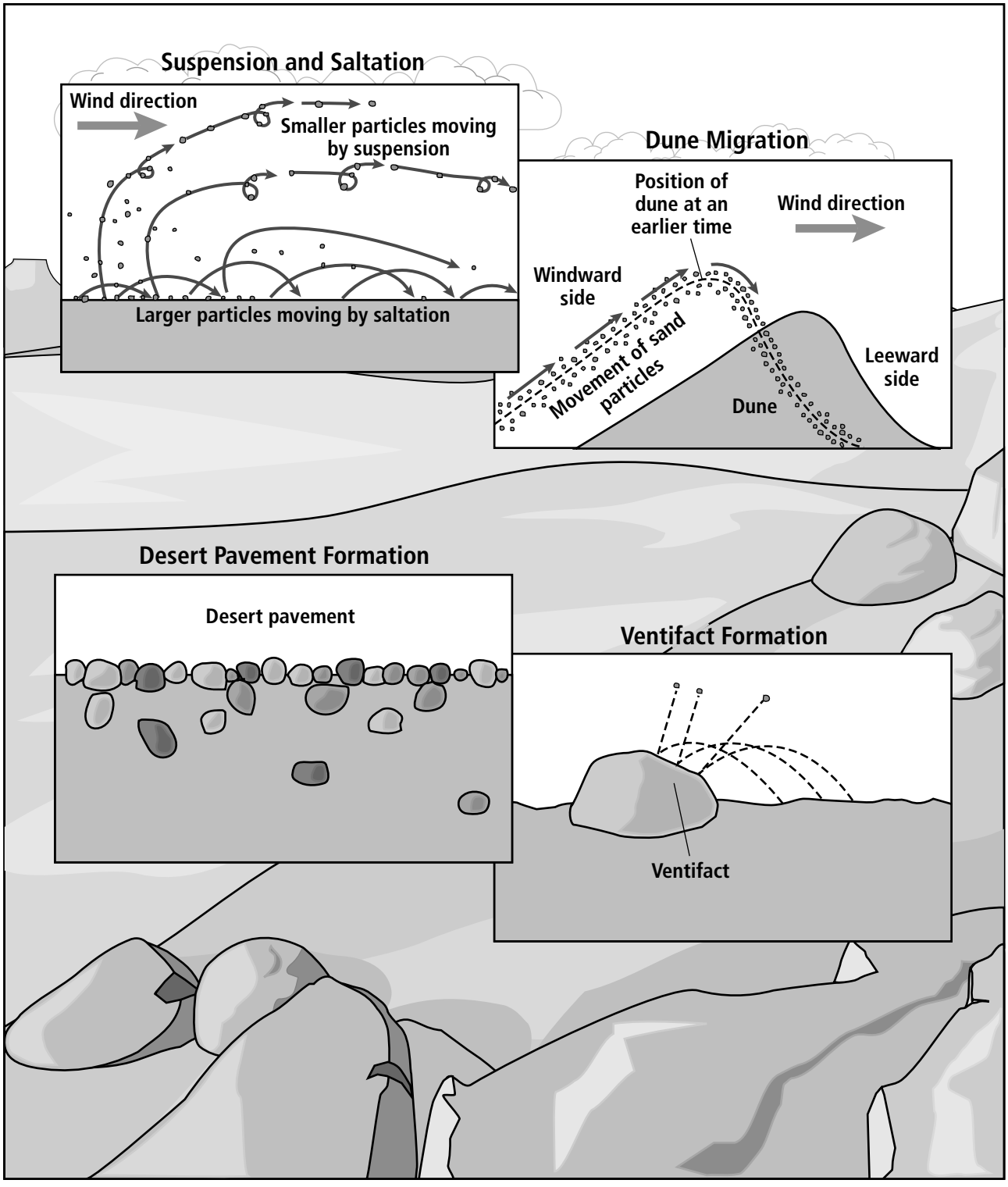
4. Under dry conditions, what helps to prevent a slump from forming?

5. How does the addition of small amounts of water under moist conditions affect the potential for a slump to form? Why?

6. How does the addition of large amounts of water under wet conditions affect the potential for a slump to form? Why?

Use with Chapter 8
Section 8.2

Wind Processes



Name Class Date

WORKSHEET 20 TEACHING TRANSPARENCY

Use with Chapter 8
Section 8.2

Wind Processes

1. How does the wind transport sediment particles?

2. Under what climatic conditions does wind transport and erosion primarily take place?

3. What is deflation?

4. What feature of the desert shown formed as a result of deflation?

5. What are ventifacts and how do they form?

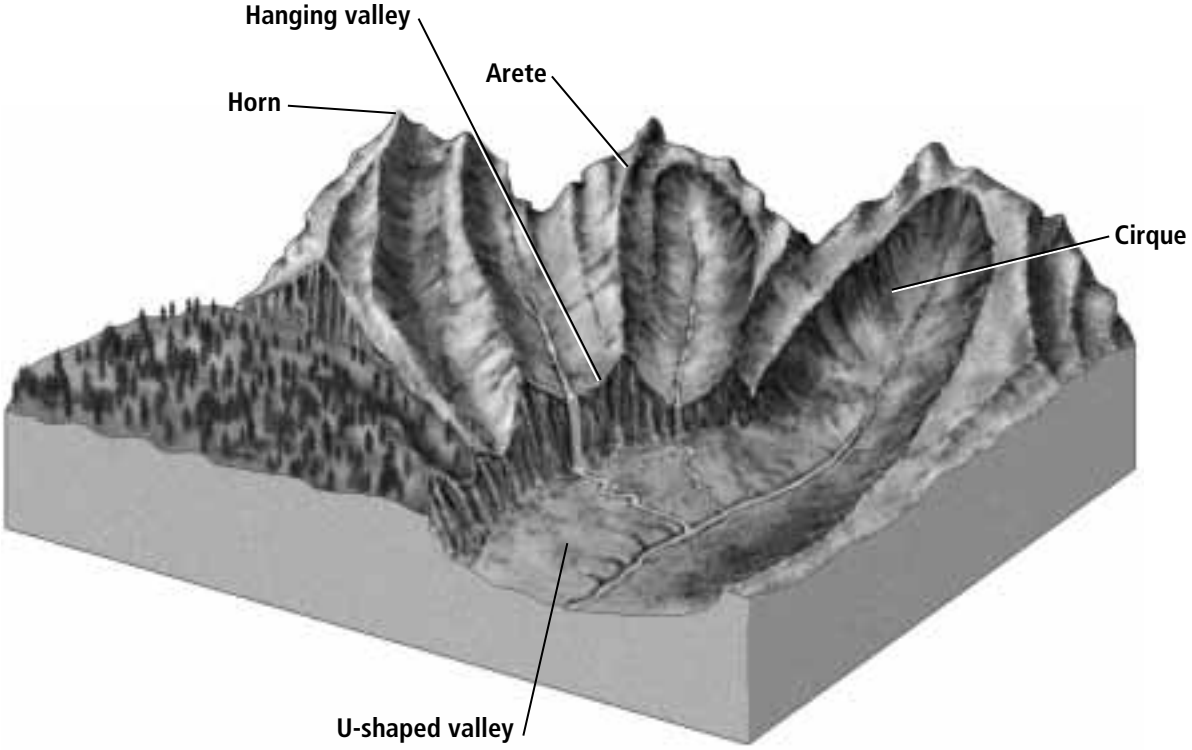
6. What are dunes?

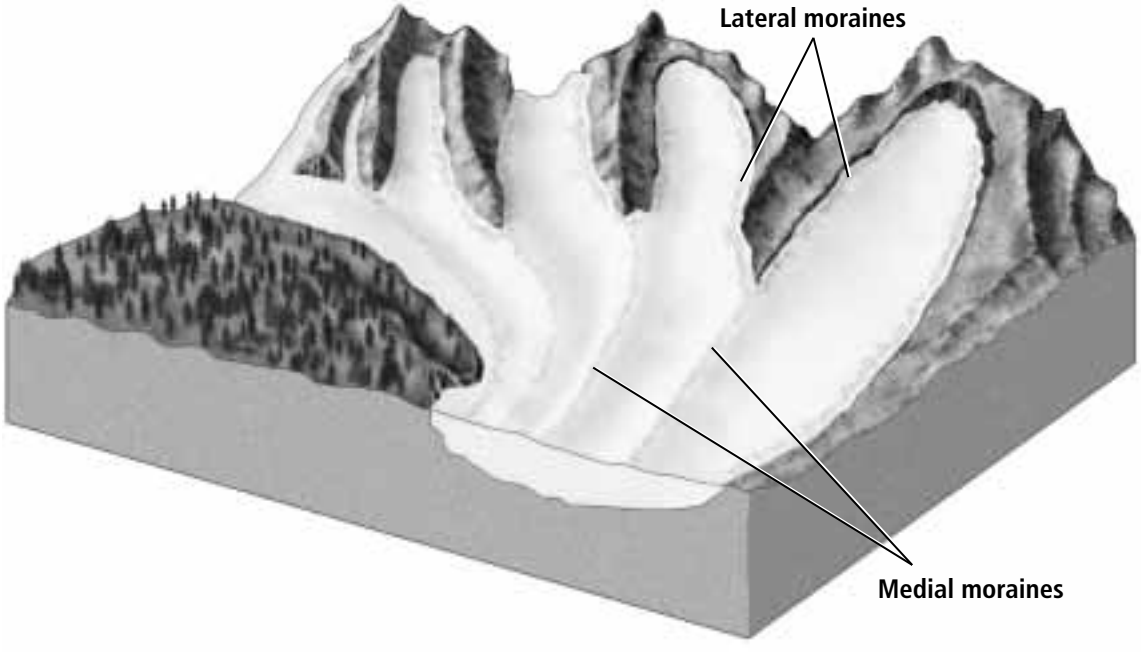
7. What causes dunes to migrate?

8. Name four conditions that determine the particular shape of a dune.

Use with Chapter 8
Section 8.3

Glacial Deposition and Erosion





Name Class Date

WORKSHEET 21 TEACHING TRANSPARENCY

Use with Chapter 8
Section 8.3

Glacial Deposition and Erosion

1. Which features shown are formed by glacial erosion?

2. Which features shown are formed by glacial deposition?

3. When do cirques form?

4. When does an arête form?

5. What is a horn and where does one form?

6. How do U-shaped valleys form?

7. What are moraines?

8. Compare the two types of moraines shown.

Name Class Date

CHAPTER 8 STUDY GUIDE

Mass Movements, Wind, and Glaciers

SECTION 8.1 *Mass Movements*

In your textbook, read about mass movement.
Use each of the terms below just once to complete the passage.

avalanche **creep** **landslide** **mass movement** **mudflow** **slump**

(1) _____ is downward movement that results from gravity acting on loose sediments and weathered rock. If the downward movement of loose material is slow, it is called **(2)** _____, whereas the rapid movement of a mud and water mixture is known as a(n) **(3)** _____. A rapid downslope slide of a thin sheet of earth materials is a(n) **(4)** _____. If these materials rotate and slide along a curved surface, it is called a(n) **(5)** _____. A(n) **(6)** _____ occurs in mountainous areas with thick accumulations of snow.

In your textbook, read about the different types of mass movement.
Briefly describe the different types of mass movement.

7. Creep _____

_____

8. Flows _____

_____

9. Slides _____

_____

10. Falls _____

_____

SECTION 8.1 *Mass Movement at Earth's Surface, continued*

In your textbook, read about mass movement and the factors that control it.
For each item in Column A, write the letter of the matching item in Column B.

Column A	Column B
_____ **11.** Determines how much material is available for mass movement	**a.** rockslide
_____ **12.** A force that works to pull material downslope	**b.** earthquake
_____ **13.** Acts as a lubricant to reduce friction between soil grains	**c.** gravity
_____ **14.** Occurs when a sheet of rock moves downhill on a sliding surface	**d.** slopes
_____ **15.** Can trigger a sudden mass movement	**e.** water
_____ **16.** Where all mass movements occur	**f.** climate

In your textbook, read about people and mass movement.
Answer the following questions.

17. How does mass movement affect people?

_____

_____

_____

18. How do people contribute to mass movement?

_____

_____

_____

SECTION 8.2 *Wind*

In your textbook, read about wind erosion and deposition.
Use each of the terms below just once to complete the passage.

abrasion deflation dunes loess ventifacts

The lowering of the land surface caused by the wind's removal of surface particles is called **(1)** _____. The process of erosion in which wind causes particles such as sand to rub against rocks is **(2)** _____. Rocks shaped by this process are called **(3)** _____. Over time, wind-blown sand accumulates to produce **(4)** _____. If the wind carries and drops finer particles such as silt, then deposits known as **(5)** _____ form.

For each statement below, write *true* or *false*.

_____ **6.** In suspension, strong winds cause particles to stay airborne for long distances.

_____ **7.** During the 1930s in the Great Plains, poor agricultural practices resulted in severe dust storms and the formation of deflation blowouts.

_____ **8.** Most sand carried by the wind moves by saltation.

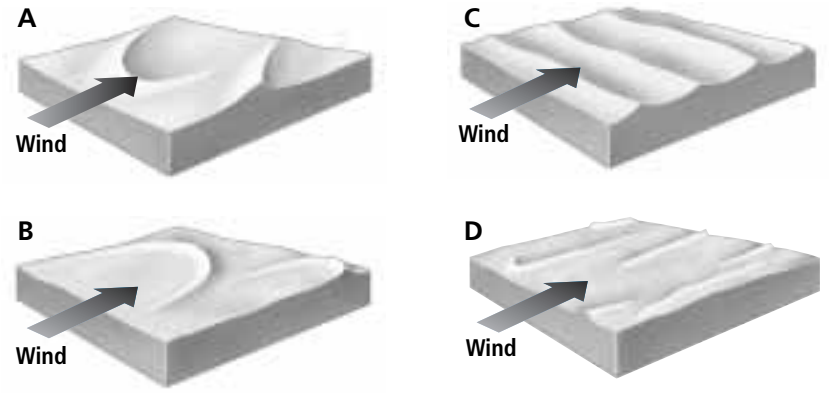
_____ **9.** The steeper slope of a sand dune is on the windward side, the side protected by the wind.

_____ **10.** Wind erosion tends to occur in areas of heavy vegetation cover.

_____ **11.** Dune migration is caused by prevailing winds continuing to move sand from the windward side of a dune to the leeward side.

SECTION 8.2 *Wind, continued*

In your textbook, read about the types of sand dunes.



Complete the table by filling in the missing information.

Diagram	Type of Dune	How and Where Formed
A	**12.**	
B	**13.**	
C	**14.**	
D	**15.**	

In your textbook, read about wind erosion and deposition.
Circle the letter of the choice that best answers the question.

16. Which of the following results in the formation of desert pavement?
a. abrasion **b.** deflation **c.** deposition **d.** saltation

17. Which of the following is true of loess?
a. It consists of sand and gravel.
b. It is deposited by melting ice.
c. Its soils are some of the most fertile on Earth.
d. Its most common component is gypsum.

SECTION 8.3 *Glaciers*

In your textbook, read about glaciers.
Use each of the terms below just once to complete the passage.

cirques **continental glacier** **drumlins** **eskers** **glacier**
moraines **outwash plain** **valley glacier**

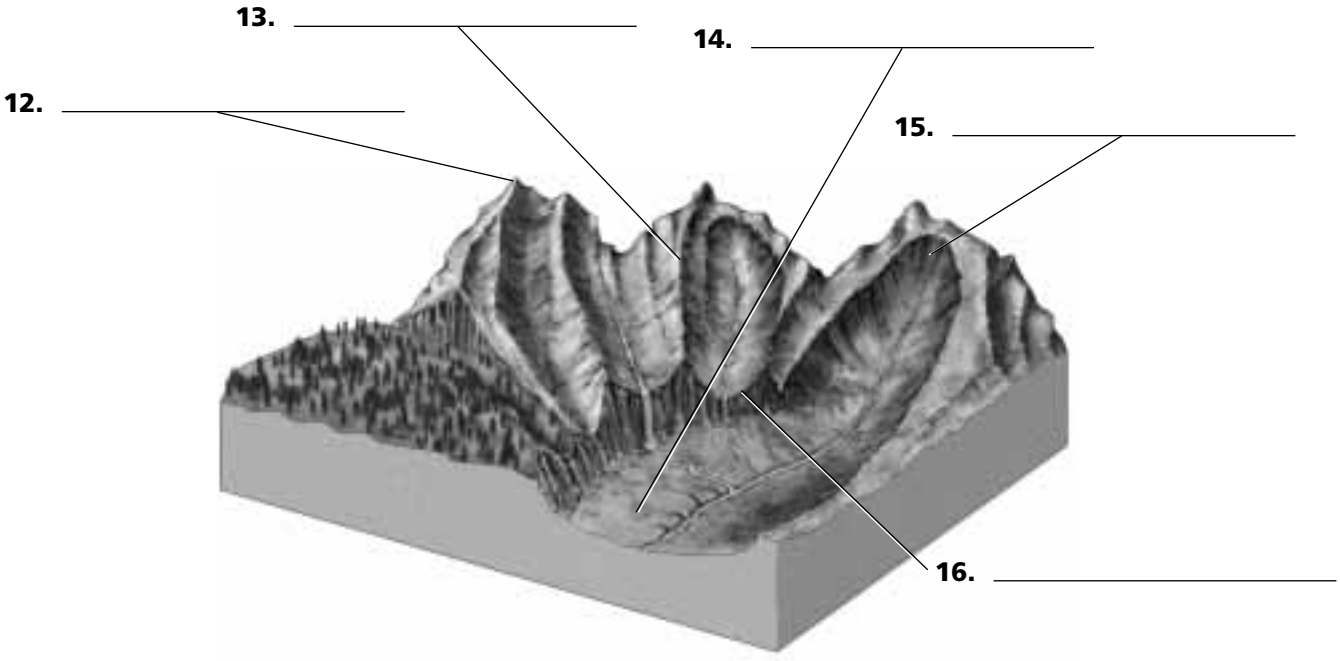
A large moving mass of ice is a(n) **(1)** _____. A moving mass of ice formed in a mountainous area is a(n) **(2)** _____, and one that covers a large continent-sized area is a(n) **(3)** _____. Deep depressions called **(4)** _____ are carved by mountain glaciers. When glaciers melt, they deposit **(5)** _____, which are ridges consisting of till. A melting glacier also forms a(n) **(6)** _____ composed of sorted gravel, sand, and fine silt. Glaciers that move over older moraines form **(7)** _____, which are elongated landforms. Sometimes glacier meltwater deposits long, winding piles of sediment called **(8)** _____.

In your textbook, read about glacial erosion and deposition.
Complete the table by filling in the missing information.

Glacial Feature	Description
9. Groove	
10. Moraine	
11.	area at the leading edge of glacier where meltwater deposits outwash.

SECTION 8.3 *Glaciers, continued*

In your textbook, read about glacial erosion.
Label the diagram below. Choose from the following: cirque, arête, horn, hanging valley, U-shaped valley.



In your textbook, read about glaciers.
Circle the letter of the choice that best completes the statement or answers the question.

17. Outwash is deposited by
- **a.** glacial ice.
- **b.** high winds.
- **c.** glacial meltwater.
- **d.** gravity.

18. Continental glaciers form from
- **a.** sorted sediments deposited by meltwaters.
- **b.** snow that accumulates and recrystallizes.
- **c.** valley glaciers that flow downslope and meet.
- **d.** mixed debris dropped by ice.

19. Which of the following is true of striations?
- **a.** They are formed by plucking.
- **b.** They are formed by deposition.
- **c.** They occur only on glacial outwash plains.
- **d.** They indicate a glacier's direction of movement.

20. Sometimes ice breaks off a glacier, gets covered by sediment, and later melts. When the resulting depression fills with water, it forms
- **a.** a kettle lake.
- **b.** an esker lake.
- **c.** a moraine-dammed lake.
- **d.** a cirque lake.

Table of Contents

Reproducible Pages

Chapter 9 Surface Water

Name Class Date

MiniLab 9

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. Then 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.

Name Class Date

GeoLab Predict the Velocity of a Stream

Water in streams flows from areas of high elevation to areas of low elevation. Stream flow is measured by recording the water's velocity. The velocity varies from one stream to another and also in different areas of the same stream. Many components of the stream affect the velocity, including sediment, slope, and rainfall.

PREPARATION

Problem

Determine how slope may affect stream-flow velocity.

Materials

1-m length of vinyl gutter pipe
ring stand and clamp
water source with hose
protractor with plumb bob
sink or container to catch water
stopwatch
grease pencil
meterstick
paper
three-hole punch

Objectives

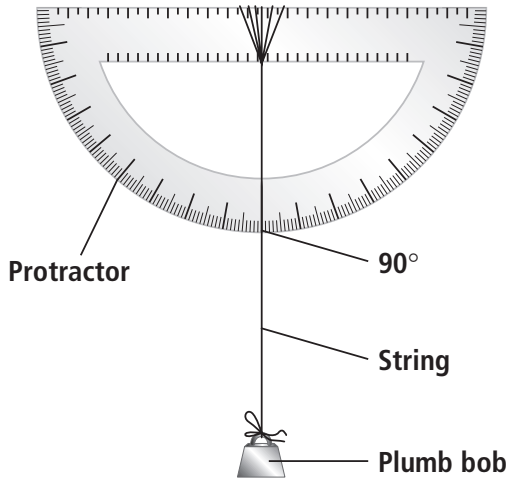
In this GeoLab, you will:

- **Measure** the time it takes for water to flow down a channel at different slopes and depths.
- **Organize** your data in a table.
- **Plot** the data on a graph to show how stream velocity is directly proportional to the stream channel's slope and depth.
- **Describe** the relationship between slope and rate of stream flow.

Safety Precautions

PROCEDURE

1. Read and complete the lab safety form.
2. Work in groups of three to four.
3. Use a three-hole punch to make 10 to 15 paper circles to be used as floating markers.
4. Use the illustration below as a guide to set up the protractor with the plumb bob.



5. Use the grease pencil to mark two lines across the inside of the gutter pipe at a distance of 40 cm apart.
6. Use the ring stand and clamp to hold the gutter pipe at an angle of 10°. Place the end of the pipe in a sink or basin to collect the discharged flow of water.
7. Attach a long hose to a water faucet in the sink.
8. Keep the hose in the sink until you are ready to use it. Turn on the water and adjust the flow until the water moves quickly enough to provide a steady flow.
9. Bend the hose to block the water flow until the hose is positioned at least 5 cm above the top line marked on the pipe. Allow the water to flow. Allow the water to flow at the same rate for all slope angles.

Name Class Date

GeoLab Predict the Velocity of a Stream

PROCEDURE

10. Drop a floating marker approximately 4 cm above the top line on the pipe and into the flowing water.

11. Measure the time it takes for the floating marker to move from the top line to the bottom line. Record the time in your science journal.

12. Repeat Step 9 two more times.

13. Repeat Steps 9 and 10, but change the slope to 20°, 30°, and then 40°.

14. Make a line graph of the average velocity, using the space below.

LINE GRAPH

ANALYZE AND CONCLUDE

1. Interpret Data What is the relationship between the velocity and the angle of the slope?

2. Apply Describe one reason that a stream's slope might change.

Name Class Date

GeoLab Predict the Velocity of a Stream

ANALYZE AND CONCLUDE

3. Infer Where would you expect to find streams with the highest velocity?

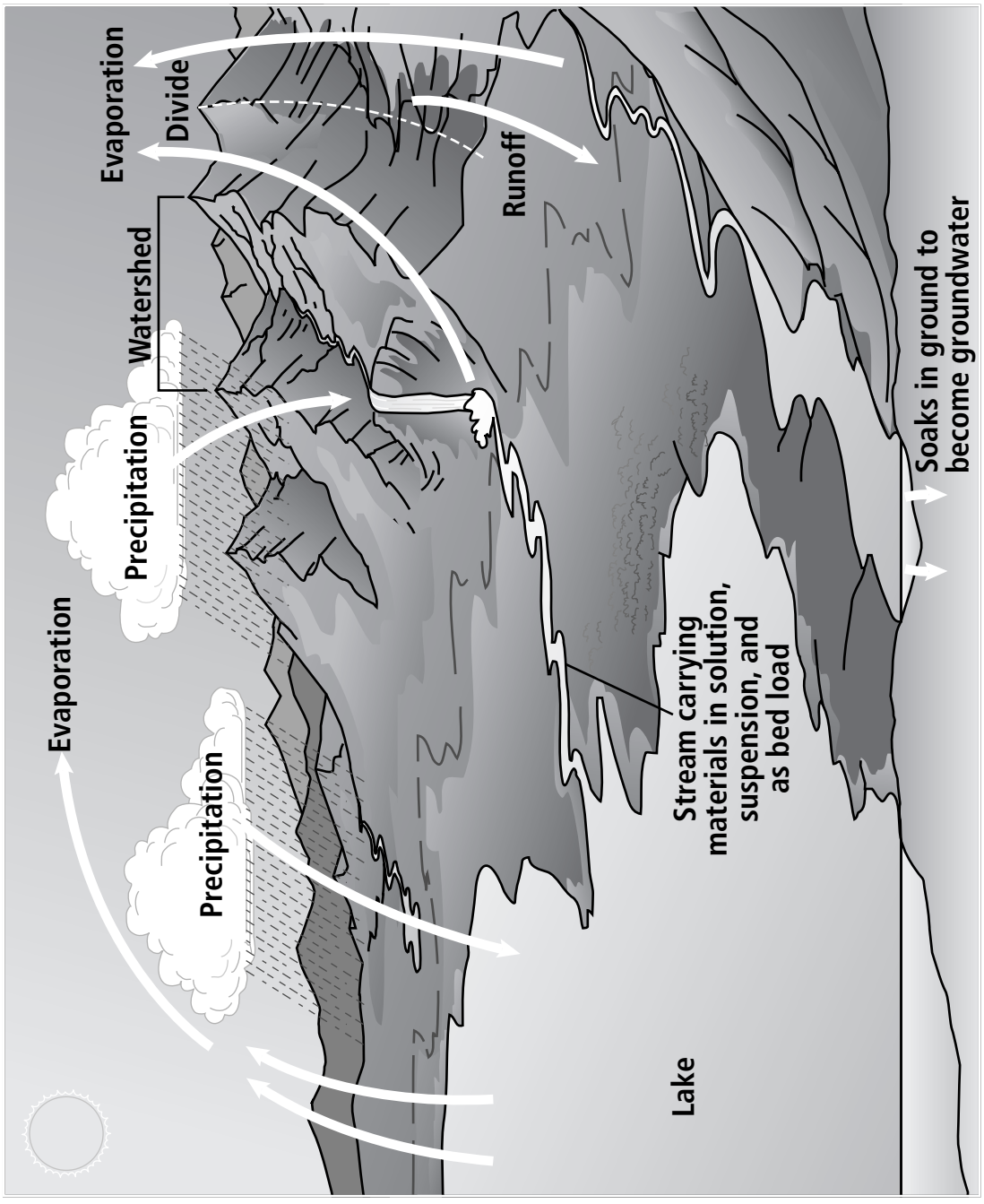
4. Predict Using your graph, predict the velocity for a 35° slope.

INQUIRY EXTENSION

Design Your Own As discussed in the chapter, the texture of the streambed can affect the rate of stream flow. Design an experiment to test this variable.

Use with Chapter 9
Section 9.1

Surface Water



Name Class Date

WORKSHEET 22 TEACHING TRANSPARENCY

Use with Chapter 9
Section 9.1

Surface Water

1. What is runoff?

2. What is the source of the runoff?

3. What becomes of the runoff in the diagram?

4. What determines whether water on Earth's surface will seep into the ground or become runoff?

5. How does the stream carry its load?

6. What is a watershed?

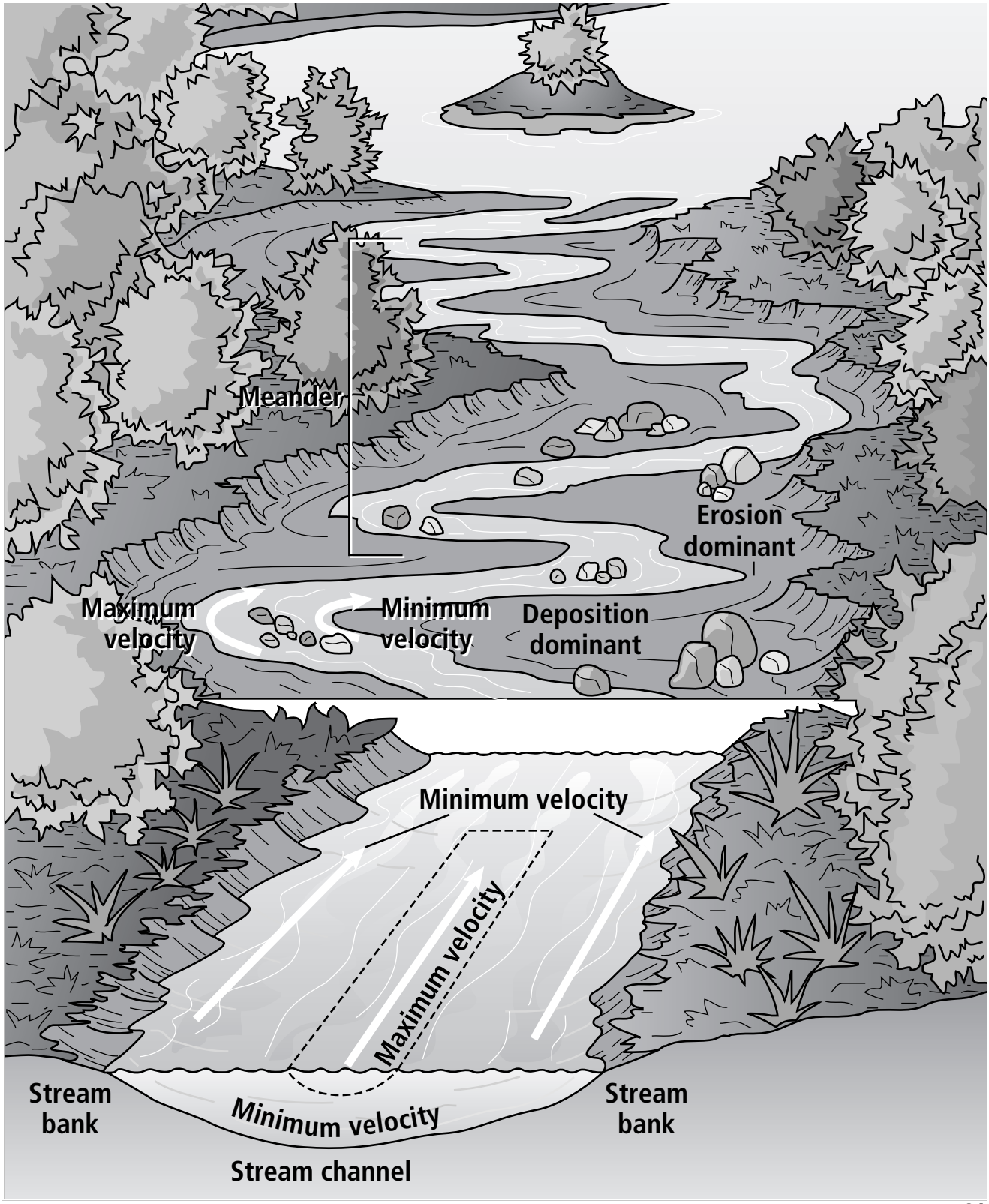
7. What separates one watershed from another?

8. Describe the largest watershed in the diagram.

9. What happens to surface water that evaporates?

Use with Chapter 9
Section 9.2

Features of a Meandering Stream



Name Class Date

WORKSHEET 23 TEACHING TRANSPARENCY

Use with Chapter 9
Section 9.2

Features of a Meandering Stream

1. In a straight stream channel, where does the water have the maximum velocity?

2. In a straight stream channel, where does the water have the minimum velocity? Explain your answer.

3. What is a meander?

4. In a meandering stream channel, where does the water have the maximum and minimum velocity?

5. In a meandering stream channel, where is deposition dominant?

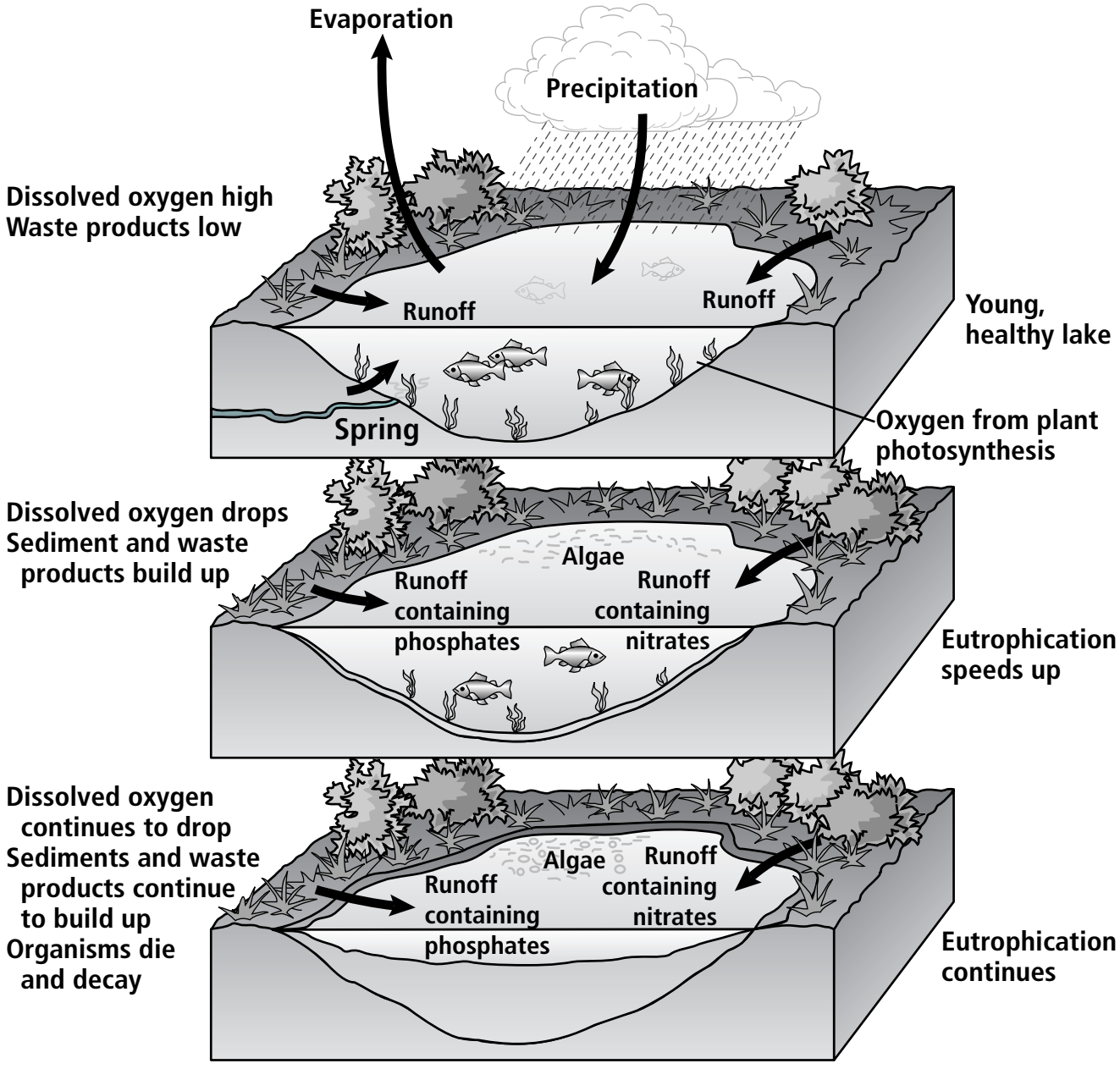
6. What is the narrow pathway in which stream water flows?

7. What holds a stream's moving water within its narrow pathway?

8. How does an oxbow lake form?

Use with Chapter 9
Section 9.3

Lake Pollution



Name Class Date

WORKSHEET 24 TEACHING TRANSPARENCY

Use with Chapter 9
Section 9.3

Lake Pollution

1. What sources supply water to the lake?

2. Describe the characteristics of the young, healthy lake.

3. What is eutrophication?

4. How does the dissolved oxygen content of the lake change during eutrophication?

5. How does eutrophication speed up?

6. What other changes occur in the lake as eutrophication continues?

Name Class Date

CHAPTER 9 STUDY GUIDE

Surface Water

SECTION 9.1 *Surface Water Movement*

In your textbook, read about surface water and the way in which it moves sediment.
Complete each statement.

1. An excessive amount of water flowing downslope along Earth's surface is called _____.
2. A stream system's _____, or drainage basin, is all of the land area whose water drains into a stream system.
3. The watershed of the _____ is the largest in North America.
4. When water runs through or over rocks containing soluble minerals, it dissolves small amounts of the minerals and carries them away in _____.
5. A stream's _____ consists of sand, pebbles, and cobbles that the stream's water can roll or push along the bed of the stream.
6. _____ is the measure of the volume of stream water that flows over a particular location within a given period of time.

For each statement below, write *true* or *false*.

_____ **7.** Soils that contain grasses or other vegetation allow more water to enter the ground than do soils with no vegetation.

_____ **8.** Light, gentle precipitation is more likely than heavy rain to end up as runoff.

_____ **9.** The slope of the land has little influence on water's ability to enter the ground.

_____ **10.** A stream's slope affects its carrying capacity.

_____ **11.** Humus creates soil spaces, which increase the soil's ability to hold water.

_____ **12.** There is a greater potential for erosion and flooding on gradual slopes than on steep slopes.

_____ **13.** Carrying capacity increases as a stream's slope and discharge increase.

SECTION 9.1 *Surface Water Movement, continued*

In your textbook, read about water on Earth's surface.
Circle the letter of the choice that best completes the statement or answers the question.

14. The path of a stream can vary considerably, depending on the slope of the land and the
- **a.** amount of humus present in the soil.
- **b.** type of material through which the stream flows.
- **c.** amount of rainfall.
- **d.** bedload of the stream.

15. The amount of dissolved material that stream water carries is usually expressed in
- **a.** parts per million.
- **b.** grams per 1000 gallons.
- **c.** cubic feet per minute.
- **d.** cubic meters per second.

16. In a stream, how are particles such as silt, clay, and sand carried?
- **a.** in solution
- **b.** as bed load
- **c.** as dissolved load
- **d.** in suspension

17. The carrying capacity of a stream depends on both the velocity and the
- **a.** temperature of the water.
- **b.** type of material through which the stream flows.
- **c.** minerals dissolved in the stream.
- **d.** amount of water in the stream.

18. Potholes may form on the bottom of a stream because of
- **a.** changes in the stream's carrying capacity.
- **b.** an increase in the dissolved load.
- **c.** particles rubbing and grinding against one another.
- **d.** an increase in suspended materials.

19. Which of the following is true about watersheds?
- **a.** Each tributary in a stream system has its own watershed.
- **b.** Watersheds always cover extremely large areas.
- **c.** Some streams do not have a watershed.
- **d.** The size of a watershed depends upon its elevation.

20. Which of the following is NOT true about streams?
- **a.** All streams flow downslope.
- **b.** Tributaries are smaller streams.
- **c.** All streams flow into the ocean.
- **d.** A large stream is called a river.

21. For water to enter the ground, there must be
- **a.** a sufficient amount of sand in the soil.
- **b.** heavy precipitation.
- **c.** large enough spaces in the ground's surface material.
- **d.** soil particles clumping together.

22. Which of the following statements is NOT part of the water cycle?
- **a.** Water falls as precipitation back to Earth.
- **b.** Water evaporates from bodies of water on Earth.
- **c.** Water soaks into the ground.
- **d.** Water dissolves minerals from rocks it flows over.

CHAPTER 9 STUDY GUIDE

SECTION 9.2 *Stream Development*

In your textbook, read about stream development.
Answer the following questions.

1. What are the stream channel and the stream banks?

2. How does a stream valley form and how deep will it be downcut?

3. Describe the formation of a meander.

4. What is a delta and how is it formed?

5. What is an alluvial fan and where are alluvial fans usually formed?

6. What is rejuvenation and under what circumstances does it occur?

SECTION 9.2 *Stream Development, continued*

In your textbook, read about stream development.
Use each of the terms below just once to complete the passage.

stream capture	**small**	**lengthening**	**gains**
waterfalls	**loses**	**headward erosion**	

The process by which small streams erode their forward paths through rock is called **(7)** _____. This process involves **(8)** _____ the stream at the valley head. At this point in their development, streams are relatively **(9)**_____ . These streams flow swiftly over rough terrain and often form **(10)** _____ and rapids as they flow over steep inclines.

Sometimes, a stream erodes its way through the high area separating two drainage basins, joins another stream, and then draws away its water in a process known as **(11)** _____. The lower portion of the captured stream **(12)** _____ its water source, while the invading stream **(13)** _____ a source of water.

In your textbook, read about deposition of sediment.
In the space at the left, write *true* of the statement is true; if the statement is false, change the italicized word or phrase to make it true.

_____ **14.** Streams that lose *headwaters* lose their ability to carry sediment.

_____ **15.** Alluvial fans are most common in *dry*, mountainous regions.

_____ **16.** Streams lose velocity when they join larger *streams*.

_____ **17.** Delta deposits usually consist of *sand* and clay particles.

_____ **18.** *Waterfalls* are more common in streams on steep slopes.

_____ **19.** Alluvial fans are composed mostly of sand and *gravel*.

_____ **20.** As a delta develops, the flow of stream water *slows*.

CHAPTER 9 STUDY GUIDE

SECTION 9.3 *Lakes and Freshwater Wetlands*

In your textbook, read about lakes and freshwater wetlands.
For each item in Column A, write the letter of the matching item in Column B.

Column A		Column B
_____	**1.** A depression in the landscape that collects and holds water	**a.** swamp
_____	**2.** The successional process that begins with the addition of nutrients and continues with the filling in of a lake	**b.** wetland
_____	**3.** A periodically saturated area that develops after a lake fills in with vegetation	**c.** lake
_____	**4.** Low-lying areas often located near streams that develop from filled-in marshes	**d.** oxbow
_____	**5.** *Sphagnum* is common here	**e.** eutrophication
_____	**6.** A type of lake formed when meanders get cut off	**f.** limestone

Number the stages in the formation and eutrophication of lakes in the order in which they occur.

_____ **7.** The decayed material falls to the bottom of the lake, filling it.

_____ **8.** Excessive algae growth occurs.

_____ **9.** Water slowly dissolves calcium carbonate, forming a cavern in limestone bedrock.

_____ **10.** Because of algae overpopulation, huge numbers of lake plants and animals perish.

_____ **11.** Agricultural fertilizers are picked up by runoff and flow into the lake.

_____ **12.** Groundwater percolates through limestone bedrock.

_____ **13.** The depression fills in with water from runoff and precipitation to become a lake.

_____ **14.** The ceiling of a limestone cavern collapses and leaves a depression.

SECTION 9.3 *Lakes and Freshwater Wetlands, continued*

In your textbook, read about the origins of lakes.
Circle the letter that best answers the question or completes the statement.

15. Which of the following is NOT one of the ways that a lake can form?
- **a.** A stream cuts off a meander to leave an isolated channel of water.
- **b.** Ocean waters recede to lower-lying areas.
- **c.** Cirques high in the mountains fill with water.
- **d.** Eutrophication causes a bog to become flooded.

16. A lake created by damming of glacial sediments is a(n)
- **a.** kettle lake.
- **b.** moraine-dammed lake.
- **c.** oxbow lake.
- **d.** runoff lake.

17. The basins of glacial lakes formed
- **a.** as a result of tectonic activity.
- **b.** during the ice ages.
- **c.** where ocean water receded.
- **d.** along the edges of moraines.

18. Which of the following does NOT contribute to maintaining a lake's water supply?
- **a.** water from direct precipitation
- **b.** runoff
- **c.** underground sources
- **d.** deposition

19. Lakes usually fill in with sediment and cease to exist after
- **a.** several thousand years.
- **b.** hundreds of thousands of years.
- **c.** millions of years.
- **d.** tens of millions of years.

20. Many lakes are found in areas where there has been
- **a.** mountain building.
- **b.** recent volcanism.
- **c.** glaciation.
- **d.** droughts.

Table of Contents

Reproducible Pages

Chapter 10 Groundwater

Name Class Date

MiniLab 10

Model an Artesian Well

How does an artesian well form? What causes the water to rise above the ground surface?

Procedure 

1. Read and complete the lab safety form.
2. Half fill a plastic shoe box or other container with sand. Add enough water to saturate the sand. Cover the sand completely with a 1- or 2-cm layer of clay or a similar impermeable material.
3. Tilt the box at an angle of about 10°. Use a book for a prop.
4. Using a straw punch three holes through the clay, one near the low end, one near the middle, and one near the high end of the box. Insert a clear straw through each hole into the sand below. Seal the holes around the straws.

Analysis

1. **Observe** the water levels in the straws. Where is the water level the highest? The lowest?

2. **Identify** the water table in the box.

3. **Analyze** Where is the water under greatest pressure? Explain.

4. **Predict** what will happen to the water table and the surface if the water flows from one of the straws.

Name Class Date

Mapping GeoLab

Track Groundwater Pollution

You can use a topographic map to estimate the direction of groundwater flow. Groundwater pollution spreads out from its source and follows the flow of groundwater. The spread and movement of the pollution resembles a plume that stems from its source.

PREPARATION

Problem

How can you determine the movement of a pollution plume?

Materials

USGS topographic map of Forest City, Florida
transparent paper
graph paper
ruler
calculator

PROCEDURE

Imagine that Jim's Gas Station has discovered a major gasoline leak from one of its underground tanks. As the local hydrogeologist, you are asked to determine the path that the gasoline will take through the groundwater, and to notify the residents of the areas that might be affected by the contamination.

1. Read and complete the lab safety form.
2. Identify the lakes and swamps in the southwest corner of the map and list their names and elevations in a data table. (**Note:** The elevations are given or can be estimated from the contour lines. The elevation of the water table in each area can be estimated from the elevations of nearby bodies of water.)
3. Note the location of Jim's gas station on Forest City Rd., about 1400 feet north of the Seminole County line (at the 96-foot elevation mark).
4. Take out a piece of paper to construct a cross section of the surface topography and the water table. Lay the paper on the map from Lake Lotus to Lake Lucien (through Jim's Gas Station).
5. On this piece of paper, mark the location of Jim's gas station.
6. Draw a small line at each place where a contour line intersects the line from Lake Lotus to Lake Lucien. Also note the elevation at each hash mark and any rivers crossed.
7. Draw a table to use for your topographic profile, using the width representing the distance between Lake Lotus to Lake Lucien. For the *y*-axis, use the elevations 60, 70, 80, 90, and 100 ft.
8. Now take your paper where you marked your lines and place it along the base of the table.
9. Mark a corresponding dot on the table for each elevation, and mark the position of Jim's gas station.
10. Connect the dots to create a topographic profile.
11. Note the elevations of the nearby bodies of water to approximate the distance from the ground surface to the water table. Use dots to indicate those distances on the topographic profile. Connect the dots to draw the water table on the topographic profile.

Name Class Date

Mapping GeoLab

Track Groundwater Pollution

ANALYZE AND CONCLUDE

1. **Calculate** the slope of the ground surface on either side of Jim's Gas Station.

2. **Estimate** the slope of the water table at Jim's Gas Station.

3. **Infer** the direction toward which the pollution plume will move.

4. **Identify** the houses and bodies of water that are threatened by this pollution plume.

5. **Conclude** Prepare a written statement to present to the local community. Explain the path the plume is predicted to take, and how this was determined.

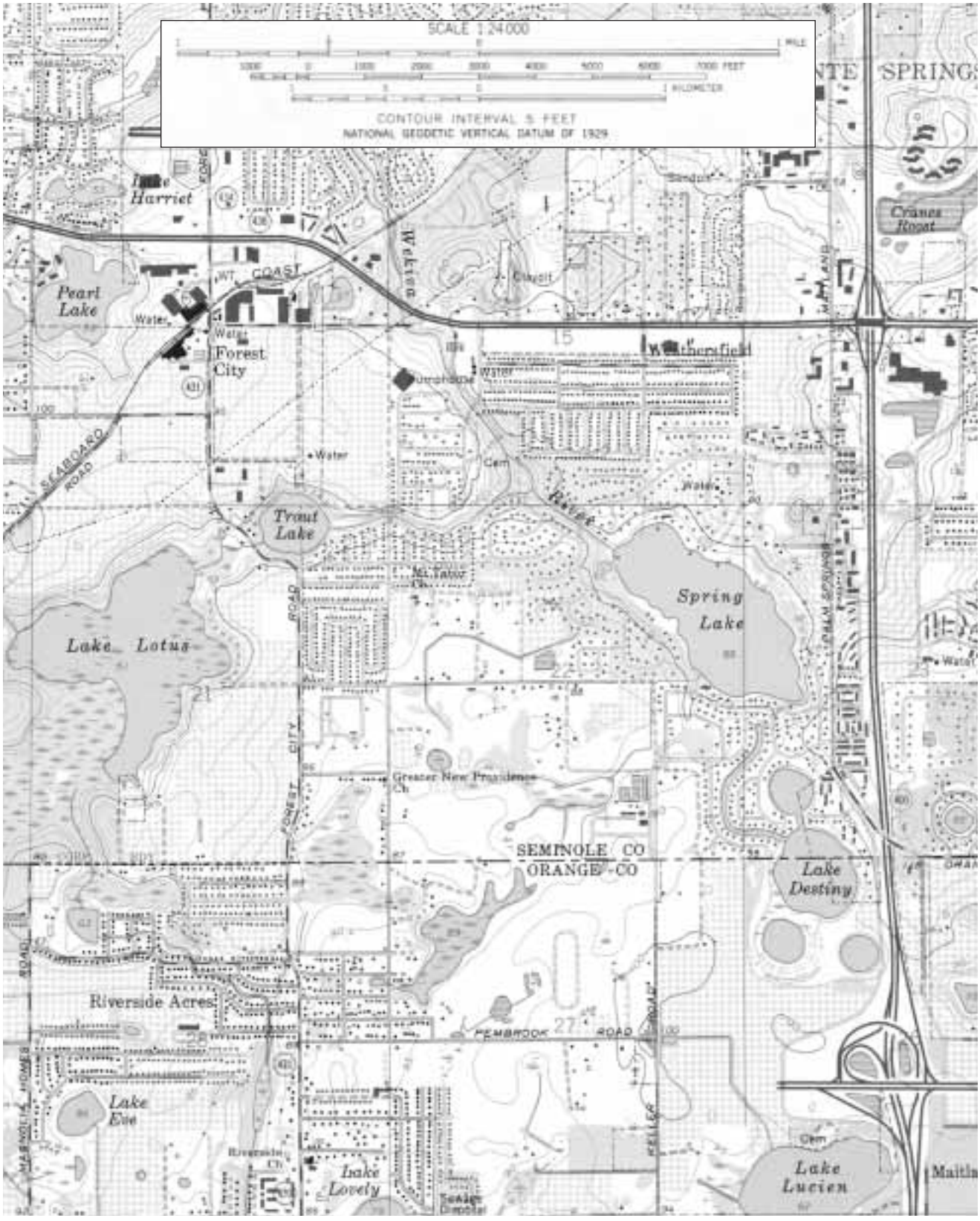
APPLY YOUR SKILL

Design Using what you have learned in this lab and in the chapter, develop a plan for stopping the pollution plume. Make a map showing where your plan will be implemented. Indicate the sites where water quality will be monitored regularly.

Name Class Date

Mapping GeoLab

Track Groundwater Pollution



Use with Chapter 10
Section 10.1

World's Water Supply

World's Water Supply				
Location	**Surface Area (km^2)**	**Water Volume (km^3)**	**Percentage of Total Water**	**Estimated Average Residence Time of Water**
Oceans	361,000,000	1,230,000,000	97.2	Thousands of years
Atmosphere	510,000,000	12,700	0.001	Nine days
Rivers and streams	—	1200	0.0001	Two weeks
Groundwater: shallow,	130,000,000	4,000,000	0.31	Hundreds to many
Lakes (freshwater)	855,000	123,000	0.009	Tens of years
Ice caps and glaciers	28,200,000	28,600,000	2.15	Up to tens of thousands of years and longer

Name Class Date

WORKSHEET 25 TEACHING TRANSPARENCY

Use with Chapter 10
Section 10.1

World's Water Supply

1. Where is the largest percentage of the world's water supply located?

2. Where is the smallest percentage of the world's water supply located?

3. What percentage of the world's water supply is groundwater?

4. What volume of water is found in the atmosphere?

5. How much more water occurs as groundwater than in rivers and streams?

6. In which location does water reside the longest? How long does it reside there?

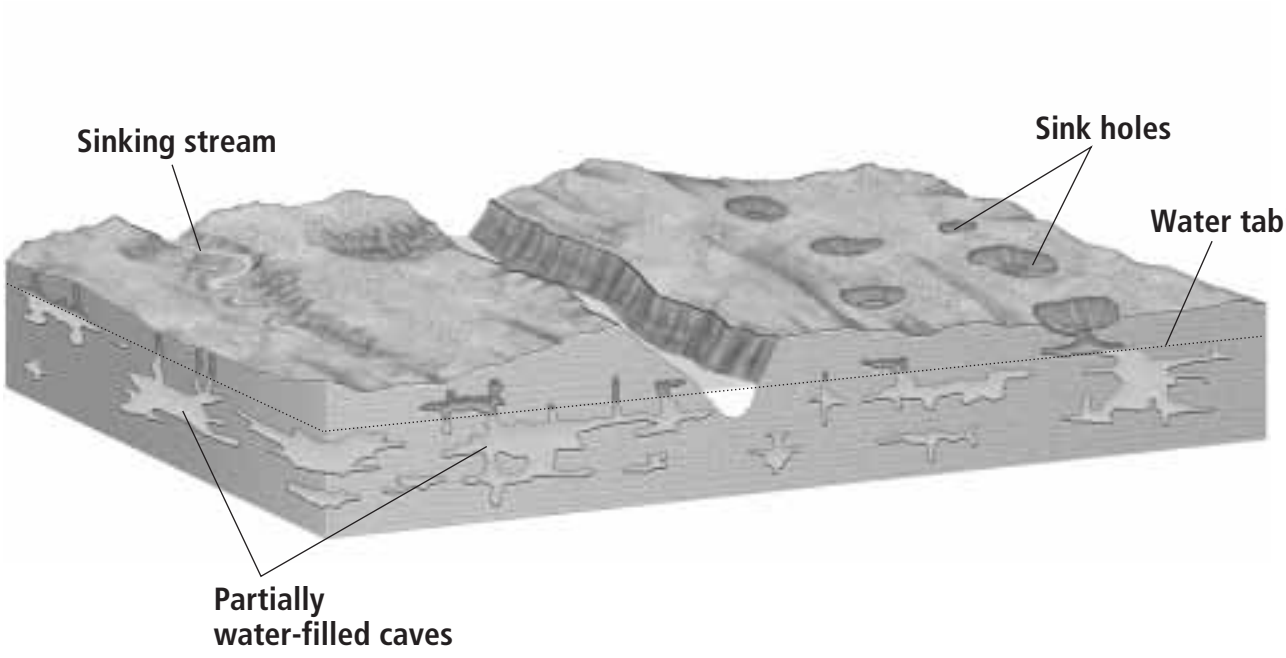
7. In which location does water reside the shortest? How long does it reside there?

8. Which locations is water most likely to move in and out of during your lifetime?

9. What surface area of water do the world's lakes represent?

Use with Chapter 10
Section 10.2

Cave Development



Name Class Date

WORKSHEET 26 TEACHING TRANSPARENCY

Use with Chapter 10
Section 10.2

Cave Development

1. Describe and classify the topography of the region shown.

2. What is a sinkhole, and how is it formed?

3. What is a cave?

4. Where do most caves form, relative to the water table?

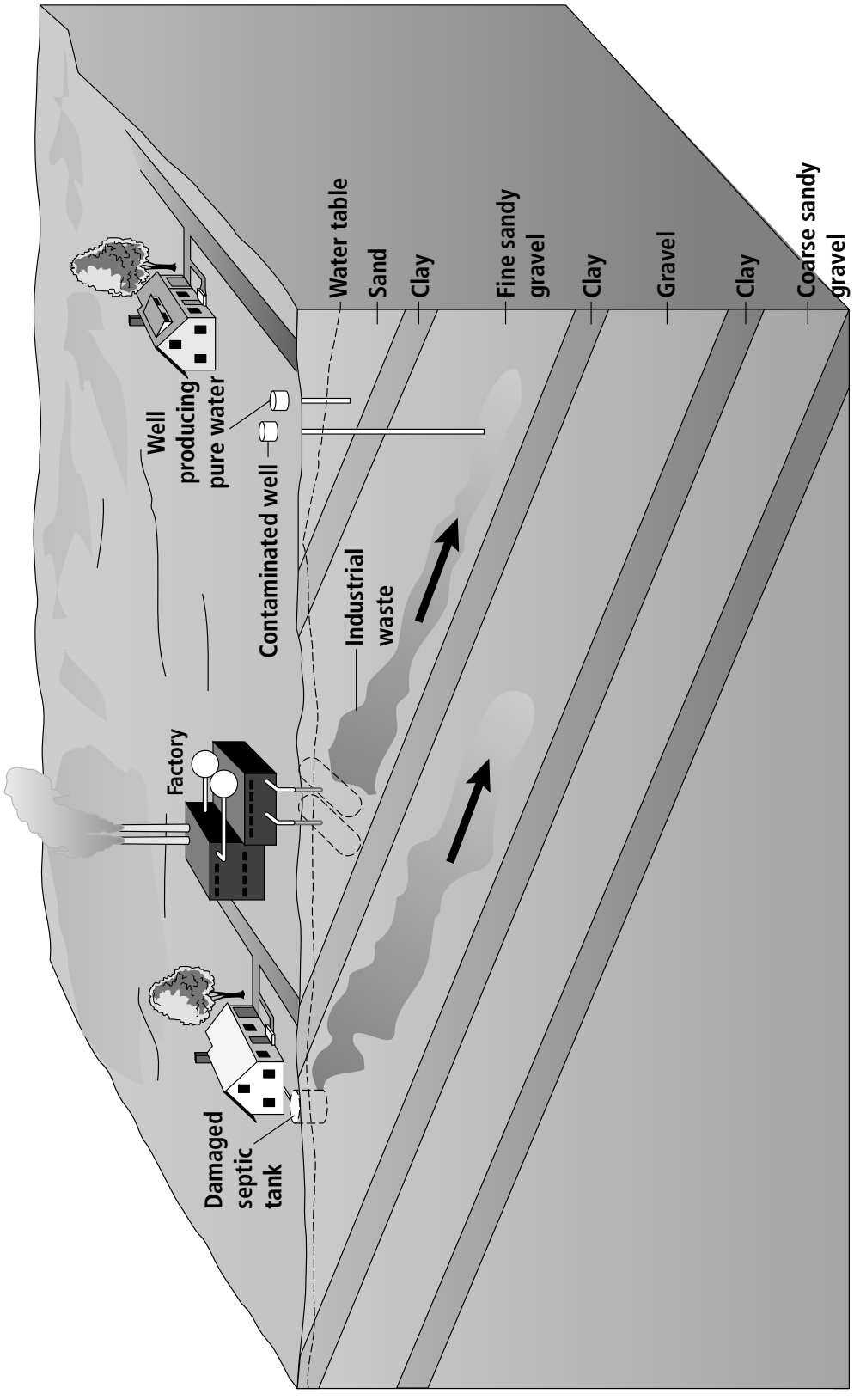
5. Describe how the caves shown formed and filled with air.

6. Under what circumstances might cave formation continue in this area?

7. How does a sinking stream form?

Use with Chapter 10
Section 10.3

Groundwater Pollution



Name Class Date

WORKSHEET 27 TEACHING TRANSPARENCY

Use with Chapter 10
Section 10.3

Groundwater Pollution

1. Is the gravel aquifer polluted, and if so, what is the source of the pollution?

2. Is the fine, sandy gravel aquifer polluted, and if so, what is the source of the pollution?

3. Is pollution from the factory likely to affect the gravel aquifer? Explain your answer.

4. To which aquifer should the factory owners dig a well in order to obtain clean well water?

5. Why is one of the wells at the house on the right able to produce pure water while the other well is contaminated?

6. Explain why the coarse, sandy, gravel aquifer is or is not polluted.

7. Why might the pure-water well prove to be an unreliable water source in the future?

Name Class Date

CHAPTER 10 STUDY GUIDE

Groundwater

SECTION 10.1 *Movement and Storage of Groundwater*

In your textbook, read about the hydrosphere, precipitation and groundwater, and groundwater storage.
Use the following terms to complete the statements.

freshwater	**hydrosphere**	**infiltration**	**polar ice caps**
porosity	**precipitation**	**water vapor**	**weather systems**

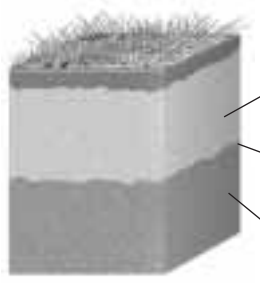
1. About 97 percent of the _____ is contained in the oceans.
2. The _____ and glaciers hold between 70 and 80 percent of Earth's freshwater.
3. Only a very small amount of all of Earth's liquid _____ is contained in rivers, streams, and lakes.
4. Water evaporates from seawater and forms invisible _____ and visible clouds.
5. The winds and _____ move the atmospheric water all over Earth.
6. _____, mostly in the form of rain and snow, falls into the oceans and on the land.
7. Precipitation that falls on land enters the ground through the process of _____ and becomes groundwater.
8. Small openings in subsurface Earth materials are pores, and the percentage of pore space in a material is its _____.

CHAPTER 10 STUDY GUIDE

SECTION 10.1 *Movement and Storage of Groundwater, continued*

In your textbook, read about the zone of saturation and groundwater movement.
Use the terms below to label the diagram.

zone of saturation zone of aeration water table



10. _____

11. _____

12. _____

Match the definition in Column A with the term in Column B.

Column A	Column B
_____ **13.** Depth below Earth's surface at which groundwater completely fills all the pores of a material	**a.** aquifer
_____ **14.** Permeable layers through which groundwater flows	**b.** groundwater
_____ **15.** Upper boundary of the zone of saturation	**c.** permeability
_____ **16.** Ability of a material to let water pass through it	**d.** water table
_____ **17.** Water found in the zone of saturation	**e.** zone of aeration
_____ **18.** Zone below the surface, but above the zone of saturation, where materials are moist	**f.** zone of saturation

Answer the following questions.

19. What is gravitational water?

_____

_____

20. What is capillary water?

_____

_____

21. How does the depth of the water table differ in stream valleys, swampy areas, and hilltops?

_____

_____

_____

_____

CHAPTER 10 STUDY GUIDE

SECTION 10.2 *Groundwater Erosion and Deposition*

In your textbook, read about dissolution by groundwater.

Circle the letter of the choice that best completes the statement or answers the question.

1. A major role in the formation of limestone is the
- **a.** dissolution and precipitation of calcium carbonate.
- **b.** reaction of carbon dioxide with calcium carbonate.
- **c.** reaction of water with limestone.
- **d.** flooding of sinkholes.

2. Carbon dioxide and water form
- **a.** precipitated calcium carbonate.
- **b.** carbonic acid.
- **c.** underground limestone deposits.
- **d.** calcium bicarbonate.

3. Which of the following statements is NOT true about groundwater?
- **a.** Most groundwater contains some acid.
- **b.** Groundwater is made up of mostly H_2O ions, which is why it readily dissolves limestone.
- **c.** Carbonic acid forms when groundwater percolates through decaying organic material.
- **d.** Calcium carbonate precipitates out when groundwater evaporates.

4. In order for caves to form in limestone, there must be
- **a.** runoff from surface streams.
- **b.** no zone of saturation.
- **c.** groundwater percolating through the cracks and joints of limestone.
- **d.** sinkholes present.

Complete each statement with the correct word or words.

5. Some caves are _____, while others contain underground streams and lakes.

6. Most _____ of significant size are formed in limestone by the dissolving activity of groundwater.

7. A depression in the ground caused by the collapse of a cave or by the direct dissolution of bedrock by acidic rain or moist soil is a(n) _____.

8. Limestone regions with sinkholes, sinks, and sinking streams are said to have _____.

SECTION 10.2 *Groundwater Erosion and Deposition, continued*

In your textbook, read about groundwater deposits.
Use the terms below to label the photograph.

stalactite **stalagmite** **dripstone column**

9. _____ _____ _____

Answer the following questions.

10. Explain how A on the photograph is formed.

_____

_____

_____

11. Explain how B on the photograph is formed.

_____

_____

_____

_____

12. Explain how C on the photograph is formed.

_____

_____

13. What kind of limestone is found in dripstone formations?

_____

14. What do we call water containing high concentrations of calcium, magnesium, or iron?

_____

CHAPTER 10 STUDY GUIDE

SECTION 10.3 *Groundwater Wells*

In your textbook, read about wells and confined aquifers.
Use each of the terms below just once to complete the passage.

artesian well **drawdown** **recharge** **well**

To obtain water, a(n) **(1)** _____ must tap into an aquifer. The difference between the original water-table level and the water level in the pumped well is called the **(2)** _____. In order for the water supply of the wells to be replenished, water from precipitation and run-off must **(3)** _____ the zone of saturation. A(n) **(4)** _____ contains water that is under pressure, which may cause the well water to spurt into the air.

For each statement, write *true* or *false*.

_____ **5.** To produce water, a well must be drilled deep into aquicludes.

_____ **6.** It is very difficult to cause drawdown in an aquifer, no matter how many wells are tapped into the aquifer.

_____ **7.** An important artesian aquifer in the United States is the Ogallala Aquifer.

_____ **8.** Groundwater recharge is faster during periods of heavy precipitation.

_____ **9.** Wells which contain pressurized water are called ordinary wells.

_____ **10.** Confined aquifers cannot become polluted.

_____ **11.** Water in an aquifer with high porosity and high permeability flows faster than in an aquifer with low porosity and low permeability.

_____ **12.** Overpumping of groundwater can form a cone of depression around a well.

_____ **13.** If the water tables drop, shallow wells can go dry.

SECTION 10.3 *Groundwater Wells, continued*

In your textbook, read about threats to our water supply and protecting our water supply.
Answer the following questions.

14. What are four common sources of groundwater pollution?

15. What are two natural pollutants?

16. How can salt get into freshwater supplies?

17. Where does radon originate?

For each statement below, write *true* or *false*.

_____ **18.** Subsidence is caused by flooding caves.

_____ **19.** Most pollution plumes spread extremely slowly, and time is available for alternate water supplies to be found.

_____ **20.** Most chemical contaminants can be removed easily from the groundwater and aquifers.

_____ **21.** If the recharge areas of confined aquifers are polluted, then the aquifer becomes polluted, too.