

What's in the *Planets and Moons* Unit?

Planets and Moons is 40 sessions in length. The unit immerses students in learning about the Solar System with a focus on how technology is used to explore the Solar System. The unit has four investigations—each with 10 sessions. Nine student books engage students in doing, talking, reading, and writing about the science of planets and moons. About half of the sessions in the unit have a literacy focus. As students read the books, they work to master the reading comprehension skills of setting goals, visualizing, and synthesizing; they write scientific explanations; and they learn to use nonfiction text features, such as photographs and data tables.

Investigation 1—Earth's Shape and Motion. Students pose questions about space and then read *Exploring Planets and Moons*, about ways that scientists and engineers explore space. They discuss their ideas about Earth's shape and gravity, then gather evidence to write explanations about why you cannot launch a spaceship by dropping it off the edge of Earth. They use two different models to investigate Earth's rotation, then read about rotation and orbit in *Spinning Through Space*. They write a scientific explanation about why the lengths of a day on Jupiter and on Earth are different.

Investigation 2—The Moon and Beyond. Students get evidence about the Moon's changing appearance from reading *Observing the Moon*. They use this evidence to construct two different models. They revisit lunar phases using a computer simulation and discuss questions about the Moon in a Roundtable Discussion. They analyze Galileo's observations of Jupiter's moons, and they write a scientific explanation about whether Jupiter's moons would have phases. They observe the planets using Solar System Objects cards, construct a scale model of the Solar System, then read about size and scale in *How Big Is Big? How Far Is Far?* They use a reference book, *Handbook of Planets and Moons*, to make comparisons between different planets and moons.

Investigation 3—Solar System Objects. Students expand their understanding of what is in the Solar System using the Solar System Objects cards to observe, compare, and classify the Sun, planets, moons, asteroids, comets, and Kuiper Belt objects. They read about why Pluto is no longer classified as a planet in *What About Pluto?* and write an explanation about the classification of a recently discovered space object. They investigate conditions and surface features on different Solar System objects. They read about how a scientist uses models to study surface features in *Planetary Scientist*, and then they choose a planet or moon to research and write about.

Investigation 4—Designing for Exploration. In the final investigation, students focus on how engineers design technology to explore space. Students design landers that would work on the fictional planet Oobleck and write about how their landers meet mission goals. They read about the design process in *Tomato Landers* and about different technologies designed to achieve particular goals in *Technology for Exploration*. They focus on the planet or moon they researched and work in teams to design a lander to explore that planet or moon. They write explanations about their landers and share their designs in presentations to the class.

UNIT OVERVIEW

Planets and Moons Overview Chart

Investigation 1: Earth's Shape and Motion

SESSION 1.1	SESSION 1.2	SESSION 1.3	SESSION 1.4	SESSION 1.5
Exploring Planets and Moons	Questions About Earth	Investigating Earth	Making Sense of Earth's Shape and Gravity	Writing About Earth's Shape and Gravity
READING	SCIENCE INQUIRY	SCIENCE INQUIRY	SCIENCE/LITERACY	LITERACY DEVELOPMENT
SESSION 1.6	SESSION 1.7	SESSION 1.8	SESSION 1.9	SESSION 1.10
Modeling the Spinning Earth	Investigating Day and Night	Spinning Through Space	Writing About Rotation	Making Sense of Orbiting and Rotating
SCIENCE INQUIRY	SCIENCE INQUIRY	READING	LITERACY DEVELOPMENT	SCIENCE/LITERACY

Investigation 2: The Moon and Beyond

SESSION 2.1	SESSION 2.2	SESSION 2.3	SESSION 2.4	SESSION 2.5
Observing the Moon	Modeling Lunar Phases	Making Sense of Lunar Phases	Observing Jupiter's Moons	Writing About Lunar Phases
READING	SCIENCE INQUIRY	SCIENCE/LITERACY	SCIENCE INQUIRY	LITERACY DEVELOPMENT
SESSION 2.6	SESSION 2.7	SESSION 2.8	SESSION 2.9	SESSION 2.10
Introducing the Planets	Scale Model of the Solar System	How Big Is Big? How Far Is Far?	Handbook of Planets and Moons	Making Sense of the Planets
SCIENCE INQUIRY	SCIENCE INQUIRY	READING	READING	SCIENCE/LITERACY

Investigation 3: Solar System Objects

SESSION 3.1	SESSION 3.2	SESSION 3.3	SESSION 3.4	SESSION 3.5
Classifying Solar System Objects	What About Pluto?	Comparing Solar System Objects	Writing About Classification	Investigating Air Resistance
SCIENCE INQUIRY	READING	SCIENCE/LITERACY	LITERACY DEVELOPMENT	SCIENCE INQUIRY
SESSION 3.6	SESSION 3.7	SESSION 3.8	SESSION 3.9	SESSION 3.10
Conditions on Other Planets and Moons	Observing and Discussing Surface Features	Planetary Scientist	Researching Planets and Moons	Making Sense of Other Planets and Moons
SCIENCE INQUIRY	SCIENCE/LITERACY	READING	SCIENCE/LITERACY	SCIENCE/LITERACY

Investigation 4: Designing for Exploration

SESSION 4.1	SESSION 4.2	SESSION 4.3	SESSION 4.4	SESSION 4.5
Investigating Oobleck	Designing Oobleck Landers	Writing About Oobleck Missions	Tomato Landers	Making Sense of the Design Process
SCIENCE INQUIRY	SCIENCE INQUIRY	LITERACY DEVELOPMENT	READING	SCIENCE/LITERACY
SESSION 4.6	SESSION 4.7	SESSION 4.8	SESSION 4.9	SESSION 4.10
Technology for Exploration	Planning Lander Designs	Designing Planet and Moon Landers	Writing About Planet and Moon Missions	Sharing Lander Designs
READING	SCIENCE INQUIRY	SCIENCE INQUIRY	LITERACY DEVELOPMENT	SCIENCE/LITERACY

Planets and Moons: Knowledge, Strategies, and Abilities

Science Targets	Literacy Targets
SCIENCE KNOWLEDGE <ul style="list-style-type: none"> • Movement of Planets and Moons • Solar System • Science and Technology SCIENCE INQUIRY <ul style="list-style-type: none"> • Visualizing • Making Explanations from Evidence • Using and Evaluating Models • Comparing and Contrasting NATURE AND PRACTICES OF SCIENCE <ul style="list-style-type: none"> • Understanding That Science Knowledge Is Based on Evidence • Understanding the Role of Creative Thinking in All Aspects of Science • Understanding How Scientists Engage in the Practices of Science • Recognizing That the Scientific Community Seeks to Improve Explanations 	READING <ul style="list-style-type: none"> • Setting Goals • Synthesizing • Visualizing • Using Nonfiction Text Features WRITING <ul style="list-style-type: none"> • Writing Scientific Explanations • Using Scientific Language and Vocabulary LISTENING/SPEAKING <ul style="list-style-type: none"> • Participating in Scientific Discourse • Making Explanations from Evidence • Using Scientific Language and Vocabulary

Assessment Features	
FORMATIVE ASSESSMENT <ul style="list-style-type: none"> • Quick Checks for Understanding • Critical Junctures • Embedded Assessments • Daily Written Reflections 	SUMMATIVE ASSESSMENT <ul style="list-style-type: none"> • Science Concepts • Science Vocabulary • Reading Comprehension • Science Inquiry • Science Writing • Nature and Practices of Science • Attitudes About Science

Exploring Planets and Moons

READING

INVESTIGATION 1 Earth's Shape and Motion

UNIT GOALS

Science Knowledge/ Conceptual Vocabulary

- movement of planets and moons
- solar system
- science and technology

Science Inquiry/ Reading Comprehension Inquiry

- observing and questioning
- investigating and modeling
- analyzing data and drawing conclusions

Comprehension

- reading science texts
- using comprehension strategies
- using nonfiction text features

Nature and Practices of Science/Oral and Written Discourse

Nature and Practices of Science

- understanding that science knowledge is based on evidence
- understanding the role of creative thinking in all aspects of science
- understanding how scientists engage in the practices of science
- recognizing that the scientific community seeks to improve explanations

Discourse

- acquiring scientific language
- writing informational text for various purposes
- participating in scientific discourse

Summary

Students begin the *Planets and Moons* unit by sharing and recording questions they have about space, planets, and moons. Next, they read *Exploring Planets and Moons*, a book about three people who investigate planets and moons in different ways. The teacher introduces setting reading goals as a comprehension strategy, then models setting a reading goal—to learn about how different people explore planets and moons. As students read the book in pairs, they record new ideas from the text that relate to the reading goal. After reading, students share these new ideas and connect them to their prior knowledge.

Students learn:

- Scientists and engineers explore space in a variety of ways.
- Setting goals is a useful strategy for reading nonfiction text.
- Setting goals helps readers focus as they read.
- Photographs are a useful feature of nonfiction text.

What You Need and Getting Ready

Information on preparing for this session can be found on page 5.

Time Frame

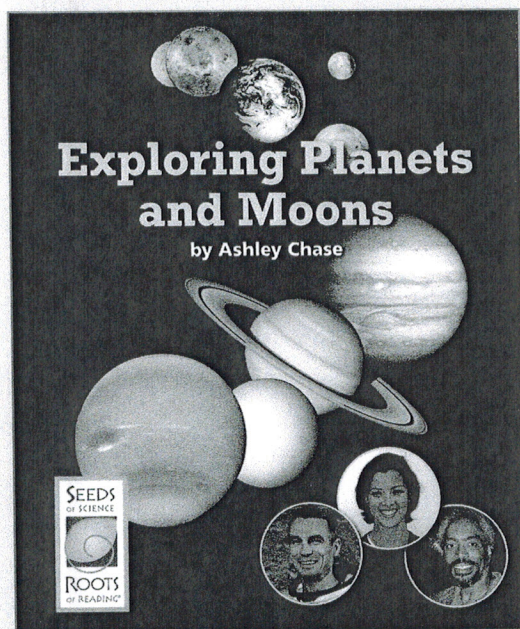
	Estimated Time
Introducing the Unit	15 minutes
Before Reading	10 minutes
During Reading	25 minutes
After Reading	10 minutes
TOTAL	60 minutes

Introducing the Unit

1. Introduce topic. Explain to the class that they will be studying about space science in a unit called *Planets and Moons*. They will learn in the same ways that scientists do—by investigating, reading, discussing ideas, and writing. They will learn a lot about planets and moons and later use what they learn to plan missions and design spacecraft to land on other planets and moons.

Teaching Support and Considerations

About the Book



Exploring Planets and Moons sets the context for the unit and helps students see that there are a variety of ways to explore the Solar System and beyond.

Literacy Notes

About Text Features. Students will read nine science books over the course of this unit, all of which have a variety of text features common to science texts such as indexes, tables of contents, diagrams, photographs, and tables. Students learn about the purpose of these features and will learn to use them to locate information and determine important ideas. If your students are not familiar with specific text features, you may want to spend some additional time discussing each as they are addressed in the unit. As you teach about text features, be sure to emphasize that they are present in most nonfiction texts. Encourage students to look for and use them when reading other texts across the curriculum.

Overview. *Exploring Planets and Moons* introduces three people and the various ways they study planets and moons. Students read about astronaut Eugene Cernan and how the work of the *Apollo 17* mission added to our understanding of the surface of the Moon. They are introduced to engineer Jessica Collisson Samuels, learning about her work on the Mars rovers *Spirit* and *Opportunity*, which have added greatly to our understanding of conditions on the planet Mars. Students then read about space scientist Gibor Basri, who uses powerful telescopes to gather information about distant planets orbiting other stars.

LANGUAGE OF SCIENCE

Science Content Vocabulary

atmosphere
composition
conditions
design
engineer
exploration
gravity
lunar phase
mission
moon
orbit
planet
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Solar System
Solar System object
sphere
surface feature
technology

Science Inquiry Vocabulary

claim
classify
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evaluate
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Language of Argumentation

What do you think?

What is your claim?

Why do you think that?

What is your evidence?

Do you agree? Why?

Do you disagree? Why?

How sure are we?

How could we be more sure?

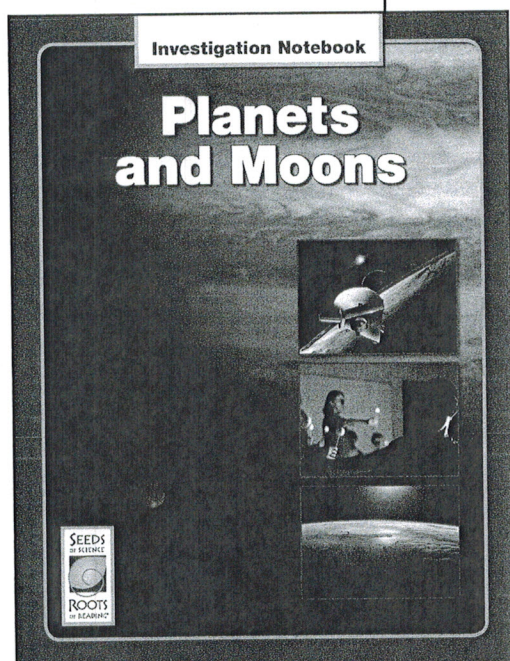
INVESTIGATION 1
Earth's Shape and Motion

Figure 1–1. Students use the Investigation Notebook to guide and support their learning throughout the unit.

Investigation Notebook, p. 2
with sample response

Question Log

1. How big is the Universe?

2. Is there life on other planets?

3. _____
4. _____
5. _____
6. _____
7. _____

2. Invite questions. Ask, “What questions do you have about space, planets, and moons?” Lead a brief class discussion in which students share their ideas and questions. Acknowledge that this is a very exciting topic and that this same kind of curiosity is what has led space scientists to explore and study the Solar System and beyond.

3. Introduce Investigation Notebooks. Say, “Just like scientists, you’ll write down your ideas, questions, and discoveries as you learn about this topic.” Distribute the Investigation Notebooks, and give students a moment to flip through them.

4. Students record questions. Have students turn to page 2, Question Log. Give them about five minutes to record a few questions they have about space, planets, and moons. Let them know they’ll have many chances to return to this log and add new questions.

5. Introduce guiding questions. Say, “Scientists ask questions all the time. One important way of learning is by asking questions and then investigating, or trying to find out more about something.” Tell students you have a question of your own that will help guide their investigations throughout the unit. Post the guiding question you prepared before class and read it aloud.

How do scientists investigate planets and moons?

Explain that over the next few weeks, students will investigate—or find out more about—this question.

Before Reading

1. Introduce book. Hold up a copy of *Exploring Planets and Moons*. Say, “This book is about three people who explore planets and moons in different ways. In the book, you’ll read about some of the things they’ve learned from studying and exploring other planets and moons, including planet Earth and Earth’s Moon.”

Teaching Support and Considerations

Instructional Rationale

Value of Investigation Notebooks. Teachers who used an Investigation Notebook rather than distributing individual student sheets report that their students were more motivated to do careful work, referred back to their work more often, teacher preparation time was significantly reduced, paper management in the classroom was simplified, and student work was simpler to monitor and assess. Although purchasing notebooks for individuals or using the master notebook supplied in the kit to duplicate additional notebooks can be expensive, we strongly recommend that you find a way to provide your students with notebooks.

About Question Logs. Most teachers find that the subject of space science generates enthusiastic questions and rich discussions. Many students are filled with wonder and excitement about space, and their curiosity will quickly infect the whole class. That is why a discussion like this is a good way to launch the *Planets and Moons* unit. However, in this session, it's important to keep the discussion brief in order to leave time for reading the book. The Question Log (which students use throughout the unit) is a tool for capturing student questions without spending a great deal of time on this discussion. Let students know there will be time later in the unit to talk and write about their questions.

The Role of Guiding Questions. Posting guiding questions on the wall throughout the unit is a valuable way to focus students' attention on the most important content of the sessions. Guiding questions act as reminders to students of their goals for learning and help them relate specific experiences to broader concepts. It can be very rewarding for students to see progress in their ability to answer guiding questions more and more completely as they progress through the unit. Incorporating the guiding questions into the concept wall will help students relate ideas in the unit to the guiding questions.

Instructional Suggestions

What One Teacher Did. One teacher asked for a parent volunteer who was willing to make copies of the Investigation Notebook at his workplace. Many workplaces have sufficiently large copy volumes that they are happy to make such an in-kind contribution.

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What is your claim?

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What is your evidence?

Do you agree? Why?
Do you disagree? Why?

How sure are we?
How could we be more sure?

Exploring
Planets and Moons

READING

INVESTIGATION 1
Earth's Shape and MotionInvestigation Notebook, p. 4
(optional)**Getting Ready to Read****Exploring Planets and Moons**

Before reading *Exploring Planets and Moons*, read the sentences below. If you **Agree** with the sentence, write an "A" in front of it. If you **Disagree** with the sentence, write a "D" in front of it. Then read the book. After you read, come back to this page and see if your ideas have changed. Be ready to explain your thinking.

- ___ You have to be an astronaut to explore space.
- ___ Astronauts have found orange soil on the moon.
- ___ All spacecraft take people into space.
- ___ Engineers have found ways to repair spacecraft from millions of miles away.
- ___ There might be other planets far out in space that are the same size as Earth.

Investigation Notebook, p. 5
with sample response**Reading with a Goal****Exploring Planets and Moons**

Class reading goal:

learn how different people explore planets and moons

What did you learn about this reading goal?

Astronauts have traveled to the moon.
Engineers send rovers to other planets.
You can explore space with a telescope.

2. **Connect reading and science investigations.** Explain that scientists often read to find out more about a topic they're investigating. In order to know as much as they can about a topic, scientists read about the work of other scientists.
3. **Introduce setting goals as a comprehension strategy.** Say, "Readers often set goals for their reading. When you decide what you're going to pay attention to before you start reading, you are setting a goal." Explain that having a goal in mind is useful because it helps you focus your attention as you read.
4. **Set a goal for today's reading.** Tell students to raise their hands in response, then ask, "Have you ever wondered about how people explore space?" Explain that because this is something many students wonder about, this will be the goal for today's reading—to learn about different ways that people explore planets and moons.
5. **Post and begin chart.** Post the Reading Goals chart you prepared before class and say that this chart will be used to keep a list of reading goals that the class will set together. Write today's reading goal on the chart under the book's title (Figure 1–2).

Reading Goals

Exploring Planets and Moons

learn how different people explore planets and moons

Figure 1–2. Students will see a growing list of reading goals over the course of the unit.

6. **Students record reading goal.** Have students turn to page 5, Reading with a Goal: *Exploring Planets and Moons*, in their Investigation Notebooks. Have them record the goal on this page, and ask them to keep this goal in mind as they read today.
7. **Explain reading task.** Indicate the space at the bottom of the student sheet where students can record notes as they read. They should record at least one new idea they learned from the book about how people explore planets and moons.

Teaching Support and Considerations



English Language Learners

Reading Scaffold. It's very important for ELLs (and all readers) to learn strategies they can use to monitor and improve comprehension as they read. Before students read in this session, meet with a small group and discuss what students can do if they don't understand a part of the book as they read. Encourage them to notice when a part of the book is confusing or unclear, and to reread that section a little more slowly. Choose a page of *Exploring Planets and Moons* to read with the students, and pretend that you don't understand part of the page. "Think aloud" as you model noticing a break in your comprehension and then rereading slowly. Add that partner discussion can also be helpful and have them discuss with a partner what the passage means. Encourage students to use these strategies as they read. After reading, meet with these students again and discuss parts of the book they found confusing. As a group, reread and discuss to clarify the meaning of some of these passages.

Providing More Experience

Prepare: Getting Ready to Read. For each book in the unit, we provide an optional anticipation guide in the Investigation Notebook called Getting Ready to Read. Anticipation guides encourage students to activate their prior knowledge before reading, promote active reading, and encourage students to monitor their comprehension. Anticipation guides are helpful for all students, and are especially recommended for English Language Learners. To use this activity, have students turn to page 4 in their Investigation Notebooks. Explain that students should work with a partner to decide if they agree or disagree with each statement. Have them write, in front of each statement, an "A" if they agree, or a "D" if they disagree. After reading, ask partners to revisit the statements and discuss whether they want to change any responses based on what they read.

Literacy Notes

About Setting Goals for Reading. The *Seeds of Science/Roots of Reading*® program emphasizes teaching students comprehension strategies that are especially useful in the context of doing inquiry science and reading about science content. One focus of the *Planets and Moons* unit is teaching students to set a goal for reading, or to read with a purpose. This strategy helps students make connections and encourages them to think about connections between what they've already learned and what they read. This strategy also helps students be more active readers as they keep a particular question or focus in mind and monitor their reading to see if what they have read relates to the goal. Though you supply the reading goal in this first session, over time, students will learn how to set their own goals.

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Language of Argumentation

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Do you agree? Why?
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How sure are we?
How could we be more sure?

Exploring Planets and Moons

READING

INVESTIGATION 1 Earth's Shape and Motion

Investigation Notebook, p. 6
(optional) with sample response

Reading Reflections

Exploring Planets and Moons

Choose a photograph from the book that was interesting and made you think.

Write the page number here: 16-17

Describe the photograph.

It shows the Mars rover on the planet Mars. You can see rocks and hills, and the red ground on Mars. You can also see what the rover looks like.

What did this photograph make you think about?

It made me think about what it would be like to go to Mars. I also thought about how the rovers drove around Mars and wondered if this was one of the pictures they took.

What did you learn from looking carefully at this photograph?

I learned what it looks like on Mars. The soil is red and there are a lot of rocks.

8. Prepare to read. Distribute one copy of *Exploring Planets and Moons* to each pair of students and explain that they will read with a partner. As needed, set expectations for how students should work together and read with their partners.

During Reading

- 1. Students read.** Have students begin reading with their partners. Circulate to listen as they read, and remind them to record at least one new thing they learn while reading. Check in with students and ask them to tell you what they have learned about how people explore planets and moons.
- 2. Early finishers.** If students finish early during partner reading, have them return to the anticipation guide (Getting Ready to Read) on page 4 of their Investigation Notebooks (if you had them use this optional activity before reading) or have them turn to page 6 and complete the optional Reading Reflections.

After Reading

- 1. Share new ideas.** Ask a few student volunteers to state the reading goal and share what they learned. You may want to take notes on the board as students share. Help students see how the reading goal and the ideas they read about are related.
- 2. Discuss role of illustrations as nonfiction text feature.** Say, "Illustrations are an important part of nonfiction text, especially in science. Illustrations give readers more information and help us visualize what is written about with words on the page." Explain that photographs in books about space are particularly important because they allow us to learn about objects in space that are very far away.
- 3. Focus on images of Earth from space.** Have students turn to page 7 in the book. Ask them to describe the view of Earth they see. Emphasize that this photograph helps us visualize something that most people have not seen firsthand—what Earth looks like from space. Let students know that they will learn more about the shape of Earth in future sessions.

Teaching Support and Considerations

Literacy Notes

Suggested Approach to Reading. Throughout this unit, we suggest that students read the books in pairs. This allows them time to apply and practice the reading strategies they're learning, keeps them focused on the task, and provides opportunities for them to assist each other with reading. Of course, you can use any effective reading procedures you've already established with your class. If there's extra time, it's valuable to have students read the book more than once. Repeated reading builds fluency and gives more practice with new vocabulary and concepts.

About Partner Reading. Be aware of the need to spend some time establishing procedures for partner reading. This will, of course, vary depending on the needs of your class. Before reading the first book in the unit, provide instruction on how to read with a partner. Set clear expectations for partner work, and consider posting a list of guidelines for expected behavior (such as sharing the reading equally, helping each other understand the text, and speaking in a quiet voice). Establishing procedures takes time at first but will pay off in terms of student learning and management of the sessions. Over time, students gain practice working together and will need fewer reminders about reading together effectively.

Instructional Suggestions

Additional Support: Reading. While the *Planets and Moons* books were designed to be accessible to fourth and fifth graders, you may find some students need additional support. Make sure you pair readers who need more support with a partner who is slightly more fluent. Some students may also need more time to read the text. We've found that many teachers are pleasantly surprised at the ways participation in the unit's science activities helps students build familiarity with the vocabulary and concepts, enabling many to read independently. If time permits, students may also benefit from repeated readings. Please note that we discourage teachers from reading the entire book aloud; it denies students the opportunity to engage in reading informational text and practice skills critical for school success.

Providing More Experience

Reinforce: Reading Reflections. Reading Reflections pages for each book are included in the Investigation Notebooks. These are optional, written activities designed to reinforce concepts in the books and encourage reflection on what was read. They are designed for early finishers to use during partner reading. They can also be used in a variety of other ways, such as with the whole class after an optional second reading. This Reading Reflections (on page 6 of the Investigation Notebook) offers a chance for students to describe and reflect on one of the photographs in the book.

LANGUAGE OF SCIENCE

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