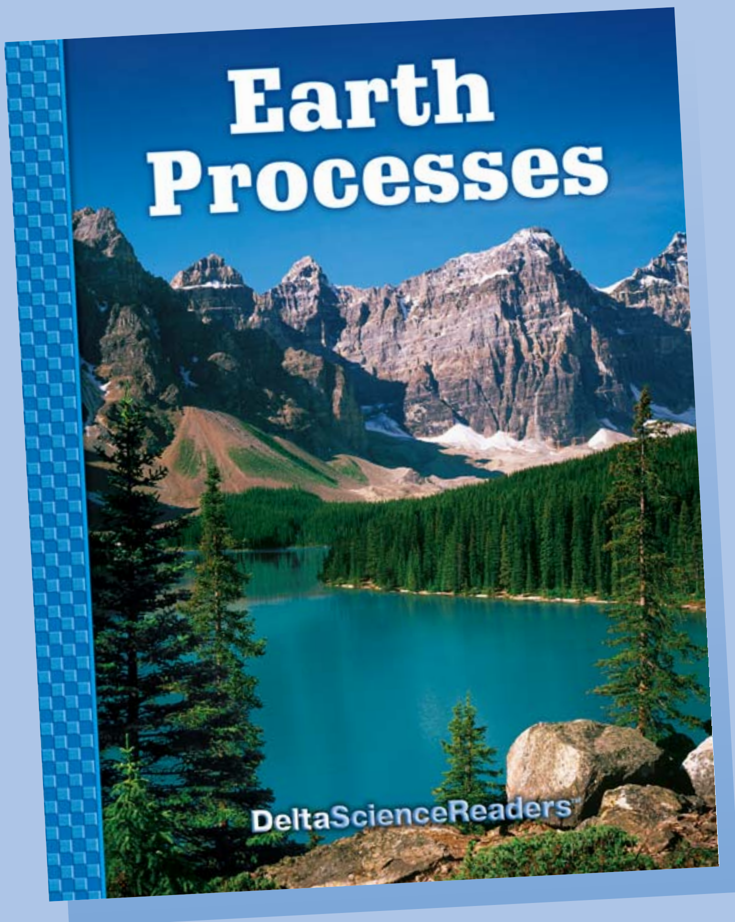
Delta Science Reader *Earth Processes*
Teacher's Guide



In the Delta Science Reader ***Earth Processes,*** students read about changes in Earth's surface. They learn about Earth's slowly moving plates and how their movements are related to earthquakes, volcanoes, and mountain building. They read about weathering, erosion, and deposition and discover how these destructive and constructive forces continually reshape Earth's surface. Students also find out how rocks and soil form and how, over time, rocks can be changed from one type to another in the rock cycle. They are introduced to a famous geologist—Harry Hess—whose studies of the ocean floor led to the theory of sea-floor spreading. Finally, students learn about the geologic time scale and the fossil record.

DELTA SCIENCE READERS for grades 6–8 are content-rich, 24-page informational texts that present key science concepts and vocabulary. They cover important science topics in an accessible, engaging format.

TEACHER'S GUIDES for Delta Science Readers for grades 6–8 contain general background information for linking science and literacy, assessment, and including all learners, as well as a comprehensive teaching plan. The teaching plan features three-step lessons and spotlight panels on science, literacy, and meeting individual needs.

Contents

INTRODUCTION

Delta Science Readers for grades 6–8 are content-rich, 24-page informational texts. Based on key science standards for the topic, they are used in conjunction with hands-on kits or as stand-alone texts.

As students reach middle school, their reading abilities and knowledge of literacy skills and strategies greatly affect their success in understanding informational text. Middle school readers often need guidance in reading for information, especially as the content load of the text increases and becomes more complex. This guide provides the middle school teacher with both science and literacy support to help students learn.

Science and Literacy

Delta Science Readers are outstanding resources for building both science knowledge and literacy skills and strategies. Students interacting with informational text are exploring language fully, exercising all four aspects of literacy: reading, writing, speaking, and listening.

Reading Informational Text

Reading to gain information is markedly different from reading for literary experience or to perform a task. Informational text is often read nonlinearly, or selectively. From section to section, the difficulty level, concentration of new vocabulary, structural pattern, and unfamiliarity of content may vary. Use the following guidelines to help your students get the most out of reading nonfiction text.

Prereading. Help students anticipate content and predict learning outcomes before they begin to read. Always preview informational text with students so that they can develop a focused purpose for reading and be able to answer the question, "Why am I reading this?"

Reading Strategically. A number of reading strategies support the comprehension of science text, in part because of the strong relationship between science and reading comprehension skills. The following comprehension skills are common to both reading and science:

- Identify main ideas and supporting details
- Compare and contrast
- Relate cause and effect
- Trace a sequence of events
- Draw conclusions based on evidence
- Demonstrate critical thinking
- Generate questions
- Summarize information
- Interpret graphics
- Recognize patterns and relationships
- Make predictions

Some of these skills are applied in the process of extracting and processing information. Others are applied in more demanding ways as students evaluate, analyze, interpret, and synthesize ideas.

Monitoring Comprehension. Help students read actively. Active readers think about the organization and presentation of information and monitor their own comprehension. Provide these tips: reread difficult passages; vary the pace of reading; stop and think about a passage; ask questions; think aloud while reading; take notes; make a prediction about what will come next; or paraphrase what has been read. Also, some students can process and share information better when paired with a reading partner.

Using Graphic Organizers. Graphic organizers are diagrams that show the relationships among ideas. Unlike traditional outlines, graphic organizers are visual representations. They show, rather than tell about, associations among important facts and supporting details. Encourage students to create their own graphic organizers. The most effective ones are those generated by students themselves as they interact with information. Useful formats include the KWL chart (see p. T1), concept web, T-chart, Venn diagram, flowchart, and cycle chart.

Keeping Science Notebooks. Responding to informational text in writing promotes higher levels of understanding. Students should use their notebooks for all writing related to the topic. This can include graphic organizers, vocabulary lists, predictions, questions, observations, labeled illustrations and diagrams, personal discoveries, activity sheets, and note taking.

Building Science Vocabulary

Studying science involves learning specialized vocabulary terms. It may also mean relearning familiar words that have different meanings in science. Help students acquire new science vocabulary through multiple activities. Examples include analyzing word parts, understanding word origins, identifying word families, crafting definitions in their own words, role-playing or illustrating definitions, connecting new words to known words, using context clues, and using science language as they write and talk about science topics.

Previewing Vocabulary. When previewing the boxed vocabulary words for each section, you may wish to focus on the terms most critical to your curriculum needs. You may also wish to have students work in pairs or in small groups to share their ideas about words and meanings.

It is important for students to keep written records of their growing science language in their science notebooks. You may begin this record during the vocabulary preview, using any of the following ideas or your own method:

- Have students sort the vocabulary words into lists of terms they know and don't know. As they read and learn, the "Know" list should grow and the "Don't Know" list should shrink.
- Ask a volunteer to read the words out loud so students can hear correct pronunciations.
- Group related words together in a chart.
- Identify words with familiar roots, prefixes, or suffixes.
- Note familiar words that have a special or different meaning in science.
- Let students select one vocabulary word they know and illustrate it or use it in an original sentence.

Reading and Vocabulary Growth. Support the natural link between science and literacy by making your science classroom a library as well as a laboratory. Make available other kinds of reading material about the topic in addition to the Delta Science Readers. Examples include nonfiction trade books, newspaper and journal articles, computer printouts from validated and reliable sources, textbooks, reference books such as almanacs and encyclopedias, posters, CD-ROMs, and so on. Seeing science concepts and vocabulary used in other contexts reinforces understanding.

*See the **Glossary** pages, T23–T24, for many additional suggestions on building vocabulary.*

Assessment Features

Students' knowledge and skills should be assessed in as many modalities as they are taught so that all students can show what they know. This Delta Science Reader teacher's guide offers a variety of tools and strategies for measuring student achievement throughout the learning process.

Preassessment Preassessments take place prior to learning and provide information on students' awareness and experience regarding the topics.

- **Access Prior Knowledge**—informal assessments of students' entry-level understanding.

Ongoing Assessment Ongoing, formative assessments are integrated into the daily teaching and learning process. They not only measure ongoing student progress but also provide insights for reshaping and improving instruction.

- **Read to Understand Questions**—self-assessments or more formal evaluations of student mastery of key concepts. Suggested answers are provided.
- **Alternative Assessments**—additional choices, usually nonverbal, that provide other ways for students to demonstrate competencies.
- **Meeting Individual Needs**—teaching ideas that serve as assessments for students who have difficulty communicating fluently.
- **Answers to Caption Questions**—self-assessments related to student interpretation of graphic elements.
- **Notebooks**—student responses to science text and experiences that reveal growth in level of understanding and ability to organize ideas.

Postassessment Postassessments, or summative assessments, are opportunities for students to demonstrate what they have gained as a result of the learning experience.

- **Review and Reflect**—summative assessments showing the degree to which students can recognize patterns and understand relationships in the overall subject matter.
- **Writing Links**—writing assignments that require students to apply and communicate knowledge.
- **Cover to Cover**—opportunity for students to synthesize learning by comparing and contrasting front and back cover photographs.
- **Unit Test**—selected-response and short-answer questions (with answer key), provided with this teacher's guide, that measure comprehension of key science vocabulary and concepts.

Including All Learners

All students can be active participants in the scientific process and can become scientifically literate citizens. Further, all teachers can successfully guide students to learn and enjoy science. Making science content universally accessible may require implementing different instructional strategies and accommodating multiple intelligences. The guidelines listed below will help you meet the challenges of your diverse classroom.

Hands-on Science

The science classroom is an ideal environment for diverse learners because of its reliance on hands-on exploration of the world. Research has shown that all students are highly motivated to learn science when actively engaged in hands-on activities. Hands-on investigations are therefore an essential component of science education. Hands-on, inquiry-based science helps extend the reach of instruction to all students while enhancing and reinforcing student learning.

English Language Learners

When reading informational science text, language students are confronted with the challenge of learning content while becoming proficient in English. They may have the cognitive ability to perform in class and understand scientific meanings, but they may be unable to communicate, by reading, writing, speaking, or even listening, with proficiency and confidence. Using effective strategies, teachers can make content more accessible while language learners improve their English.

- Reinforce reader content with hands-on activities.
- Simplify vocabulary, not content.
- Allow multiple opportunities to practice new vocabulary.
- Present information orally and visually.
- Allow ELLs to demonstrate science learning nonverbally.
- Assess science comprehension, not English fluency.
- Promote a classroom environment in which students are comfortable sharing ideas and taking risks.

Learners with Special Needs

Individual student needs, abilities, and disabilities vary widely, and the accommodations appropriate for each classroom will be unique. Begin with a student's individual educational plan (IEP). Tailor the presentation, classroom setup, teaching strategy, and materials to ensure student safety and to enable each student to participate as fully as possible.

- Present instruction in the context of real-world situations.
- Pair students who have difficulty reading with friends who read fluently.
- Allow extra time for completing activities.
- Assign one task at a time and give instructions in different ways.
- Introduce new vocabulary in different, meaningful ways.
- Review material more often.
- Repeat other students' comments and questions for everyone to hear clearly.

Advanced Learners

Advanced learners benefit from meaningful assignments that extend and enrich their knowledge of science. Encourage students who readily grasp the basics of science concepts and processes to deepen their explorations. Students performing above grade level can cultivate high levels of science thinking through further research, investigation, or other guided or independent projects.

- Provide enrichment opportunities for students who can and wish to work on independent projects.
- Ask questions that encourage creative or imaginative answers.
- Model thinking that leads to problem solving, synthesizing, analyzing, and decision making.
- Make available more sophisticated resources for exploring the topic.
- Invite students to present their research to the class in a format of their choosing.

*See the **Meeting Individual Needs** spotlight panels throughout this guide for specific suggestions for including English Language Learners, learners with special needs, and advanced learners.*

About the Teaching Plan

The format and content of the three-step lesson plans and spotlight panels for each ***Think About . . .*** section in the student book are described below. Use the suggestions and strategies as appropriate for your teaching style and the needs of your students.

Three-Step Lesson Plan

The lesson plan for each section begins with a list of learning objectives. The final objective in each list highlights one reading skill that promotes science comprehension.

1 Before Reading Before-reading strategies set the stage for reading each section. Prereading efforts are particularly important with informational text because the reader will encounter new and complex ideas, different text forms and structures, and unfamiliar vocabulary. Make the process less daunting by accessing prior knowledge and previewing the section.

Access Prior Knowledge. These discussion prompts help you engage and motivate students by linking the main ideas students will read about to their existing knowledge and experiences. In some cases, it may be appropriate to identify and address common misconceptions about the topic at this point.

Preview the Section. This is a "walk-through" of the section content and vocabulary. Point out or discuss the boxed Read to Understand questions and vocabulary words. These indicate the main topics and key terms covered in the section. Also, look together at the section title and subheads. Based on the preview, students can generate questions, make predictions, and set a purpose for reading this section.

2 Guide the Learning Help students interact with the text, monitor comprehension, and integrate new ideas with existing knowledge as they read. A variety of grouping strategies is suggested so that students may benefit from collaborative learning.

Discuss and Explore. These questions elicit student responses that demonstrate comprehension of facts and concepts. The science and literacy skills developed during reading include

- relate cause and effect
- identify main idea and supporting details
- trace sequence of events
- compare and contrast
- describe
- predict

Critical Thinking. These questions challenge students to dig deeper and exercise higher-order thinking skills, such as

- infer
- draw conclusions
- interpret
- summarize
- generate questions

3 Assess After-reading assessments for each *Think About . . .* section include

Read to Understand Answers. Sample answers to the Read to Understand questions are provided. The questions can function either as informal self-assessments for students or as part of an ongoing written or oral assessment of student progress.

Alternative Assessment. These assessment opportunities, such as hands-on demonstrations or visual presentations, accommodate multiple learning and communication modes.

This teacher's guide offers opportunities for multiple measures of student progress. *See **Assessment Features,** p. Tiii, for additional tools.*

Spotlight Panels

Special feature boxes appear on each page to provide additional support.

Science. Additional science background information, historical perspectives, and facts and figures of interest that support science instruction and can be shared with students as appropriate.

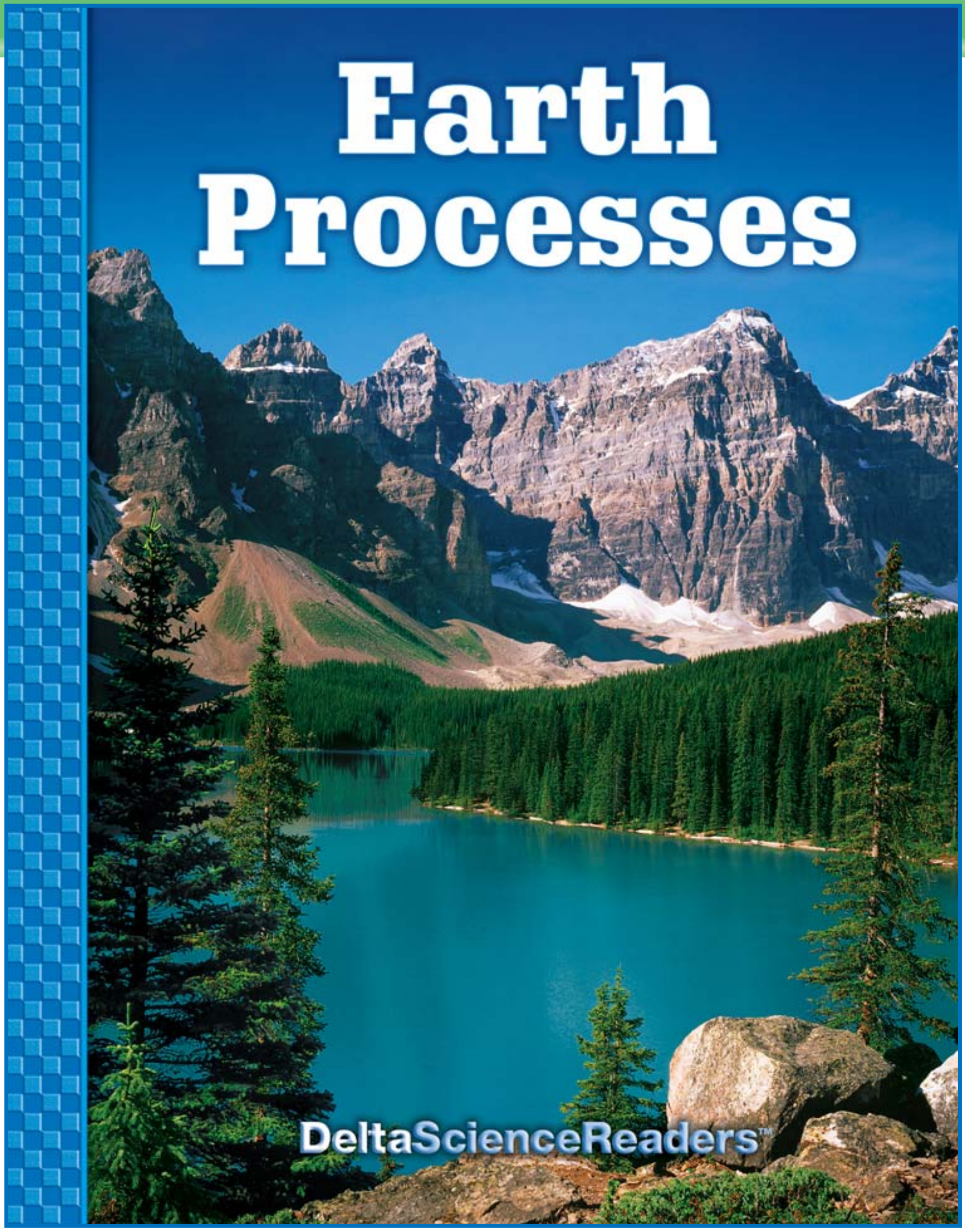
Literacy. Ideas for strengthening literacy skills in the areas of reading comprehension, vocabulary, notebooking, organizing ideas, and using the visuals.

Meeting Individual Needs. Suggestions for making science content and vocabulary accessible to English Language Learners and students with special needs and for including and challenging advanced learners.

*Teaching pages for **People in Science** and **Did You Know?** also offer suggestions for activating prior knowledge and building comprehension and include science spotlight panels. The Glossary pages provide many helpful vocabulary-building strategies.*

TEACHING ***Earth Processes***

The Delta Science Reader ***Earth Processes*** presents the key science concepts related to Earth's structure and geologic history, the rock cycle, and the forces that continually change Earth's surface. The book provides opportunities for students to engage in science inquiry by applying literacy skills and strategies to informational text. Students explore science as they develop informational literacy.



Build Background

Front Cover. Access students' prior knowledge of earth processes by displaying the front cover and discussing the title. *What is a process?* (a series of actions or changes that lead to an outcome) *What do you think an earth process might be?* (Accept all ideas.) Ask, *What do you see in the photograph on the cover?* (mountains, ice or glacier, rocks, forest, lake) *How do you think the mountains were formed? How do you think the lake formed?* (Accept all reasonable answers.)

Encourage students to share what they know about how natural processes change Earth's surface from their personal experiences and from previous hands-on explorations in science. Stimulate discussion with questions such as *What are some of the landforms (such as mountains, plains, hills, shorelines, river valleys) in the area where we live? How do you think they formed? What are some natural events that change Earth's surface? Do you think these changes happen quickly or slowly?*

Such discussions help students make connections between what they already know and new information that will be presented in the book. Based on the title and cover, have students predict what they might learn about in this book.

Preview the Book

In a preview, students scan the book quickly to see the structure and to find the main topics and most important text features. Have students preview *Earth Processes* before reading.

Roadmap for Reading. Tell students that previewing is like looking at a map before taking a trip. It helps us know where we are going! Using a preview to anticipate content increases student interest in the material to be studied. For that reason, a preview is a vital part of reading for information, or nonfiction reading. Use the preview to activate prior knowledge, make predictions about what the text will cover, and set a purpose for reading.

DeltaScienceReaders™

Earth Processes

CONTENTS

Table of Contents. Begin the preview with the table of contents. Think of the table of contents as an outline of the book. It lists the different parts of the book and the topics covered in each part. Page numbers are given for the main section headings. After students have skimmed the table of contents, ask if they have ever studied any of these topics before. Look at the photographs on the contents page. Can students guess where in the book they might find out about the objects pictured?

Text Features. Next, have students "walk through" the book. Ask them to look at the headings, subheadings, and graphics (photographs, diagrams, captions, illustrations, labels, graphs, and tables) and tell why they are helpful. Focus their attention on organizational features such as the boxed Read to Understand questions, boxed vocabulary lists, boldface words, and Glossary.

For each new feature students identify, have them ask questions: Why are these [*boxes*] here? What are the purposes of [*map keys*]? How do these [*boldface words*] help us understand the topic? What if the book did not have [*figure numbers*]?

Start a KWL Chart

Have students make a four-column KWL chart in their science notebooks. Based on the book's title and their preview, have them fill in the first two columns—What I Know (K) and What I Want to Know (W). Have students fill in the third column, What I Learned (L), as they work through the book. After students have finished reading about each topic, they can fill in the last column with questions they still have about the topic. Generating questions is an important critical thinking skill for responding to text and motivating more investigation.

Conceptual Framework

Help students make meaning of the content covered in *Earth Processes* by building a conceptual framework—a theme around which students can organize ideas and information. For this topic, such a framework might be **Things change over time.** Things that change over time can be as vast and slow as continents moving over millions of years, or as small and quick as a gully forming near the schoolyard after a sudden rainstorm. Earth has changed over its long history, is changing today, and will continue to change.

Begin by discussing students' experiences of observing changes in nature. For each suggestion, have students describe the evidence that a change occurred and how long they think the change process took. As students read, they can relate their learning about earth processes to the framework. When possible, help students connect the information in the book to natural and human-made changes that are affecting local geology.

OBJECTIVES
(pages 2–3)

- Understand how Earth's layers differ in composition and temperature.
- Relate density and temperature of earth materials to their depth inside Earth.
- Explain how heat is transferred from Earth's core to the surface.
- Use reading skills such as comparing and contrasting to achieve science comprehension.

1 Before Reading

Access Prior Knowledge

Ask students questions to elicit their ideas about what Earth's interior is like. *What do you think it is like deep inside Earth? Why do you think so? How do you think scientists find out about Earth's interior?* Invite students who have visited the Grand Canyon (Fig. 1) or a similar geological feature to describe their observations.

Preview the Section

Use the Read to Understand questions to set a purpose for reading (answers on p. T3). Preview the Vocabulary words using one of the methods described on p. Tiii. Remind students that these important words appear in boldface type in the text and are defined in the Glossary. (See pp. T23–T24 for vocabulary-building ideas.)

2 Guide the Learning

Discuss and Explore

Compare and Contrast *How does continental crust differ from oceanic crust?* (Continental crust is thicker and made mostly of granite. Oceanic crust is thinner and made of basalt.) *How are the two types of crust alike?* (Both form the outermost layer of Earth. Both are solid rock.)

Think About . . .

What Is Inside Earth?

▲ **Figure 1** Over time, the Grand Canyon in Arizona was carved out by the flowing water of the Colorado River. We can see that Earth's surface is constantly changing. But what is happening deeper inside Earth?

Read to Understand

- How do Earth's three main layers differ from one another?
- How does heat move through Earth's interior?

VOCABULARY

geologist	outer core
crust	inner core
continent	conduction
mantle	convection
core	convection current

Geologists are scientists who study Earth. They want to know about the materials that Earth is made of and how Earth has changed during its history. Geologists cannot drill deep enough to study Earth's interior. The deepest well ever drilled is only about 12 kilometers (7.5 miles) deep. But the distance to Earth's center is more than 6,300 kilometers (almost 4,000 miles). So geologists use other ways to collect information about what it is like inside Earth.

Scientists get clues about Earth's interior by studying the lava of volcanoes, which comes from deep inside Earth. Other evidence about Earth's interior comes from studying certain rocks at Earth's surface. These rocks actually formed deep inside Earth. Over time, they were pushed up closer to the surface and exposed when the rock above them was worn away. Geologists also study earthquakes. The energy waves produced by earthquakes move differently through different materials. By measuring the speed of earthquake waves and the paths they take, geologists have learned much about the different materials that make up Earth.

Geologists have learned that Earth is made up of three main layers: the crust, the mantle, and the core. Earth's outermost layer is the **crust.** The crust covers Earth's entire surface and varies in thickness from 6 kilometers (about 4 miles) to 90 kilometers (about 56 miles). The crust is thinnest under the oceans and thickest under the **continents,** or large land masses. The crust is composed of rock with a thin layer of soil over it. Crust on the ocean floor is made mostly of the rock basalt. Continental crust is mostly granite.

2

SCIENCE

Background The deepest hole ever drilled is located on Russia's Kola Peninsula, in the Arctic near Norway. The borehole to study Earth's crust was begun in 1970, and drilling at the site still continues. Even this deep well barely scratches Earth's surface, so geologists use clues from other sources to study Earth's makeup: **(1) Lava** comes from magma that originates in the mantle. By studying lava chemistry, geologists learn about processes going on deep inside Earth. **(2) Rocks on Earth's surface** contain clues about the makeup of Earth's interior because many kinds of rock are formed deep inside Earth by intense heat and pressure. **(3)** Physical properties of Earth's interior layers can be studied by measuring **earthquake waves** that travel through the planet (covered on reader p. 9). The outer core was determined to be liquid when scientists observed a "shadow" where certain earthquake waves, which cannot travel through liquids, were not transmitted.

Under Earth's crust is the **mantle,** which is made of rock that contains iron and magnesium. The mantle is Earth's thickest layer and it makes up most of Earth's mass. The upper part of the mantle is rigid. The lower part of the mantle flows very slowly.

Earth's center, called the **core,** is made mostly of the metals iron and nickel. The **outer core** is liquid and flows slowly. The **inner core** is solid.

The density of the materials inside Earth increases with depth. The core and the lower mantle are made of heavier materials than the layers above them. They are also under great pressure from the weight of the rock above. So the core and the lower mantle have a greater density than the upper mantle and crust.

The temperature of the materials inside Earth also increases with depth. The inner core is the hottest layer of Earth. Scientists think the inner core may be as hot as the surface of the Sun! Heat energy moves from warmer to cooler areas, so heat moves outward from the core. The movement of heat energy from one place to another is called heat transfer. Heat from deep inside Earth reaches the surface mainly through two processes: conduction and convection.

Conduction is the transfer of heat energy through solid matter as one particle strikes another. Heat moves through Earth's core and crust by conduction. The same process is at work when heat from a stove burner is transferred to a pot on the stove.

Convection is the transfer of heat energy by flowing material such as a liquid or gas. Heat moves through Earth's mantle by convection. As matter in the lower mantle is heated, it expands, becomes less dense, and is pushed upward by the cooler, denser material around it. As the matter rises, it cools and becomes more dense. As its density increases, the matter sinks back down. Then it is heated again and the cycle repeats. This cycling of heated matter due to density differences is called a **convection current.** Some scientists say that convection occurs throughout the mantle. Others suggest that this important process takes place only in the upper mantle. Convection currents cause dramatic changes on Earth's surface.

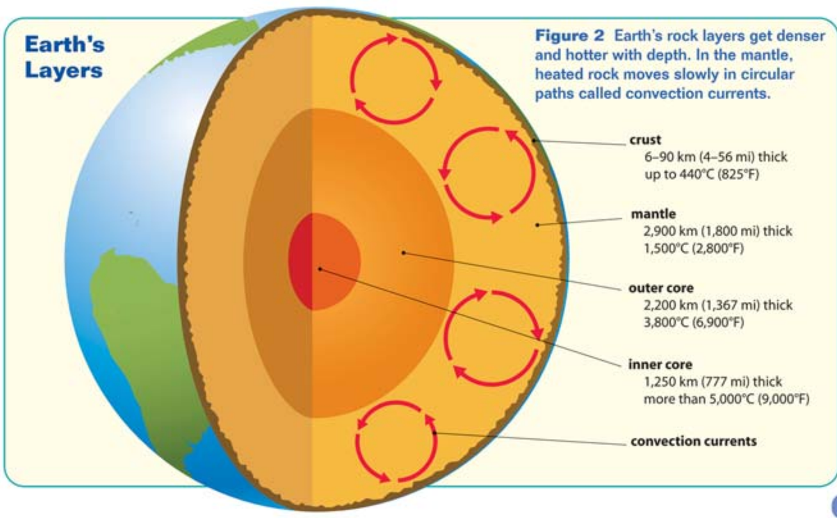


Figure 2 Earth's rock layers get denser and hotter with depth. In the mantle, heated rock moves slowly in circular paths called convection currents.

MEETING INDIVIDUAL NEEDS

English Language Learners Help ELL students acquire science vocabulary by pointing out terms from this section that have different meanings in everyday use: *crust, mantle, core,* and *current*. Have students work in groups to create a chart with the column heads Term, Everyday Meaning, and Scientific Meaning. They can use the Glossary and a dictionary to fill in the columns for each term and then work together to make up and write sentences for each definition. More terms can be added to the chart throughout the unit.

Learners with Special Needs Use a demonstration to show convection currents. Heat a clear beaker of water on a hot plate, add 2–3 drops of food coloring, and watch the color flow naturally with the convection current.

Advanced Learners Have students create a model of Earth, which can be used in the Alternative Assessment, with advanced learners leading this assessment effort.

Explain Review the concept of density. Density is a property of matter, from which everything is made, including layers of Earth. Density is the amount of mass in a given volume of matter. If the pressure on a given mass is increased, its density increases.

Ask, *Why does the density of materials increase with depth inside Earth?* (The pressure from the weight of rock increases with depth. This pressure causes more mass to be squeezed into a smaller area.)

Critical Thinking

Analyze *Why does heat move through the inner core and the crust by conduction, rather than by convection?* (Convection requires flowing material in order to transfer heat. The solid inner core and the solid crust do not flow. Therefore, heat must be transferred through these layers by conduction.)

3 Assess

Read to Understand Answers

How do Earth's three main layers differ from one another? Earth's three main layers—crust, mantle, and core—differ in composition, thickness, temperature, and density.

How does heat move through Earth's interior? Heat moves through the core and crust by conduction and through the mantle by convection.

Alternative Assessment

Have students create and/or analyze a physical model of Earth's layers using modeling clay or other everyday materials. Ask students to label or discuss temperature, density, and heat flow in each layer.