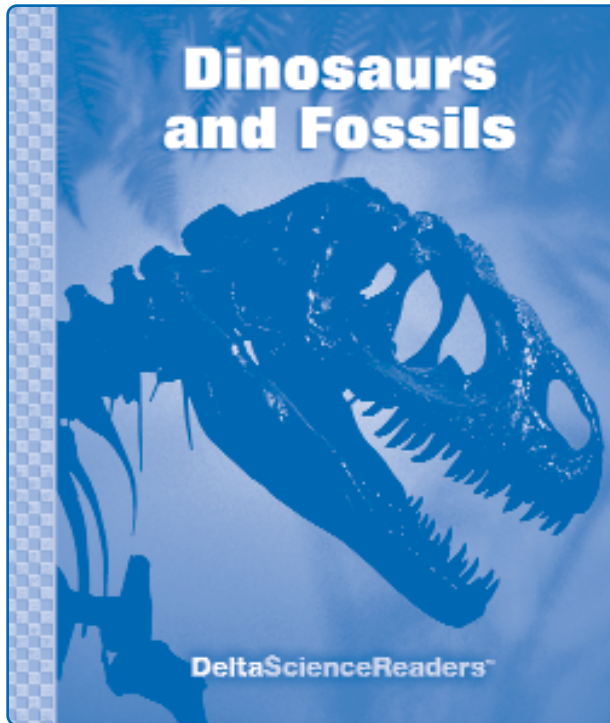


Dinosaurs and Fossils



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 *Dinosaurs and Fossils*, students discover what dinosaurs were, when they lived, what they were like, and how they may have become extinct. They read about fossils. They find out how different kinds of fossils form and what scientists can learn from fossils. Students learn the two main classifications of dinosaurs and meet examples of each type in a “field guide.” They also read about paleontologists—scientists who study the history of life on Earth—and the work they do. Finally, students learn about Sue, the largest and most complete *Tyrannosaurus rex* skeleton ever found.

Students will

- ▶ discover facts about dinosaurs
- ▶ find out how living things become fossilized
- ▶ learn that fossils provide evidence about plants and animals that lived long ago
- ▶ understand that adaptations helped some dinosaurs survive in their changing environment
- ▶ find out how scientists classify dinosaurs into groups
- ▶ examine nonfiction text elements such as table of contents, headings, and glossary
- ▶ interpret photographs and illustrations to answer questions
- ▶ complete a KWL chart

READING IN THE CONTENT AREA SKILLS

- Set a purpose for reading
- Compare and contrast dinosaurs and reptiles
- Draw conclusions about fossils
- Identify main ideas and supporting details in text passages
- Identify cause-and-effect relationships related to the extinction of the dinosaurs
- Demonstrate critical thinking
- Summarize and paraphrase

NONFICTION TEXT ELEMENTS

Dinosaurs and Fossils includes a table of contents, headings, photographs, illustrations, captions, boldfaced terms, a time line, a map, and a glossary.

CONTENT VOCABULARY

The following terms are introduced in context and defined in the glossary: *adaptation, bird, body fossil, carnivore, cast, classify, cold-blooded, dinosaur, extinct, fossil, fossil record, herbivore, invertebrate, life cycle, mineral, mold, omnivore, paleontologist, petrified, predator, prey, reptile, scavenger, sediments, sedimentary rock, trace fossil, vertebrate, warm-blooded.*

BEFORE READING

Build Background

Access students' prior knowledge of dinosaurs and fossils by displaying and discussing the cover. Ask, *What does this photograph show?* (part of a skeleton, an animal skull) *What is this a skeleton of?* (dinosaur) *Are dinosaurs living today?* (no) *When do you think the dinosaurs lived?* (Some students may know that dinosaurs lived millions of years ago).

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: *How have scientists learned about dinosaurs? What are the names of some dinosaurs? What do you think happened to the dinosaurs?*

Begin a group KWL chart by recording facts students know about dinosaurs and fossils in the K column and questions they have about dinosaurs and fossils in the W 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, 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 dinosaurs and fossils. Point out that these words are defined in the glossary. Choose one word and have students find its definition in the glossary.

Pronunciations of the dinosaur names and geologic time periods students will read about in *Dinosaurs and Fossils* are listed on the inside back cover, facing the glossary. Point out this list and the pronunciation key during the preview.

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, some of the words can be categorized according to whether they relate to what animals eat or what animals are like physically. Develop a two-column chart like the one that follows.

What Animals Eat	What Animals Are Like
carnivore	cold-blooded
herbivore	warm-blooded
omnivore	invertebrate
	vertebrate

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 2–12)

Pages 2, 3 *What Is a Dinosaur?*

- Have students read the first paragraph and look at the illustrated time line across the bottom of the pages. Ask questions to elicit facts about the Age of Dinosaurs. *When did the first dinosaurs live?* (about 225 million years ago) *When did dinosaurs become extinct?* (about 65 million years ago) Have students look at the time line to find out what geologic time period these

events occurred in. (Dinosaurs first lived in the Triassic Period of the Mesozoic Era. They became extinct at the end of the Cretaceous Period.) *Were dinosaurs the first living things on Earth?* (no) *What lived on Earth before the dinosaurs?* (plants and other kinds of animals) You may wish to point out that fish, insects, amphibians, and reptiles all were living before the dinosaurs.

- Before students continue reading, review what they know about dinosaurs. Then have them read to discover what dinosaurs were like. Guide students to compare and contrast dinosaurs and reptiles. Ask, *What is reptile skin like?* (It is covered with scales or plates.) *What was dinosaurs' skin like?* (Some dinosaurs also had skin covered with scales or plates.) *How do reptiles reproduce?* (They lay eggs.) *How did dinosaurs reproduce?* (They laid eggs.) *How else were dinosaurs like reptiles?* (They were vertebrates.) *How were dinosaurs different from reptiles?* (Reptiles are cold-blooded; some dinosaurs may have been warm-blooded.) Students may also mention that some dinosaurs had wings and feathers, which modern reptiles do not have.
- As appropriate, explain that fish, reptiles (such as lizards and snakes), and amphibians (such as frogs and salamanders) are all cold-blooded animals. Warm-blooded animals include birds and mammals (such as dogs, horses, and humans).
- Explore the possible relationship between dinosaurs and birds. Ask, *Why do some scientists think that birds are relatives of the dinosaurs?* (Birds walk on two legs and have wings and feathers. Some dinosaurs walked on two legs and had wings and feathers.) You may wish to explain that scientists are not sure whether any winged dinosaurs actually flew by flapping their wings; most winged dinosaurs were probably gliders.

- Ask, *How do scientists classify dinosaurs?* (by the way their hips were shaped) *What are the two main groups of dinosaurs?* (the *Saurischia*, which had hips like the hips of lizards, and the *Ornithischia*, which had hips like the hips of birds).
- If necessary, provide help with the pronunciation of *invertebrates* (in-VUR-tuh-brates), *vertebrates* (VUR-tuh-brates), *Saurischia* (saw-RIS-kee-uh), *Ornithischia* (or-nuh-THIS-kee-uh), *Mesozoic* (mez-uh-ZO-ik), *Triassic* (tri-AS-ik), *Jurassic* (juh-RAS-ik), and *Cretaceous* (krih-TAY-shus).

Pages 4, 5 *What Is a Fossil?*

- Have students read the first two paragraphs on page 4 to learn what fossils are. Then ask them what kinds of things they think can become fossils. (bones, teeth) Have students read to discover what other kinds of fossils have been found. When they finish, ask volunteers to tell in their own words what a fossil is. (A fossil is body parts, tracks, and other remains or traces of something that lived long ago that have been preserved.) Ask, *What conclusion can you draw about why most fossils are found in sedimentary rock?* (The bodies of animals that were not quickly buried under mud, sand, or silt were destroyed and not preserved as fossils.)
- Check students' understanding of how fossils are formed by asking, *What is the difference between a trace fossil and a body fossil?* (A trace fossil shows a change in the environment, such as a track in mud. A body fossil is the cast or mold made by an animal's body or body part or by a plant.) *How do bones become petrified?* (Minerals seep into the bones and turn them into rock.)
- Assess understanding by having students summarize what can be learned from different types of fossils and where they are found. Students should understand that fossils provide evidence about plants and animals that lived long ago, as well as

about the nature of the environment they lived in and the history of Earth itself. Elicit that the location gives clues to Earth's history; bones give clues to a dinosaur's height, weight, shape, and general appearance; teeth and droppings show what an animal ate; nests and eggs are clues to how they reproduced and cared for their young; and footprints show what their feet looked like and how they moved.

- If necessary, provide help with the pronunciation of *Parasaurolophus* (pair-uh-sor-uh-LOAF-us).

Further Facts

- A young farmer, Pliny Moody, plowing a field in Massachusetts, discovered the first dinosaur tracks in the United States in 1802. He turned up a slab of stone with several large (31 cm, or 1 ft) birdlike footprints. The tracks are believed to belong to a small *Ornithischian* dinosaur.
- The first nearly complete dinosaur skeleton was discovered in 1858 in New Jersey by fossil hobbyist William Parker Foulke. The duck-billed *Hadrosaurus* was assembled at the Academy of Natural Sciences in Philadelphia. It was later the first mounted dinosaur skeleton on public display in the world.
- A very recent fossil discovery in China supports a link between dinosaurs and birds. *Microraptor gui*, a small (77 cm, or 30 in.) predatory carnivore, had two pairs of wings and was covered with feathers. It may have lived in trees and glided from branch to branch.

Pages 6, 7 *What Were Dinosaurs Like?*

- Have students read the first two paragraphs on page 6. Ask, *What is the main idea you learned about dinosaurs?* (Dinosaurs were not all alike.) *What details support this main idea?* (Some were plant-eaters, some were meat-eaters, and some ate both plants and meat. Some were predators, and some may have been scavengers.) Ask

students how they think scientists can tell what kind of food a dinosaur ate. (by the shape of its fossil teeth)

- Extend the discussion by asking students if they can think of any present-day animals that are herbivores (deer, cows), carnivores (lions, eagles), omnivores (bears, turtles), and scavengers (vultures, hyenas).
- Have students read the next three paragraphs about the life cycle of dinosaurs. Ask, *What present-day animals have a life cycle similar to that of dinosaurs? How are their life cycles alike?* (A reptile's life cycle is similar to that of dinosaurs because reptiles lay eggs, and the young hatch from the eggs and grow into adults.)
- Review the concept of *life cycle* as needed. An organism's life cycle is the changes it goes through during its life. Animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. Life cycles are different for different kinds of organisms. Point out that an important similarity between life cycles of dinosaurs and reptiles is that their young hatch from eggs.
- Have students finish reading the text, look at the illustrations on page 7, and read the captions. Assess understanding by asking, *What is an adaptation?* (Something that helps a living thing survive, such as special body parts or ways of acting.) *What is one way in which dinosaurs adapted to the changing climate of Earth?* (Some of them had body plates to help keep them cool.)
- If necessary, provide help with the pronunciation of *herbivore* (UR-bih-vor), *omnivore* (OM-nih-vor), *Triceratops* (tri-SAIR-uh-tops), *Spinosaurus* (spine-uh-SOR-us), and *Omeisaurus* (o-may-SOR-us).

Pages 8, 9 *Saurischia*

- Read the introduction with students. Ask whether students have ever seen a field guide to flowers, birds, or other living

things. Explain that these pages are like a field guide to some of the dinosaurs in the group named *Saurischia*. Point out that each illustration is accompanied by the name of the dinosaur, a descriptive paragraph, and a list of facts.

- Have students read the entries for *Tyrannosaurus rex* and *Oviraptor*. Help students compare and contrast the two types of dinosaur. Ask, *In what ways were T. rex and Oviraptor alike?* (They both walked on two legs, had tiny arms, had claws, and ate meat.) *How were they different?* (*T. rex* was huge, and *Oviraptor* was very small. *T. rex* had teeth, but *Oviraptor* had none.)

Further Facts

- Many scientists believe that dinosaurs in this group—the theropods—were the ancestors of modern birds.
- Scientists found an *Oviraptor* nest with the fossil of the mother dinosaur curled around her eggs. She may have been protecting the eggs from a sandstorm that killed her, or perhaps she was just nesting or laying eggs when it struck. (It was first thought—incorrectly—that the dinosaur was raiding the nest of another species, as its name “egg-thief” shows.)
- Students familiar with the *Jurassic Park* films may be interested to know that some of the dinosaur stars did not live during the Jurassic Period. Both *Tyrannosaurus rex* and *Velociraptor* lived during the late Cretaceous. In the films, *Velociraptor* was 400 times its real size. (As appropriate, explain that the term “late Cretaceous” means the end of the Cretaceous Period, nearer in time to the present. The beginning of the period is referred to as the early Cretaceous Period.)
- Have students read page 9 to learn about *Brachiosaurus* and *Argentinosaurus*. Discuss the information with students. Ask, *What is the most surprising thing you*

learned about these giant dinosaurs? (Responses will vary, but students may say they were surprised that these huge dinosaurs were plant-eaters.)

- If necessary, provide help with the pronunciation of *Tyrannosaurus rex* (tih-ran-uh-SOR-us reks), *Oviraptor* (o-vih-RAP-tor), *Brachiosaurus* (bray-kee-uh-SOR-us), and *Argentinosaurus* (ar-jen-teen-uh-SOR-us).

Pages 10, 11 *Ornithischia*

- Read the introduction with students. Ask them to examine the illustrations and point out the armor they see on each dinosaur. You may wish to explain that the dinosaurs’ colors come from the artist’s imagination; we have no way of knowing what colors dinosaurs actually were. Ask, *In addition to the shape of their hips, what are some ways that all Ornithischia were alike?* (Most had some kind of armor covering their bodies. They were all plant-eaters.) Invite students to compare these plant-eating dinosaurs with *Brachiosaurus* and *Argentinosaurus*. Ask, *Why do you think the plant-eating Saurischia did not have armor?* (Students may suggest that their large size protected them from predators.)
- Have students read about the four *Ornithischia* in the “field guide.” Then ask them to suggest other features besides their stiff body covering that might have protected these dinosaurs from danger. (Possible answers: *Stegosaurus*’s tail spikes and *Ankylosaurus*’s tail club might have been swung to strike at predators; *Triceratops* could have kept predators away with its horns; *Parasaurolophus* might have used its crest to smell a nearby predator.)
- Point out that not all these dinosaurs lived during the same time period. Have students identify which dinosaurs may have existed at the same time. Ask, for example, *Which of these dinosaurs lived during the late Jurassic Period?*

(*Brachiosaurus* and *Stegosaurus*) Would *T. rex* have been able to hunt *Brachiosaurus*? Why not? (No, *T. rex* lived during the late Cretaceous.)

- If necessary, provide help with the pronunciation of *Stegosaurus* (steg-uh-SOR-us) and *Ankylosaurus* (ang-kih-luh-SOR-us).
- After students have read the field guide pages (pages 8–11), point out the list of facts for each dinosaur. Ask, *What information is given in these lists?* (the dinosaur’s height, length, and weight; where it was found; the time period when it lived) Invite students to practice classifying and ordering. They might group the dinosaurs according to when they lived or which continent they lived on. They might put the dinosaurs in order according to size—smallest to tallest, shortest to longest, lightest to heaviest. Challenge students to think of other ways to classify or order the dinosaurs in the field guide.

Page 12 *Why Did Dinosaurs Become Extinct?*

- Have students read the text on page 12 and look at the map. After they read, ask, *What do some scientists think caused the extinction of the dinosaurs and other living things?* (a meteorite that struck Earth around 65 million years ago) Guide students to state the cause-effect chain of events that followed. Ask, *What happened when the object struck Earth that caused the dinosaurs to die?* (Clouds of ash, dust, and smoke were sent into the sky. The clouds blocked the sun’s light. The climate grew colder, which caused plants to die. This caused plant-eating dinosaurs to die. Because they had no prey, the meat-eating dinosaurs died.)
- If necessary, provide help with the pronunciation of *meteorite* (ME-tee-uh-rite), *Chicxulub* (CHEECH-uh-loob), and *Yucatán* (yoo-kuh-TAN).

Further Facts

- Based on the size of the Chicxulub impact crater, scientists estimate that the meteorite that struck Earth was 10 kilometers (6 miles) across. Help students think of a familiar place that is about that far from your school. That distance equals the diameter of the meteorite that formed the crater.
- Earth is constantly being hit by space debris, but most of it burns up before it reaches Earth’s surface. Nevertheless, some space scientists look for, track, and categorize asteroids and comets that may travel near Earth. A scale called the Torino Scale has been developed to describe the potential for collision with a comet or asteroid.
- One famous example of a crater on Earth that is visible today is Meteor Crater near Winslow, Arizona. This huge pit—1.2 kilometers (0.8 miles) wide and over 180 meters (600 feet) deep—is believed to have been made by a meteorite that crashed to Earth about 50,000 years ago.
- Another crater example is Chubb Crater in Canada. A 250-meter- (820-foot-) deep lake fills this 1.4-million-year-old crater.

People in Science (page 13)

Paleontologists

- Ask students whether they know what a paleontologist is. If necessary, explain that a paleontologist is a scientist who studies the history of life on Earth as shown in fossils and the rocks in which they are found. Then have students read page 13 to find out about the work of paleontologists.
- Ask, *In what way are paleontologists like detectives?* (Like detectives, paleontologists look for clues, and they put the clues together to answer questions or solve mysteries.) *What do you think is the most exciting part of a paleontologist’s work?* (Accept reasonable responses, such

as discovering a new species of dinosaur or finding out something new about how dinosaurs may have lived.)

- If necessary, provide help with the pronunciation of *paleontologist* (pay-lee-on-TOL-uh-jist) and *rhinoceros* (ri-NOSS-uh-ross).

Further Facts

- Sir Richard Owen (1804–1892) was a surgeon who became an expert in paleontology by studying comparative anatomy. He was a founder of the British Natural History Museum.
- Owen obtained a skeleton of *Archaeopteryx* (ar-kee-OP-tur-iks), the oldest known fossil bird, for the museum. The animal had some features of birds, such as wings, and some of dinosaurs and reptiles, such as teeth and a long bony tail.

Did You Know? (pages 14, 15)

About Sue

- Before they read, ask students whether they have ever seen a dinosaur skeleton or model at a natural history or science museum. Invite them to share their impressions of the exhibit. Then have students read pages 14 and 15, look at the photographs, and read the captions to find out about Sue, an amazing *T. rex* find.
- Ask, *What made Sue such an important find?* (It is the largest and most complete *T. rex* skeleton ever found.) *How did Sue get that name?* (She was named after Sue Hendrickson, the fossil hunter who discovered her.) *What important discovery did scientists make about Sue?* (She had a wishbone like chickens do.) *Why is this important?* (It is a clue that birds are related to dinosaurs.)

Further Facts

- Sue's bones showed signs of aging, which meant that she was an old

dinosaur. She also had broken ribs that had healed before she died.

- When Sue lost a tooth, a new one grew to take its place.
- Studies of Sue's skull and brain case show that she had an amazing sense of smell. Almost half of her brain was used just for the sense of smell!

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 dinosaurs and fossils? 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. Scientists classify dinosaurs into what two groups? (lizard-hipped dinosaurs, or Saurischia, and bird-hipped dinosaurs, or Ornithischia) Name two other ways in which dinosaurs could be classified. (Students may mention that they could be grouped by what they ate, when they lived, whether

they walked on two or four legs, or whether they had armor plates or not. Accept other reasonable grouping categories as well.)

2. What are the two main types of fossils? How is each formed? (The two kinds of fossils are trace fossils and body fossils. Trace fossils show a change an animal made in its environment, as when footprints in mud harden. Body fossils form when layers of sediments harden around a dead animal or plant. A mold is left when the animal or plant rots away. Sediments fill in the mold and form a cast in the shape of the animal or plant.)
3. What is an adaptation? Give an example of a dinosaur adaptation. (An adaptation is a body part or behavior that helps an animal survive in its environment. The long neck of *Brachiosaurus*, which enabled it to reach tree leaves to eat, and the defensive spikes on *Stegosaurus*'s tail are examples of dinosaur adaptations. Students may name others.)
4. Why do scientists think that a meteorite caused the dinosaurs to become extinct? (A large meteorite struck the Earth about 65 million years ago, which is when the dinosaurs became extinct. The effects of such a strike would be the cooling of Earth's climate from dust and ash clouds blocking the sun. That would have destroyed the dinosaurs' food supply.)

Writing Links/Critical Thinking

Present the following as writing assignments.

1. You are a paleontologist who has just discovered an animal fossil. Write about your discovery. Describe where and how you found the fossil. Tell what the fossil looks like. Explain how it might have formed. Draw conclusions about the kind of animal it is a fossil of. What can the fossil tell you about how the animal lived and what kind of environment it lived in? (Responses will vary.)

2. Paleontologists work in several different areas. Some travel all over the world and work in the field, searching for fossils and digging them up. Some work in universities, teaching students about paleontology or studying the findings of field research. Some work in museums, planning exhibits and working on the museums' fossil collection. If you were to become a paleontologist, what type of work would you choose to do? Why? (Responses will vary.)

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.