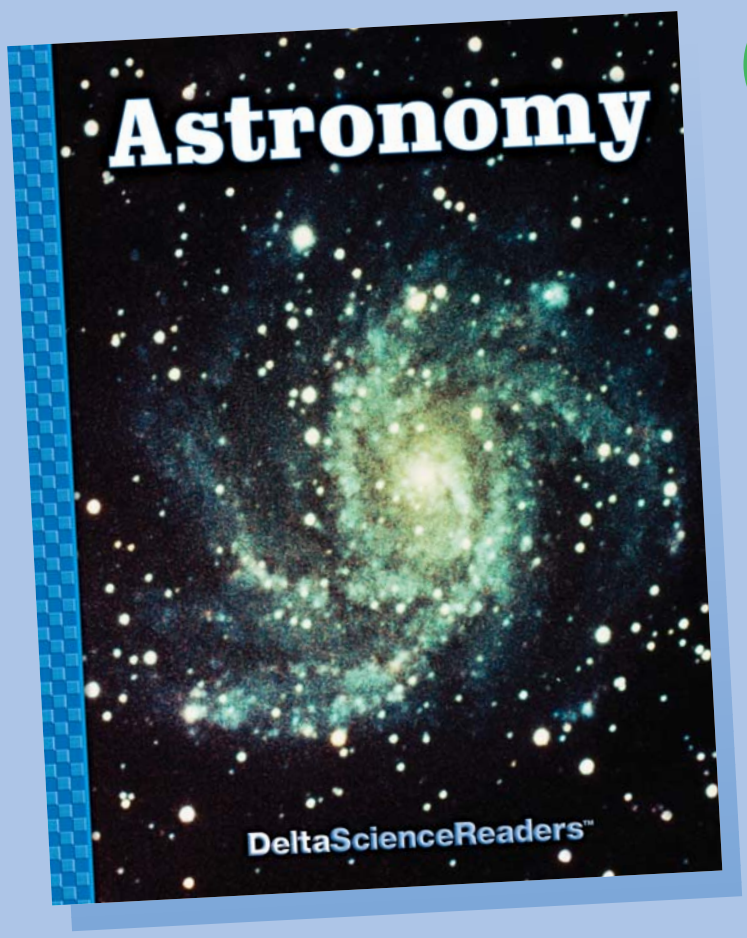
Delta Science Reader *Astronomy*
Teacher's Guide



In the Delta Science Reader ***Astronomy,*** students read about the characteristics and movement patterns of objects in our solar system and beyond, such as planets, moons, asteroids, meteoroids, and comets. They learn about our Sun and other stars—magnitudes, distances, temperatures, and composition—and the main sequence. They find out how stars produce and release energy and are introduced to the ongoing process of star formation and destruction. They also read about star systems, constellations, and the shapes and compositions of different types of galaxies. Finally, students learn how astronomers use tools and technologies such as telescopes, artificial satellites, and space probes to study space, and they trace the history of space exploration.

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 that have 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** page, 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 that show 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, English Language Learners (ELLs) 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 the main idea and supporting details
- trace a 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.

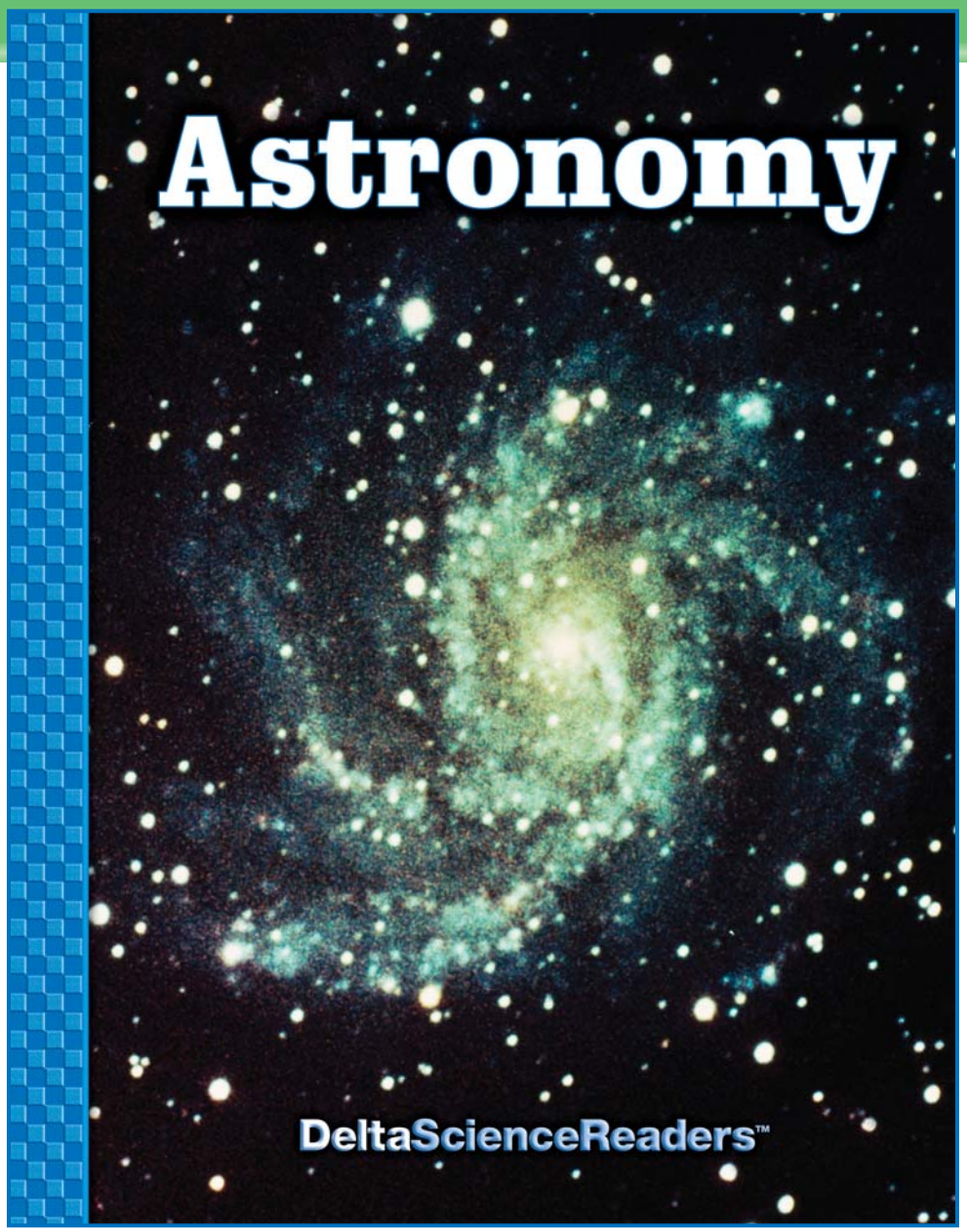
Science. Additional science background information, historical perspectives, and facts and figures of interest that support science instruction and can be shared with students as appropriate.

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 page provides many helpful vocabulary-building strategies.*

TEACHING *Astronomy*



The Delta Science Reader ***Astronomy*** presents the key science concepts related to the objects in space; the life stages of stars and the grouping of stars into galaxies; the formation of the universe; and tools and technologies scientists use to study space. 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 astronomy by displaying the front cover and discussing the title. *What do you see in this photograph?* (Possible answers: stars; a galaxy; clouds; gases; black space) *How do you think this photograph was taken?* (using a telescope) *Where is this galaxy located?* (a great distance from Earth; beyond our solar system and beyond our own galaxy) *What is the name of our galaxy?* (the Milky Way) *How would you define the word* astronomy? (Accept all reasonable ideas.)

Encourage students to share what they know about astronomy from their personal experiences and from previous explorations in science. Stimulate discussion with questions such as *When have you heard about astronomy in the news?* (Students may think of reports on recent space missions, such as space shuttle flights or the Mars rover landing, space probes, and the Hubble Space Telescope.) *What do you know about the objects in our solar system?* (Accept all reasonable descriptions.) Encourage students to share their observations of the night sky—the Moon, stars and constellations, planets, and perhaps meteors or artificial satellites.

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 *Astronomy* 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.

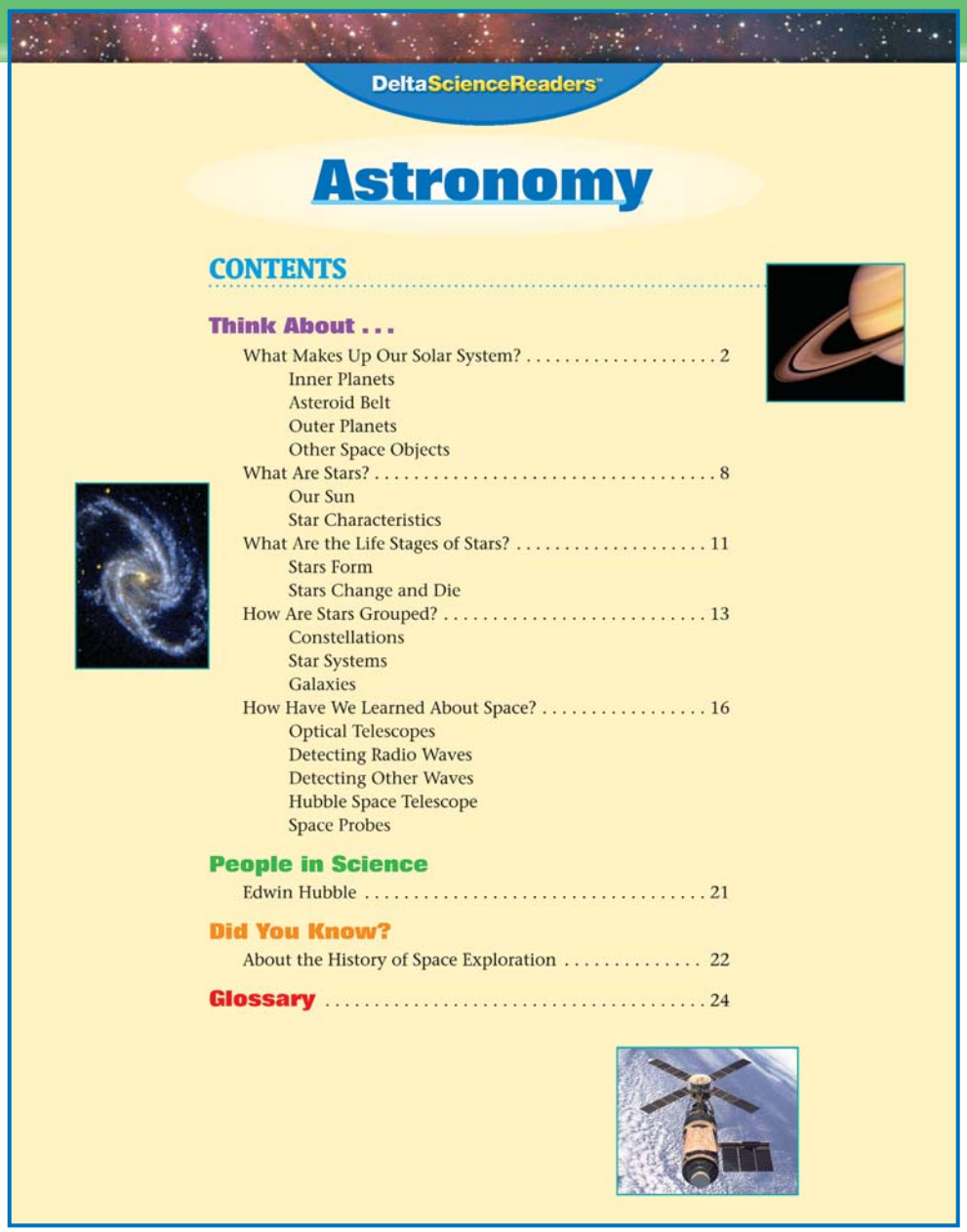


Table of Contents. Begin the preview with the table of contents. Think of the table of contents as an outline of the book. It lists the different parts of the book and the topics covered in each part. Page numbers are given for the main section headings. After students have skimmed the table of contents, 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, boldfaced words, and Glossary.

For each new text feature students identify, have them ask questions: Why are these [*boxes*] here? What is the purpose of [*captions*]? How do these [*boldfaced words*] help us understand the topic? What if the book did not have [*labels*]?

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.

Conceptual Framework

Help students make meaning of the content covered in *Astronomy* by building a conceptual framework—a theme around which they can organize ideas and information. For this topic, such a framework might be **Matter in the universe is grouped into different levels of organization.** Earth is part of a solar system, which is part of the Milky Way galaxy, which is part of a cluster of galaxies, each of which contains hundreds of billions of stars. At each level, objects are separated by great distances, yet held together by gravity. As students read, they can relate their learning about the universe to the framework.

Internet Resources

New discoveries are constantly being made in the field of astronomy. To help you stay up-to-date, a list of Internet resources is provided on p. T23. These websites can serve as a source for student research, as well as for the spectacular imagery captured by current space missions. Use the Astronomy Picture of the Day website as the homepage on your classroom computers during the unit to spark students' interest: http://antwrp.gsfc.nasa.gov/apod.

OBJECTIVES
(pages 2–7)

- Summarize the characteristics and movement patterns of objects in our solar system.
- Compare and contrast features of the inner and outer planets.
- Explain the relationship between gravity and planetary orbits.
- 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 the universe. *What do you think of when you hear the words* outer space? *What are some of the objects you have observed in space? What makes up the universe?* Write students' ideas on the board and discuss their observations. After the discussion, allow students time to fill in additional questions in the second column of the KWL charts they began on p. T1.

Preview the Section

Use the Read to Understand questions to set a purpose for reading (answers on p. T7). Preview the Vocabulary words using one of the methods described on p. Tiii. Remind students that these important words appear in boldfaced type in the text and are defined in the Glossary. (See p. T24 for vocabulary-building ideas.)

ADDRESSING MISCONCEPTIONS

Students may believe that the Earth is at the center of the solar system, or that it is the largest body in the solar system. Point out the relative size and location of Earth in Fig. 1.

Think About . . .

What Makes Up Our Solar System?

READ TO UNDERSTAND

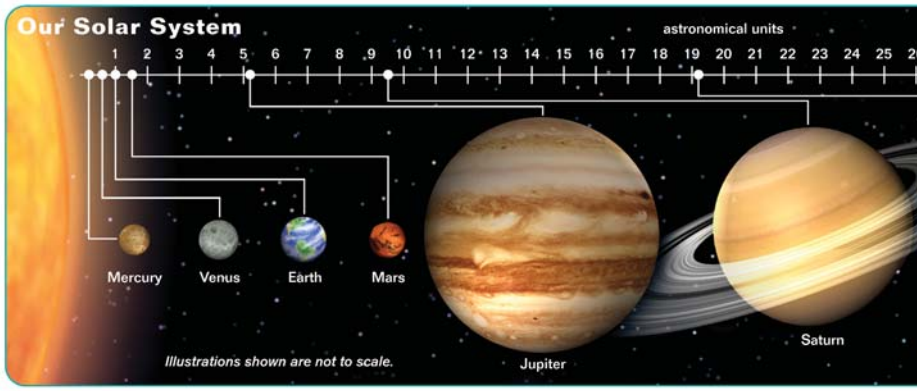
- What force holds a moon in orbit around a planet?
- What unit is used to measure distances in the solar system?

VOCABULARY

astronomy, universe, planet, revolve, orbit, elliptical, solar system, moon, rotate, axis, gravity, astronomical unit (AU), nebula, inner planets, crater, asteroid, outer planets, comet, meteoroid

Astronomy, the scientific study of objects in space, is an ancient science. People have observed the daily, monthly, and yearly cycles of change among the Sun, Moon, and stars for thousands of years. Early stargazers were limited to the study of space objects and events they could view with their eyes alone. The invention of the telescope around 1608 allowed astronomers to see farther than ever before. Newer technologies allow us to explore space directly by launching spacecraft carrying scientific instruments and even people. All of space, including all the matter and energy contained within it, is called the **universe.** Our understanding of Earth's place in the universe grows as we make new discoveries each year.

Earth is one of nine **planets** that, together with a variety of smaller objects, **revolve,** or travel in a path, around the Sun. This path is called an **orbit.** Orbits are **elliptical,** which means they are more oval in shape than perfectly circular. Any space object that orbits a larger space object is called a satellite. The Sun and all of its satellites make up the **solar system** (Figure 1). Many of the planets have smaller satellites called **moons** orbiting them. In addition to revolving, planets and moons also **rotate,** or spin, on an axis. An **axis** is an imaginary line that runs through the middle of an object.



2

LITERACY

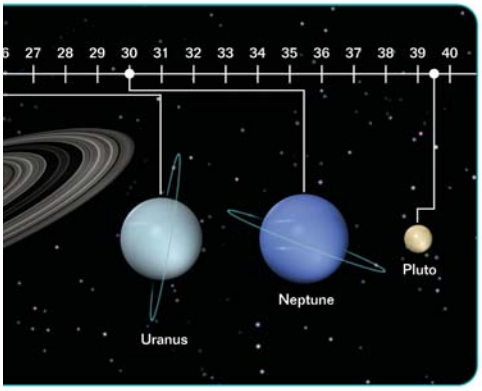
Vocabulary: Word Parts Word parts are the building blocks of language. A root gives a word its core meaning. A prefix is added to the beginning of a root or a word, and a suffix is added to the end. Prefixes and suffixes change the meaning of the root word. Help students figure out the meanings of scientific terms such as *astronomy, universe, revolve,* and *nebula* (introduced on pp. 2–3) by breaking them down into word parts. Ask students to use a dictionary to find the meanings of *astro-* (star) *-nomy* (knowledge of), *uni-* (one), *vers* (turning), *re-* (again, back), *volv* (to roll), and *nebul* (mist, cloud, fog) and to construct definitions based on the word parts. Have students write each word part on an index card, along with its definition, and file the cards in a divided box that they can add to while reading this book. (See p. T24 for more word parts used in *Astronomy* vocabulary.)

The force that keeps satellites in orbit is called **gravity.** Every object exerts gravitational force on every other object. This force pulls objects toward each other. Suppose you drop an apple. It will fall to the ground because gravity exists between the apple and Earth. The strength of the force of gravity between any two objects depends on how much mass the objects have. It also depends on the distance between the objects. The force of gravity is stronger when objects have more mass or are closer together.

A kilometer is a unit we use to measure distances on Earth. But the distances between objects in our solar system are much larger than the distances between places on Earth. That is why scientists use astronomical units to measure distances in our solar system. An **astronomical unit (AU)** is the average distance between Earth and the Sun. One AU equals 150 million kilometers (about 93 million miles).

Evidence collected by astronomers suggests that our solar system began as a rotating cloud of dust and gas called a **nebula.** As the nebula spun, it contracted and formed the Sun and the planets (Figure 2).

▼ **Figure 1** Nine planets revolve around the Sun in our solar system. However, the discovery in 2003 of a large space object located beyond Pluto might change that number to ten.



Solar System Formation

▲ **Figure 2** The planets in our solar system likely formed about 4.6 billion years ago.

SCIENCE

Facts and Figures In the 1990s, advances in science and technology allowed scientists to begin discovering planets orbiting other stars besides our Sun—**extrasolar planets.** Distant solar systems are all unique. In some, huge planets made of gases orbit very close to their suns. Some solar systems even have two or three suns. Despite these differences, scientists still believe that most solar systems form in the same general way that ours did—from a rotating cloud of gas and dust. So far, about 200 extrasolar planets have been found. Keep up with current discoveries at http://planetquest.jpl.nasa.gov.

The California and Carnegie Planet Search (http://exoplanets.org) is building an automated planet finder that will search for rocky, Earth-like planets. If any are identified on which water might exist as a liquid, scientists will use radio telescopes to search the planets for radio transmissions from intelligent life.

ADDRESSING MISCONCEPTIONS

Students may be confused about the difference between astronomy and astrology. The term *astronomy* applies to the use of the scientific method to study objects in the universe. The term *astrology* refers to the incorrect and misleading idea that the movements of planets influence human behavior and events. Emphasize that astrology is not a science and that it cannot predict the future. However, the movement of objects in space is based on scientific laws and *can* be predicted.

2 Guide the Learning

Discuss and Explore

Interpret Graphics: Figure 1 Call on students to name the distance from the Sun to each planet using the distance scale at the top of Fig. 1. Point out the sentence stating that illustrations are not to scale. Ask why. (The huge sizes and vast distances of planets and satellites in our solar system make them difficult to represent proportionally in models and diagrams.) For example, drawn to scale, the diameter of Jupiter should be more than 10 times larger than Earth's. Have groups of students create a way to represent planet diameters or their distances from the Sun in a model that *is* to scale. See http://www.lpi.usra.edu/education/K12/planetsize/planetsize.html for helpful ideas.

Calculate To demonstrate distances in the solar system, present this math problem: *How long would it take to travel by car from Earth to the Sun driving nonstop at 100 km/h (about 62 mph)?* (about 170 years!) Have students make up math problems about the solar system.

Critical Thinking

Model Play a game of charades in which students act out the meanings of *revolve, orbit, elliptical, rotate, axis,* and *gravity.*