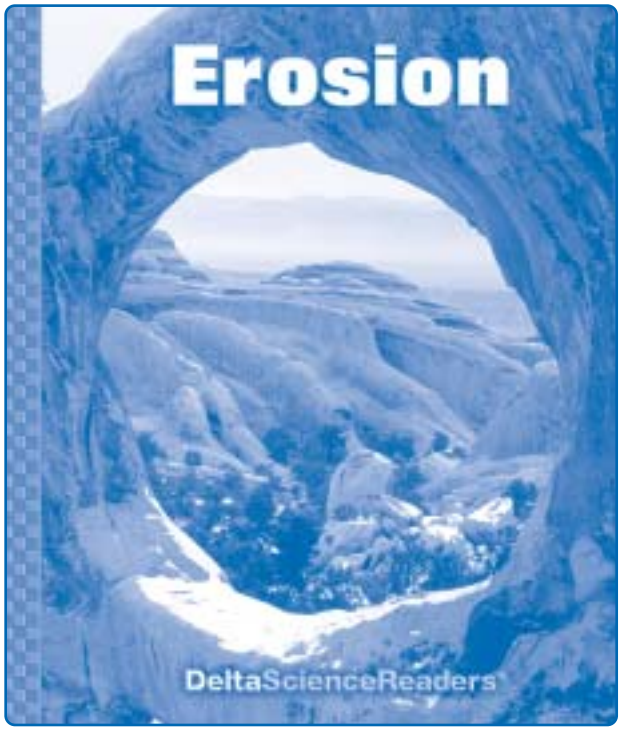
DELTA SCIENCE READER

Erosion



Delta Science Readers *are nonfiction student books that provide science background and support the experiences of hands-on activities. Every* ***Delta Science Reader*** *has three main sections: Think About . . . , People in Science, and Did You Know?*

Be sure to preview the reader Overview Chart on page 4, the reader itself, and the teaching suggestions on the following pages. This information will help you determine how to plan your schedule for reader selections and activity sessions.

Reading for information is a key literacy skill. Use the following ideas as appropriate for your teaching style and the needs of your students. The After Reading section includes an assessment and writing links.

OVERVIEW

In the Delta Science Reader *Erosion*, students read about Earth's structure. They find out about the slowly moving plates that make up Earth's surface and how they are related to mountain building, trenches, earthquakes, and volcanoes. They learn about physical and chemical weathering and how they contribute to soil formation. They are introduced to the causes of erosion and deposition and the landforms that are the results of these forces. They also read about soil conservationists and the ways they work to conserve soil and control erosion. Finally, students learn about floods.

Students will

- learn the layers and composition of Earth
- discover that landforms are the result of a combination of constructive and destructive forces
- explore the ways erosion, weathering, and deposition change Earth's surface features
- examine nonfiction text elements such as table of contents, headings, and glossary
- interpret photographs and graphics to answer questions
- complete a KWL chart

READING IN THE CONTENT AREA SKILLS

- Identify causes and effects of forces related to plate movements, earthquakes, weathering, and erosion
- Draw conclusions about weathering and erosion
- Identify main ideas and supporting details in text passages
- Compare and contrast physical and chemical weathering
- Demonstrate critical thinking
- Interpret graphic devices
- Summarize text information
- Explain the steps in the process of cave formation

NONFICTION TEXT ELEMENTS

Erosion includes a table of contents, headings, photographs, captions, diagrams, boldfaced terms, and a glossary.

CONTENT VOCABULARY

The following terms are introduced in context and defined in the glossary: *arch, barrier island, chemical weathering, continental glacier, convection, core, crust, delta, deposition, dune, earthquake, erosion, fertile, flood, floodplain, glacial till, glacier, gravity, groundwater, humus, landforms, mantle, mass movement, mineral, moraine, oxbow lake, physical weathering, plates, rock, runoff, sandbar, sea-floor spreading, sediment, sinkhole, soil, soil horizon, soil profile, stack, subduction, valley glacier, volcanic island, volcano, weathering.*

BEFORE READING

Build Background

Access students' prior knowledge of erosion by displaying and discussing the cover. Ask, *What do you see in the photograph on the cover?* (a rock formation; a rocky or desert landscape; a rock or cliff with a hole carved in it) *How do you think this rock shape was formed?* (Accept all ideas.) You may wish to explain that the photograph shows a natural rock formation in Arches National Park in Utah. The rock shape is one of more than 1,500 sandstone arches and "windows" in the park. As students read the book, they will find out how forces of nature worked to create such formations.

Read the title aloud, and invite students to share what they know about the topic from their personal experiences and hands-on explorations in science. To stimulate discussion, ask questions such as these: *What happens to things that are left outside, unprotected from the weather? How do you think wind, rain, ice, and snow affect things in nature, such as rocks? What kinds of changes might weather cause in Earth's surface features?*

Begin a group KWL chart by recording facts students know about erosion in the K column. You may want students to copy the KWL chart so they can maintain their own charts as they read.

K What I Know	W What I Want to Know	L What I Learned	+ What I Want to Explore Further

Preview the Book

Explain that when students preview nonfiction, they should look at the title, the table of contents, headings, boldfaced words, photographs, illustrations, charts, graphics, and captions.

Then preview the book with students. Call attention to the various nonfiction text elements and explain how they can help

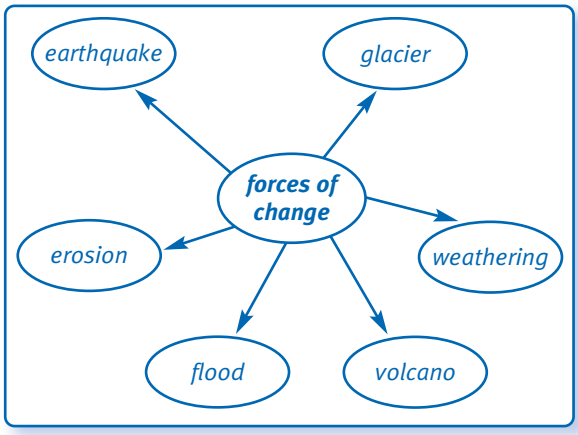
students understand and organize what they read. Ask questions such as these: *How do the headings help you predict what you will read about? What do you see in this picture? How do you think it will help you understand the text?* Explain that the words in boldface type are important words related to erosion. Point out that these words are defined in the glossary. Choose one word and have students find its definition in the glossary.

Conclude the preview by inviting students to suggest questions they would like to have answered as they read the book. Tell them to add the questions to the W column of the KWL chart.

Preview the Vocabulary

You may wish to preview some of the vocabulary words before reading, rather than waiting to introduce them in the context of the book. Possibilities include creating a word wall, vocabulary cards, sentence strips, or a concept web.

For example, many words are related to forces that affect Earth's surface features, or landforms. Develop a web like the one that follows.



▲ *Concept web for* ***forces of change.***

Set a Purpose

Discuss with students what they might expect to find out from the book, based on their preview. Encourage them to use the questions on the KWL chart to set an overall purpose for reading.

GUIDE THE READING

Preview the book yourself to determine the amount of guidance you will need to give for each section. Depending on your schedule and the needs of your class, you may wish to consider the following options:

- **Whole Group Reading** Read the book aloud with a group or the whole class. Encourage students to ask questions and make comments. Pause as necessary to clarify and assess understanding.
- **Shared Reading** Have students work in pairs or small groups to read the book together. Ask students to pause after each text section. Clarify as needed and discuss any questions that arise or have been answered.
- **Independent Reading** Some students may be ready to read independently. Have them rejoin the class for discussion of the book. Check understanding by asking students to explain in their own words what they have read.

Tips for Reading

- If you spread out the reading over several days, begin each session by reviewing the previous day's reading and previewing what will be read in the upcoming session.
- Begin each text section by reading or having a volunteer read aloud the heading. Have students examine any illustrations or graphics and read accompanying captions and labels. Discuss what students expect to learn, based on the heading, illustrations, and captions.
- Help students locate context clues to the meanings of words in boldface type. Remind them that these words are defined in the glossary. Provide help with words that may be difficult to pronounce.

- As appropriate, model reading strategies students may find helpful for nonfiction: adjust reading rate, ask questions, paraphrase, reread, visualize.

Think About . . . (pages 2–13)

Pages 2, 3 *What Is Earth's Structure? Layers, Moving Plates*

- Generate interest in the text by asking, *What do you think is inside Earth?* Explain, *Long ago, people had no way of knowing what Earth was like inside. Today, scientists have instruments that have given us a good idea of Earth's insides.* Have students view the diagram of Earth's inner structure on page 2 and read the caption and labels.

- Check comprehension by asking, *What are Earth's three main layers?* (the crust, the mantle, and the core) *How many layers does the core have? What are they?* (two, the outer core and the inner core) *What do you notice about the thickness of the crust compared to the rest of Earth's layers?* (The crust is very thin.) Then have students read the section titled "Layers" on page 2.

- Ask, *What is the main idea—the most important point—about the crust on page 2?* (The crust covers Earth's entire surface.) *What details support this main idea?* (The crust is Earth's rocky outer layer; the continents and the oceans are on the crust.)

- Then have students finish reading pages 2 and 3 and study the diagrams at the bottom of page 3. Assess comprehension by having students summarize the main ideas about plates. (Earth's surface is made up of separate moving sections called plates. Convection in the mantle forms convection currents that make the plates move. The slowly moving plates cause changes in Earth's surface, especially at plate boundaries.)

- Ask, *What happens when plates move away from each other? Do they leave a gap?* (No, hot magma pushes up between the plates and forms new crust.) *What is this process called?* (sea-floor spreading) *What two effects can happen when one plate bumps or crashes into another?* (One plate can slide up over the other, forming a mountain range and a deep ocean trench. The two plates can be forced together, pushing up blocks of crust and forming a mountain range.) *What is the process called when one plate sinks under another plate?* (subduction) Point out the prefix *sub-* and ask students what they think it means. (under) Can they think of other words with the prefix *sub-?* (submarine, subway, suburb, subtotal, subtract)

- Check comprehension by having students explain what is happening in each of the diagrams at the bottom of the page. *How did the diagrams help you understand these processes?* (They show in pictures what the text describes in words.)

- If necessary, provide help with the pronunciation of *Celsius* (SEL-see-us) and *Fahrenheit* (FAIR-uhn-hite).

Further Facts

- The idea that the continents have changed position—which led to the theory of plate tectonics—was first proposed in 1912 by a German scientist named Alfred Wegener (1880–1930). He suggested that at one time the existing continents were joined together as one supercontinent, which he called *Pangaea,* meaning "all lands."

- Pangaea began to split up about 200 million years ago. The continents continue to move. Europe and North America are estimated to be moving apart about 2–4 cm (about 0.75—1.5 in.) a year.

Page 4 *Earthquakes and Volcanoes*

- Before students read page 4, invite them to share what they know about earthquakes and volcanoes. Then have them read the section on earthquakes.

After reading, discuss the causes and effects of earthquakes. Ask, *What can happen when pressure bends or cracks a plate?* (It can cause an earthquake.) *What effect did an earthquake have on the road in the photograph?* (The earthquake caused a wide, deep crack to form in the road.) *Where do some earthquakes happen?* (at boundaries where plates slide past or push against each other)

- Next, have students read the section on volcanoes. Point out that volcanoes both destroy and create Earth's landforms. Ask, *How do volcanoes destroy landforms?* (They can blow off the tops of mountains.) *How do volcanoes create landforms?* (Lava hardens and builds up land. Volcanoes under the ocean can form volcanic islands. The mid-ocean ridge is a volcanic mountain chain. All new ocean floor comes from volcanoes.)

Further Facts

- Chains of volcanoes can form over hot spots—very hot places deep in Earth's mantle—as a moving plate slides across the hot spot. This is how the Hawaiian Islands were formed. The islands at the northwest end of the chain formed first. Other islands formed as the Pacific Plate continued moving northwest. A new volcano growing on the ocean floor southeast of the island of Hawaii (the Big Island) may someday become another island in the state. It is already named: Loihi.

- There are about 1,500 historically active volcanoes in the world. Some estimates of the number of undersea volcanoes exceed 1 million.

- Most of Earth's active land volcanoes are in a circle around the Pacific Ocean. Many earthquakes also take place here. This area is called the Ring of Fire. The reason there are so many volcanoes and earthquakes in the Ring of Fire is that this is where many of Earth's plates meet the Pacific Plate.

Page 5 *What is Weathering?* and *Physical Weathering*

- Before having students read page 5, write the term *weathering* on the board. Ask students what they notice about the word. (It has the word *weather* in it.) Explain that *weathering* is the term used for a force that can change rocks. Invite students to speculate on what is involved in weathering. (Accept reasonable responses. Students should infer that weathering may involve certain weather conditions.)

- Have students read the introduction on page 5. Ask, *What is weathering?* (the breaking down of rocks into smaller pieces) *What natural forces are involved in weathering?* (wind, water, temperature changes, plants) *What are the two kinds of weathering?* (physical weathering and chemical weathering)

- Have students read page 5 to find out about physical weathering. Assess understanding by having students summarize how each natural force causes changes in rocks. (Running water tumbles rocks around and breaks them up. Wind blows sand against rocks and wears away the rock. Temperature changes cause water in rocks to freeze and break the rocks apart. Plant roots can grow into cracks and break rocks apart.)

Page 6 *Chemical Weathering*

- Have students examine the photographs on page 6 and read the captions. Then have them read the text to learn about chemical weathering. After they read, have them compare and contrast physical and chemical weathering. Ask, *How are physical and chemical weathering alike?* (They both break down rocks.) *How are they different?* (In physical weathering, rocks are broken down by natural physical processes and forces, such as water freezing and melting in cracks, rocks being tumbled by water, wind blowing sand against rocks, and plants growing in cracks. In chemical weathering, water,

oxygen, and acids change the chemical makeup of rocks and break them down.)

- Have students describe the steps in the process by which chemical weathering creates huge underground caves. (Rainwater and carbon dioxide mix together and create weakly acidic groundwater. The acid dissolves parts of rocks underground. The holes in the rocks get larger and larger, forming caves.)

- If necessary, provide help with the pronunciation of *oxygen* (OK-sih-juhn), *carbon dioxide* (KAR-buhn die-OK-side), *lichens* (LIE-kenz), and *acidic* (uh-SID-ik).

Page 7 *Soil Formation*

- Have students read about soil formation on page 7 and study the cutaway diagram of a soil profile. Ask, *What is soil mostly composed of?* (weathered rock) *What else does soil contain?* (decayed plant and animal material, called humus, and water and air) To check comprehension, have students summarize the three main layers of soil and what each is made of. (topsoil, made of sand, silt, clay, and humus; subsoil, made of bits of rock mixed with a little humus; parent layer, made of large pieces of rock with no humus) Ask, *What is another name of layers of soil?* (soil horizons) *Why do you think no plants or animals live below the subsoil?* (Students may recognize that without humus, the parent material lacks enough of the right kind of nutrients to support life.)

- If necessary, provide help with the pronunciation of *humus* (HYOO-muhs).

Page 8 *What Causes Erosion and Deposition?*

- Have students read page 8, study the photographs, and read the captions to learn about erosion and deposition. Ask, *What is the difference between weathering and erosion?* (Weathering is the breaking down of rocks by wind, water, and other natural forces. Erosion is the movement of weathered rock and soil by water, ice, and wind.) *What conclusion can you draw about how long it takes for weathering and erosion to change Earth's surface?* (The process takes a very long time.)

- Contrast some of the very slow processes of weathering, erosion, and deposition with the rapid earth-changing events students have read about: volcanoes and earthquakes. As students read the next sections about different forces of erosion, tell them to think about whether the forces work quickly or slowly to reshape the land.

- *What are the results of weathering and erosion?* (The shape of the land is changed. Some of Earth's landforms are created by weathering and erosion.) Discuss the definition of *landforms* as shapes or features of Earth's surface. Make a class list of landforms students have seen or know about. Decide which are the primarily caused by weathering and erosion. (Students may suggest valleys, canyons, gullies or ravines, stone arches such as those shown on the cover, mesas, sand dunes, cliffs, or caves.)

- Point out that landforms are the result of a combination of constructive and destructive forces. Ask, *What do you think the term* destructive force *means? Give an example.* (A destructive force is one that breaks down material or is harmful to the land, as when chemical weathering wears away rock to create a cave or when windblown sand carves a rock formation like the one on the cover.) *What do you think the term* constructive force *means? Give an example.* (A constructive force is one that builds up or makes something new, or is helpful for the land, as when a volcano makes a new island or a mountain range is built at a plate boundary.)

Page 9 *Running Water*

- Have students read the text about running water on page 9. Ask, *What is the main*

idea of this section? (Moving water is a main cause of erosion.) *What three main things affect the amount of erosion a stream or river causes?* (how steep the land is, the number and type of plants on the land, the amount of water that is moving) *How do plants slow down erosion?* (Their roots hold the soil in place.) *What conclusion can you draw from this about land that has been cleared for farming or another purpose?* (Students may realize that cleared land is more vulnerable to erosion than uncleared land.)

- Ask, *What are some ways in which erosion and deposition create landforms?* (Rivers wear away rock, forming valleys and canyons. Winding rivers can change course and form oxbow lakes. Sediments dropped by rivers when they enter the ocean settle to the bottom and form new land called deltas.)

- Students may be interested to know the origins of the terms *oxbow lake* and *delta*. Explain that both names are related to the shape of the landform. An oxbow lake resembles an oxbow—a U-shaped frame attached to a yoke for a team of oxen; the oxbow forms a collar for the ox's neck. A river delta is triangular in shape, resembling the uppercase form of delta, the fourth letter of the Greek alphabet: Δ.

- If necessary, provide help with the pronunciation of *deposition* (deh-puh-ZIH-shuhn).

Page 10 *Waves*

- Have students read the text about waves on page 10 and look at the photographs and captions. Ask, *How do waves both destroy and create landforms?* (Waves wear away rock, creating sea cliffs and forming arches. Waves carry sand and pebbles from one place to another. Sand deposited by waves can form sandbars and barrier islands. Stones deposited by waves form rocky beaches.)

Page 11 *Gravity and Mass Movement*

- Have students read the text about gravity and mass movement on page 11. Ask, *What is mass movement?* (the movement of large amounts of rock and soil downhill) *How is gravity related to mass movement?* (Gravity causes mass movement.)

- Have students summarize the different types of mass movement. (rockslides, when gravity causes loose rocks to fall; mudflows, or rivers of mud; slumping, when soil and plants move together as a mass; creep, which is very slow mass movement)

Pages 12, 13 *Groundwater, Wind, and Glaciers*

- Before students read the section on groundwater, review with them what they learned about chemical weathering on page 6. Ask, *What happens when water in the ground mixes with carbon dioxide?* (It forms a weak acid that dissolves rock and can hollow out underground caves.) Ask whether any students have ever toured a cave, and invite them to share their observations. Explain that students will learn more about the effects of groundwater when they read page 12. Then have them read the paragraphs under "Groundwater." Ask, *How does groundwater cause deposition?* (When groundwater becomes less acidic, it deposits the rock that was once dissolved in it.) *What is the result of this kind of deposition?* (As the water drips, it creates stalactites that hang down from the ceiling of a cave and stalagmites that build up on the floor.)

- Invite students to speculate how wind causes erosion and deposition. Students may suggest that wind picks up sand and dust in one place and drops it in another. Have them read the section about wind on pages 12 and 13 to confirm their ideas. Then ask, *How does wind cause erosion?* (It picks up and carries away dust and sand

and deposits them in another place. Wind blasts rocks with the sand it carries and grinds them down.) *What is one type of landform formed by wind?* (sand dunes)

- You may wish to tell students that because of the huge dust storms that struck the central United States in the 1930s, the area was called the Dust Bowl. The natural grasslands had been plowed under in order to plant wheat. When the drought killed the wheat, the exposed topsoil was carried off by the wind. Thousands of families were forced to leave their homes. The problem was eventually brought under control after windbreaks were planted and some of the native grassland was restored.

- Have students read the section on glaciers on page 13. Ask, *What is a glacier?* (a huge moving body of ice) *What is the difference between a valley glacier and a continental glacier?* (A valley glacier is like a river of ice; a continental glacier is a sheet of ice that covers large areas of land.) *How do glaciers change Earth's surface?* (They wear away rocks and move soil and rocks to new places.) You may want to explain that there have been at least six periods in Earth's history when much of Earth's surface was covered with ice. We call these periods ice ages.

- If necessary, provide help with the pronunciation of *stalactites* (stuh-LAK-tites), *stalagmites* (stuh-LAG-mites), *Antarctica* (ant-ARK-tih-kuh), and *moraine* (moh-RANE).

People in Science (page 14)

Soil Conservationists

- Before students read, ask whether they know what a conservationist is. (a person who works to save endangered things) Ask, *What do you think a soil conservationist does?* (works to save soil) Have students make inferences about the need for soil conservation, based on what they have read about erosion. If necessary, remind them about the drought and dust storms of the 1930s, when wind picked up and carried away the soil. Ask, *What can slow down soil erosion? How?* (plants; their roots hold soil in place)

- After students read, have them confirm the inferences they made. Ask, *What do soil conservationists do?* (They work to prevent and control erosion of soil.) Have students summarize some of the methods soil conservationists have developed. (strip cropping, or planting two different crops side by side; leaving stubs of plants in fields after crops are harvested; planting windbreaks; grading stream banks; and placing rocks and plants along the banks)

Did You Know? (page 15)

About Floods

- Have students read page 15 to learn about floods. After they read, ask, *Why do you think most flooding in the United States occurs in the spring?* (That is when snow that falls in the mountains during the winter melts and flows into streams and rivers.)

- Point out that floods are another force that is both destructive and constructive. Ask, *How do floods destroy?* (They flood houses, wash away roads and bridges, drown crops, and harm or kill people and wildlife.) *How are floods helpful?* (They deposit new, fertile sediment on a river's floodplain.)

Further Facts

- Levees—embankments built along the edges of a stream or river—are an ancient method of flood control that is still being used. The ancient Egyptians built a series of levees along the Nile River for more than 966 km (600 mi).

- One of the largest levee systems today is the one built along the Mississippi River. It was begun by French settlers in the early eighteenth century. Today the system

includes more than 11,200 km (7,000 mi) of levees. Some levees reach 15 m (50 ft) in height.

- Another method of flood control is the construction of artificial channels. The Los Angeles River, which runs through that city's downtown, is contained by a concrete channel. While protecting the city from flooding, the channel has taken away the natural beauty of the river.

AFTER READING

Summarize

Complete the KWL chart you began with students before reading by asking them to share the answers to their questions. Call on volunteers to retell each text section. Then have students use the information in the KWL chart to write brief summary statements.

Discuss with students how using the KWL strategy helped them understand and appreciate the book. Encourage them to share any other reading strategies that helped them understand what they read. Direct attention to the fourth column in the chart and ask: *What questions do you still have about erosion? What would you like to explore further?* Record students' responses. Then ask, *Where do you think you might be able to find this information?* (Students might mention an encyclopedia, science books, and the Internet.) Encourage students to conduct further research.

Review/Assess

Use the questions that follow as the basis for a discussion of the book or for a written or oral assessment.

1. What fast processes cause changes in Earth's surface, and how do they do this? (Earthquakes shake the ground and can cause landslides and cracks in Earth's surface. Volcanic eruptions can blow off the tops of mountains; lava flows build up land. Other fast processes include rockslides, mudflows, floods, slumps, and wave action during a major storm.)

2. What slow processes cause changes in Earth's surface, and how do they do this? (Weathering breaks rocks down into smaller pieces. Chemical weathering can wear away rocks and create caves. In erosion, water, ice, and wind move weathered rock and soil from one place to another.)

3. What are the six main causes of erosion and deposition? (running water, waves, gravity and mass movement, groundwater, wind, glaciers)

4. What is mass movement, and what causes it? (Mass movement is the movement of large amounts of rock and soil downhill. It is caused by gravity.)

Writing Links/Critical Thinking

Present the following as writing assignments.

1. You have learned that landforms are the result of a combination of constructive and destructive forces. Describe how these forces affect Earth's surface features. (Students should mention that constructive forces include volcanic eruptions, which create new land and can form volcanic islands, and deposition of sediment. Destructive forces include weathering and erosion, which break down rocks into smaller pieces.)

2. The text states that the main cause of erosion is running water. Think about the various causes of erosion described. Why do you think running water is a more powerful force than waves, gravity, groundwater, wind, and glaciers? (Students may recognize that running water in the form of rain, runoff, and streams occurs in most places on Earth and affects surface features. Waves affect only seashores, gravity can work only on material that has already been weathered, groundwater affects only underground materials, wind is not constant, and glaciers occur in only a few places on Earth.)

Science Journals: You may wish to have students keep the writing activities related to the Delta Science Reader in their science journals.

References and Resources

For trade book suggestions and Internet sites, see the References and Resources section of this teacher's guide.