Exploring Coral Reefs

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COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS
CC.4.RInfo.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
CC.4.RInfo.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
CC.4.RInfo.5 Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.
CC.4.RInfo.6 Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in focus and the information provided.
CC.4.RInfo.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
CC.4.RInfo.8 Explain how an author uses reasons and evidence to support particular points in a text.
CC.4.RInfo.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.

Writing Standards (page 17)

CONTENT GOAL
Students will read four selections in Exploring Coral Reefs. They will explore the biodiversity of coral reef ecosystems around the world and discover why saving coral reefs is so important.

COMPREHENSION GOAL
Remind students that as thinking-intensive readers they must listen to their inner voice to monitor and repair comprehension as they read. Find opportunities to model and teach active thinking strategies to help students access content. You may want to focus on the following strategies for Exploring Coral Reefs.

• Infer and Visualize: A writer doesn’t always tell everything. Readers have to use their background knowledge and pay attention to the text and picture clues to make inferences and visualize to construct meaning.

• Monitor and Repair Comprehension: Readers are aware of their thinking as they read, listen, and view. They notice when the text makes sense and use “fix up” strategies (e.g., re-reading) when it doesn’t.
Draw the graphic organizer shown above. Ask: If you were exploring a coral reef, what do you think you would find? Write students’ responses in the graphic organizer.

Model for students by thinking aloud. You might say something similar to the following: When I look at the cover of this book, the first thing I notice is how colorful it is. Different types and colors of fish are swimming around different shapes and colors of coral. The coral looks like plants, but I don’t think it is.

Explain that coral reefs are special underwater places in the ocean. You might say: Coral reefs don’t occur everywhere on the ocean bottom—only in certain places on Earth. A wide variety of animals live in and around a coral reef. I think these would be really fascinating places to explore close-up.

Ask students to Turn and Talk about what they think they would see and do when exploring a coral reef.

Students can then Share what they think they know about coral reefs.

You may want to return to the graphic organizer to add more information after students read each selection.

BUILD SCIENCE BACKGROUND

Pages 4–6 of this teacher’s guide address how certain science concepts relate to each selection in Exploring Coral Reefs. This information will provide you with science background knowledge as you plan your teaching for this book.

Help students access background knowledge related to the science concepts. Support the concepts of biodiversity, ecosystem, and coral reef in ways that are familiar to your students.

• biodiversity: Give students two minutes to name as many different kinds of animals and plants as they can while you create a list. Explain that the list shows great variety (diversity) of life (bio). Combine those word parts to help students understand the meaning of biodiversity.

• ecosystem: Ask students to think of a forest and how the animals and plants in the forest interact with one another. Ask: How does a fox interact with a mouse? How does a bird interact with a tree? How does a tree interact with rain? How do the animals interact with air? Explain that all of the interactions between the living and nonliving things in the forest make up the forest ecosystem.

• coral reef: If possible, show students a piece of coral, or show photos of several kinds of coral in a coral reef. Have students describe how the coral feels or how they imagine it feels from the photos. Explain that coral is made of the outer skeletons of small ocean animals that live close together.

The NG Ladders on-level eBook for Exploring Coral Reefs is available in .pdf format. Project the eBook on your interactive whiteboard, or have students listen to or read it on tablets or other mobile devices.
Science concepts are a critical part of each selection in *Exploring Coral Reefs*. These science background pages will help you build content knowledge so that you may more effectively have discussions with students as they read each selection in the book.

The following big idea science concepts apply to several selections in the book:

- **Biodiversity** (student book, pp. 3, 13, 27) is the variety of living things in a region on Earth—from single-celled organisms, algae, and fungi to the largest plants and animals. Warm equatorial regions have greater biodiversity than cooler regions. Coral reefs have more biodiversity than any other marine ecosystem.

- **A coral reef** (student book, pp. 2, 18, 26) is an area of the ocean made up of coral skeletons and living coral. Coral reefs are often called “rain forests of the ocean” because of their great biodiversity. The coral animal that is the basic unit of a coral reef belongs to the invertebrate phylum Cnidaria (ni-DAR-uh). This phylum also includes jellies and anemones.

Corals are tiny immobile animals. They use tentacles to feed on small fish and plankton within their reach. Each coral animal is called a polyp. The polyp produces a hard skeleton of calcium carbonate, or limestone. These skeletons provide protection to the polyps and build up the reef at a rate of 0.3 cm to 10 cm (0.1 in to 4 in) per year, depending on the species.

- **An ecosystem** (student book, p. 4) is all the living and nonliving things in an area and their interactions. Nonliving parts of an ecosystem include air, water, soil, rocks and minerals, and sunlight. Interactions between organisms are many and involve meeting survival needs, such as shelter and food. Symbiotic relationships are those that involve particularly close relationships between two organisms. Interactions based on food and the transfer of energy—plants produce food with energy from the sun; consumers eat plants or other consumers that have eaten plants—constitute a food web. Coral reefs are some of the oldest ecosystems on Earth.

Pages 5–6 in this teacher’s guide describe how the science concepts above relate to each selection. Additional science background information is given for each selection.
In this selection, students will learn about the locations and formation of different kinds of coral reefs (student book, p. 2) and about some of the animals that are adapted to live in coral reef ecosystems (student book, p. 4).

One of nature’s most interesting symbiotic relationships is the mutually beneficial relationship between coral polyps and the algae that live within them. These tiny plantlike algae use energy from the sun to produce food, which is then shared between the algae and the polyp. In turn, the polyp provides the algae with a safe place to live where there is plenty of sunlight.

The color of a particular coral is determined by the type of algae that live within it. Pollution as well as changes in salinity, water temperature, or other environmental factors can cause coral polyps to lose their algae partners. The result is a condition called coral bleaching, in which the coral turns white. When coral bleaches, it doesn’t die, but it does become more stressed and is at greater risk of disease and death. A major coral bleaching event caused by increased water temperature occurred in 2005 in the Caribbean Sea. Half of the coral reefs in U.S. waters of the Caribbean were lost as a result of this bleaching event.

Scientists generally classify coral reefs as three types—fringing reefs, barrier reefs, and atolls. All of the world’s coral reefs occupy a band that extends 30 degrees north and south of the equator. They are found in warm, shallow, clear waters that allow sunlight to reach the ocean floor.

The biodiversity (student book, p. 13) that characterizes the Great Barrier Reef includes 600 types of corals, more than 100 species of jellies, 3,000 species of mollusks, 500 species of worms, 1,600 species of fish, 100 species of sharks and rays, many species of whales and dolphins, and even turtles and crocodiles.

Interactions between these organisms include predation for food and competition for food, shelter, and, in the case of algae, sunlight. Three kinds of symbiotic relationships exist in the reef: mutualism (both organisms benefit from the relationship, as with the clownfish and anemone), parasitism (one organism benefits at the expense of the other, as with the parasitic organisms that feed in the mouth of a grouper), and commensalism (one organism benefits while the other is neither harmed nor helped, as with fish that can hide from predators among the coral).

The Great Barrier Reef actually formed millions of years ago; it has been worn down by waves and limestone-eating organisms and then built back up over and over again. In the past, the rate of buildup has been faster than the rate of wearing down. Today, however, some scientists fear that the reef may be facing changes so critical that it may not be able to recover. Episodes of coral bleaching from increased temperatures and exposure to the sun’s ultraviolet rays may become more common. Changes in sea level can expose corals to too much sunlight if sea levels drop or too little sunlight if levels rise. Recent flooding in Australia has washed high amounts of sediments and toxins into the reef waters. These pollutants could stress long stretches of the reef.
SNORKELING IN BELIZE

Student Book, pp. 18–25
Teacher’s Guide, pp. 11–12

In this selection, students read two different accounts of snorkeling at the Belize Barrier Reef in Central America. The largest coral reef (student book, p. 18) in the Northern Hemisphere and the second largest in the world, the Belize Barrier Reef stretches along the Atlantic-Caribbean coastline of the country of Belize in Central America. Within this reef system are examples of fringing reefs, atolls (highly unusual in the Caribbean), and barrier reefs, as well as mangrove forests, hundreds of sand cays (small islands), lagoons, and estuaries. Just as scientists think most rain forest species are yet to be discovered, so too it is with coral reefs—as much as 90 percent of all reef species may yet be undiscovered. In a search for new species, scientists are exploring a recently discovered biodiversity “hot spot” in the Pelican Cays, one of the mangrove-covered cays within the Belize Barrier Reef. In just one of the lagoons, more than 40 species of sea quirts have been identified.

Historical evidence shows that the reefs were used as a fishing resource around 2,500 years ago. They continued to be fished by the Mayans between 300 B.C. and A.D. 900. Many centuries passed between the Mayan decline until the 1600s, when pirates rediscovered the rich bounty of the reef’s many resources. Today, many tourists come to visit Belize’s coastal area and snorkel or scuba dive in the reef.

SAVING CORAL REEFS

Student Book, pp. 26–31
Teacher’s Guide, pp. 13–14

In this selection, students will learn why it is important to save coral reefs (student book, p. 26) from damage caused by human activities and what actions we can all take to help save coral reefs. The main causes of coral reef degradation are climate change, pollution, and certain fishing practices. The effects of global climate change are among the greatest concerns. Rising ocean temperatures lead not only to coral bleaching but also to more frequent outbreaks of infectious disease among the reef inhabitants. Air pollution caused by carbon emissions also threatens the health of coral reef ecosystems. When too much atmospheric carbon dioxide is absorbed into the ocean, coral reef organisms become less able to make their calcium carbonate skeletons, and reef-building rates are thus slowed. Pollution from land also harms coral reefs. Runoff into the ocean from farms, deforested areas, and coastal development, among other sources, can build up sediment, add nutrients (which are harmful because coral thrives in nutrient-poor water), and introduce toxins and pathogens (disease-carrying germs). All of these additions to the reef disrupt the balance of the ecosystem and can kill sensitive species.

Certain fishing practices also damage coral reefs. For example, bottom trawling involves dragging a net along the ocean bottom, which can break off and damage fragile coral. Other practices involve removing too many fish of a species, which disrupts the ecosystem. According to information reported by the 2008 NOAA Coral Reef Conservation Program, 19 percent of all original coral reef systems have been lost, 15 percent are projected to be lost in 10 to 20 years, and 20 percent are projected to be lost in 20 to 40 years. Forty-six percent are considered not yet threatened by any known cause except by those associated with future global climate changes.
Coral Reef Adventure

Reference Article

READING OBJECTIVES
• Use details and examples to explain a text and to draw inferences.
• Explain concepts in a science article.

SCIENCE OBJECTIVES
• Describe coral reefs and understand how they form.
• Describe how different fish are adapted to live in coral reefs.

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS
CC.4.RInfo.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
CC.4.RInfo.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

A FRAMEWORK FOR K–12 SCIENCE EDUCATION
Core Idea LS1: From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function
How do the structures of organisms enable life’s functions?
LS1.D: Information Processing
How do organisms detect, process, and use information about the environment?
Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics
How and why do organisms interact with their environment and what are the effects of these interactions?

Summary “Coral Reef Adventure” is a reference article that explores three different coral reefs and describes some adaptations of the animals that live in coral reefs.

BUILD BACKGROUND FOR THE GENRE
Ask students what they already know about reference articles. Have them turn and talk to share what they know. Lead students to an understanding of the elements of a reference article. Tell them that “Coral Reef Adventure” is a reference article with the following elements:
• Its purpose is to provide brief, easy-to-scan information. It uses the same format for each reef that is featured.
• It defines and explains subject-area vocabulary and uses boldface and italics to emphasize the importance of the words.
• It presents information through photos, captions, and maps.

BUILD VOCABULARY & CONCEPTS
• coral polyps • ecosystem • fringing reef
• coral reefs • atoll • barrier reef
• biodiversity • adaptations

Remind students that Using Context Clues is a strategy to infer the meaning of an unfamiliar word. They can “read around” the word, or read a few sentences before and after it, to determine meaning from the context. Remind them to look at the photographs, too.

Another strategy to try is Creating a Content Word Wall. List the vocabulary for students. Tell students that as they discover each word in the lesson, they should write the word on a card and draw an illustration or write a sentence that helps define the word. Designate a portion of a wall or other area in the classroom as the Content Word Wall on which to display the students’ cards.

Point out other important words in the selection, such as colonies and tentacles. Follow the same steps with these words and any words that might be unfamiliar to students.
**READ**

The **content goal** for Exploring Coral Reefs is for students to learn about the biodiversity of coral reef ecosystems around the world and discover why saving coral reefs is so important. Explain that “Coral Reef Adventure” explores three different coral reefs and describes just some of the many animals that live in each. Point out the **Read to find out** statement at the top of page 2 in the student book: Read to find out how coral reefs form and how animals are adapted to living in these places.

Help students with the **comprehension goal** of accessing the content by inferring and visualizing. Model this strategy by first reading aloud the text on page 2 that contrasts the size of coral polyps with the size of the structures they build. Hold up a pencil eraser and say: This helps me visualize the size of a polyp. It’s really a tiny animal. It seems to me that such a small organism could survive on the ocean floor only if it had some sort of protection. I can also infer that it must take many millions of polyps to build a coral reef, the largest animal home on Earth.

Before students begin reading, say: As you read, visualize what the writer is describing. Form mental pictures of the ideas and examples described in the text. This can help you infer ideas that the writer doesn’t state.

**TURN & TALK**

Revisit the **Read to find out** statement. Have students turn and talk about how coral reefs form and how animals are adapted to living there. (Communities of coral polyps form coral reefs. Each polyp forms a hard outer skeleton. Adaptations that help animals live in a coral reef include their colors, their ability to move quickly, their ability to find food in tiny places, and their ability to survive in warm, shallow water.) To check understanding, have students turn and talk about the **Check In** question: How are different reef fish adapted to life in coral reef ecosystems? (Possible responses: Groupers blend into the background. Humphead parrotfish use their big head to break off chunks of coral. Butterflyfish have small pointed snouts that let them peck at their prey. The lionfish have poisonous spines. Most coral reef fish are brightly colored to help them blend in with the colorful corals, and they have flattened bodies to help them hide from predators between rocks and coral.)

**Make Inferences** Direct students’ attention to the facts listed in the sidebar on page 3. Model how to make inferences by focusing on the fourth fact. Say: The text says that corals grow best in shallow water where sunlight reaches the ocean floor. This is because the algae that corals depend on need sunlight. The text doesn’t say anything about whether corals live on the deep ocean floor, but I can infer they do not—sunlight doesn’t reach that far. Have a volunteer read the fact about the length of time it takes a coral reef to build up. Have pairs turn and talk about what this fact implies about a coral colony’s ability to replace chunks that break off or become damaged. (Possible response: It would take a long time. Damage to coral today would likely not be replaced in our lifetime.)

**Explain Concepts** Tell students to review the three types of coral reef described on pages 4, 6, and 8. Have students turn and talk to compare and contrast atolls, fringing reefs, and barrier reefs. Model by saying: Because all of these places are coral reefs, I know they are all made of layers of coral skeletons. Ask: How else are atolls, fringing reefs, and barrier reefs alike? How are they different? (Possible response: All coral reefs exist in warm, shallow ocean waters. Atolls are circular, while fringing and barrier reefs are straighter. Barrier reefs are between the shore and ocean; fringing reefs are against the shore.)

**WRITE & ASSESS**

You may want to have students do a “quick write” to assess understanding. It’s always helpful to have students reflect on both the content and their thinking process.

- What are some ways organisms interact in a coral reef?
- What questions do you still have after reading?
The Great Barrier Reef

READING OBJECTIVES
• Explain concepts in a science article.
• Interpret and explain information presented visually.

SCIENCE OBJECTIVES
• Describe how living things in the Great Barrier Reef interact.
• Describe how energy passes through a food web.

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS
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CC.4.RInfo.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

A FRAMEWORK FOR K–12 SCIENCE EDUCATION
Core Idea LS1: From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function
How do the structures of organisms enable life's functions?
LS1.D: Information Processing
How do organisms detect, process, and use information about the environment?
Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics
How and why do organisms interact with their environment and what are the effects of these interactions?

BUILD BACKGROUND FOR THE GENRE
Lead students to an understanding of the elements of a science article. Let them know that "The Great Barrier Reef" is a science article with the following elements:
• It uses facts, details, and examples to present information about the Great Barrier Reef.
• It is organized using headings and specialized vocabulary.
• Information is presented through photos, captions, a map, and a diagram.

BUILD VOCABULARY & CONCEPTS
• barrier reef • adaptations
• biodiversity • food web

Remind students that Using Context Clues is a strategy to infer the meaning of an unfamiliar word. They can "read around" the word, or read a few sentences before and after it, to make meaning from the context. Remind them to look at the photographs, too.

Another strategy to try is Using Graphic Organizer Notes. Have students create a graphic organizer with four columns: Word, Inferred Meaning, Clue, and Picture or Sentence. Ask students to write barrier reef in the first column and turn and talk about what they infer it means. Have them write the inferred meaning in the second column and the clue that helped them infer the meaning in the third column. In the final column, have them draw a picture or write a sentence that demonstrates their understanding of the word. Follow this procedure with biodiversity, adaptations, and food web.

Point out other important words in the selection, such as behavioral, interactions, and relationships. Use the same strategy for these and any words that may be unfamiliar to students.

Summary
"The Great Barrier Reef" is a science article that describes some of the interactions between living things at the Great Barrier Reef off the coast of Australia.
READ

The content goal for Exploring Coral Reefs is for students to learn about the biodiversity of coral reef ecosystems around the world and discover why saving coral reefs is so important. Explain that “The Great Barrier Reef” explores the largest coral reef in the world and describes how some of the many animals that live there interact. Point out the Read to find out statement at the top of page 12 in the student book: Read to find out how some living things interact at the Great Barrier Reef.

Help students with the comprehension goal of accessing the content by inferring and visualizing. Model by saying: When I look at the map on page 13, I can see where the Great Barrier Reef is located. The map also helps me visualize how large the reef is. It stretches along the whole northwest coast of the continent of Australia. I can imagine flying over it for hours. Based on this mental picture, I can infer that the reef must have taken a long time to build up. Its size also helps me infer that many different fish and other organisms must live there.

Before students begin reading, say: As you read, visualize the ideas that are described. Use your mental pictures and the information in the text to infer important ideas that will help you understand even more than the text states.

TURN & TALK

Revisit the Read to find out statement. Have students turn and talk about how living things interact at the Great Barrier Reef. (Possible responses: Living things interact by competing for food, shelter, and mates and by forming special relationships that benefit the living things involved.) To check understanding, have students turn and talk about the Check In question: Describe three examples of relationships on the Great Barrier Reef. (Possible response: Clownfish live unharmed within the anemone’s tentacles and chase away butterflyfish, which eat anemones. Wrasse eat parasites that live on and inside larger fish. Humhead parrotfish eat coral polyps, and reef sharks eat humhead parrotfish.)

Explain Concepts Help students understand how relationships between organisms depend on the organisms’ adaptations. Model by pointing out the photo of the clownfish on page 15. Say: The caption says the clownfish swims among the stinging anemones without harm. So I can infer that clownfish and anemones have a special relationship. Page 14, paragraph 2, says this relationship is possible because of adaptations and that clownfish are immune to the anemone’s poison. This immunity is an adaptation. Have students turn and talk about other adaptations that make the clownfish/anemone relationship possible. (Clownfish attack and drive away butterflyfish that try to eat the anemones. Clownfish are brightly colored, which draws fish for the anemones to eat; then clownfish feed on the scraps. The anemone has stinging tentacles, which give the clownfish a place to hide.) Have students identify relationships and adaptations of other organisms in the selection.

Interpret Visual Information Tell students to study the food web diagram on pages 16 and 17. Talk about how to identify individual food chains within the web. Model by pointing to the organism numbered 8. Say: The key on the right says that this animal is a day octopus. If I follow the arrow that points away from the octopus, I see what animal eats it. It is number 7, the blacktip reef shark. If I follow the arrow that points to the octopus, I see what animal the octopus eats. In this case, it is number 3, the blue sprat. So in this food web diagram, the arrows point from an organism to an organism that eats it. Tell students to turn and talk to find at least four more coral reef food chains.

WRITE & ASSESS

You may want to have students do a “quick write” to assess understanding. It’s always helpful to have students reflect on both the content of the selection and their thinking process.

• How does a food web show how living things depend on one another?
• What did this text make you think about?
"Snorkeling in Belize" is a personal narrative that describes two snorkeling trips to the Belize Barrier Reef. One is a secondhand account and the other is a firsthand account.

BUILD BACKGROUND FOR THE GENRE

Lead students to an understanding of the elements of a personal narrative. Explain that “Snorkeling in Belize” is a personal narrative with the following elements:

• It contains both a secondhand account and a firsthand account. A secondhand account is a true story of an event told by someone who did not directly experience it. A firsthand account is a true story in which the writer tells about his or her own experience.
• Photos with captions are included.
• It describes the people and places involved and tells events in chronological, or time, order.

BUILD VOCABULARY & CONCEPTS

• coral reef • barrier reef • coral polyps

Remind students that Using Context Clues is a strategy to infer the meaning of an unfamiliar word. They can “read around” the word, or read a few sentences before and after it, to make meaning from the context. Remind them to look at the photographs, too.

Another strategy to try is Creating an Online Image Bank. Select several images from the Internet and display them as you present the term coral reef, giving students a chance to anchor the meaning of the term with the images. Do the same for the terms barrier reef and coral polyps. Continue to add images to the display as you read the selections.

You may want to point out other important words, such as snorkeling and inhabitants. Have students use online image banks or context clues to determine the meaning of these and any words that are challenging or unfamiliar.
READ

The **content goal** for *Exploring Coral Reefs* is for students to learn about the biodiversity of coral reef ecosystems around the world and discover why saving coral reefs is so important. Explain that “Snorkeling in Belize” tells about two different experiences of visitors to a coral reef and the organisms they encountered. Point out the **Read to find out** statement at the top of page 18 in the student book: *Read to find out about two snorkeling trips to the Belize Barrier Reef.*

Help students with the **comprehension goal** of accessing the content by monitoring and repairing comprehension. Model this strategy by reading page 19 up to and including the point where Alfonse tells Samantha they may see nurse sharks. Say: *Wait a minute! I just read that Alfonse said it would be safe. Now I read that he says they may see sharks. From what I know, sharks are dangerous. Maybe if I continue reading, I can clear up my confusion.* Read the rest of the page and the caption and point out how the text then explains that nurse sharks usually do not harm people.

Before students begin reading, say: *To make sure you understand what is being explained, you sometimes have to re-read or continue reading. Use this strategy when you come across information that confuses you.*

TURN & TALK

Revisit the **Read to find out** statement. Have students turn and talk about the two snorkeling adventures. To check understanding, have students turn and talk about the **Check In** question: *How were the two snorkeling trips alike and different?* (Possible responses: They both took place at the same spot along the Belize Barrier Reef. The first trip was taken by Samantha Brown, who was scared but overcame her fear. The second trip was taken by the writer, Joe Baron, who enjoyed it even though he made some mistakes.)

**Make Inferences** Model for students how to make inferences about the people they have read about in this narrative. Say: *I can infer that Alfonse is good when it comes to dealing with people. I can infer this because of details in the text, like how he calmed Samantha, told her how to breathe, and carefully held a shark in his arms for her to pet. He has probably dealt with scared people before and knows how to help them.* Have students work in pairs to discuss other qualities they can infer about Alfonse. (Possible responses: He has a good sense of humor. He likes to tell stories, which might be exaggerations. He is an expert on the Belize reef.) *What can you infer about the personalities of Samantha Brown and the writer of this narrative?* (Possible responses: Samantha is adventurous but afraid of certain things, like diving into the water in Belize. The writer is a good observer and has a great sense of humor.) Have students share their inferences with the class and cite text evidence to support them.

**Compare Accounts** Help students distinguish a firsthand account from a secondhand account. Model by saying: *When I read page 19, I can tell that the writer is talking about somebody else’s experience because he refers to the people in the third person—as he or she.* Next, have students turn to the first page of the firsthand account on page 22. Have them turn and talk about how this account is different from the secondhand account. (The writer is telling about an experience that happened to him. He uses the pronoun *I.* Then confirm what a firsthand account is. Further the discussion by asking: *What information do you get from one account that you don’t get from the other?*

WRITE & ASSESS

You may want to have students do a “quick write” to assess understanding. It’s always helpful to have students reflect on both the content and their thinking process.

- **What are three things you learned about animals of the coral reef in Belize?**
- **What surprised you most about what you just read?**
Summary: “Saving Coral Reefs” is an opinion piece that explains why coral reefs are in danger, why it is important to save them, and what people can do to help save coral reefs and the animals that live in them.

BUILD BACKGROUND FOR THE GENRE

Lead students to an understanding of the elements of an opinion piece. Explain that “Saving Coral Reefs” is an opinion piece with the following elements:

- The writer presents facts about the topic in an organized way and states an opinion.
- The text uses reasons and evidence to support the opinion.
- The writer concludes by emphasizing the opinion.

BUILD VOCABULARY & CONCEPTS

- coral reefs
- biodiversity
- barrier reefs
- coral polyps

Remind students that Using Context Clues is a strategy to infer the meaning of an unfamiliar word. They can “read around” the word, or read a few sentences before and after it, to make meaning from the context. Remind them to look at the photographs, too.

Another strategy to try is Becoming Wordkeepers. Write the term coral reefs on a sticky note and ask if anyone knows the meaning of the term. Call on one of the volunteers who knows the meaning of the term to be the wordkeeper. If no one knows the term, ask a volunteer to learn it and be the wordkeeper. Explain that the wordkeeper is responsible for really knowing the term—its meaning, part of speech, and correct spelling. As the volunteer shares the meaning of the term, write the meaning and part of speech on the sticky note. Give the sticky note to the wordkeeper. Explain that other students can go to the wordkeeper if they forget the term. Likewise, designate wordkeepers for barrier reefs, biodiversity, and coral polyps.

Point out other important words, such as toxin, asthma, arthritis, and algae. Designate wordkeepers for these and any words or terms that might be unfamiliar to students.
READ

The **content goal** for *Exploring Coral Reefs* is for students to learn about the biodiversity of coral reef ecosystems around the world and discover why saving coral reefs is so important. Explain that “Saving Coral Reefs” explains the many benefits we get from coral reefs, what is endangering the reefs, and how people can protect them. Point out the **Read to find out** statement at the top of page 26 in the student book: *Read to find out why it is important to preserve the world’s coral reefs.*

Help students with the **comprehension goal** of accessing the content by monitoring and repairing comprehension. Read the caption on page 27 aloud and then model the strategy by saying: *This fact confuses me. What is meant by 1.92 million visitor-days? There are only 365 days in a year. Let me think about this carefully. I know there had to be many thousands of visitors on any given day, and each one probably spent at least a few days at the reef. I think if you add up all the days that all the visitors spent at the reef, the total would be 1.92 million. That’s a lot of tourism!*

Before students begin reading, say: *When you come across an idea that you don’t understand, see if you can re-read or read on. If not, sometimes you just have to think carefully about what the text says and you can figure it out.*

**TURN & TALK**

Revisit the **Read to find out** statement. Have students turn and talk about why it is important to preserve the world’s coral reefs. (Possible responses: People depend on tourism to coral reefs to make a living. Marine life depends on coral reef habitats. Some reef organisms produce chemicals used to make medicines. Barrier reefs protect coastlines from being worn away.) To check understanding, have students turn and talk about the **Check In** question: *What do you think is the most important reason for saving coral reefs?* (Answers will vary, but ask students to explain their responses.)

**Describe Causes and Effects** Model describing a cause and effect relationship. First have students read the paragraph on page 28, then say: *The first part of this paragraph says that burning fossil fuels causes climate change and warmer oceans. Burning fossil fuels is a cause. Climate change and warmer oceans are an effect. Have students refer to pages 28 and 29 as they turn and talk to describe other causes that have the effect of damaging coral reefs.*

**Explain the Use of Reasons and Evidence** Ask students what they think the writer’s purpose is in writing this article. (to convince the reader that protecting coral reefs is important) Explain that a writer of an opinion piece like “Saving Coral Reefs” should give reasons and evidence to support that opinion. In that way the writer can persuade readers to agree with the opinion. Have students turn and talk to find reasons the writer gives for saving coral reefs. (Possible responses: Coral reefs provide jobs and food for many people. Coral reefs are a source of medicines to help people stay healthy. Coral reefs have been growing for millions of years, and many animals live in these habitats.)

Have students read the information on page 30 and turn and talk about reasons conservation of coral reefs should begin now. (One-third of all coral reefs are in danger of dying. Three-quarters of all coral reefs might be gone by 2050.) Tell students to turn and talk about these facts, what they think about them, and what they might do to help save coral reefs.

**WRITE & ASSESS**

You may want to have students do a “quick write” to assess understanding. It’s always helpful to have students reflect on both the content of the selection and their thinking process.

- **What are some causes of coral reef damage and what can be done about them?**
- **What did this text remind you of?**
Discuss

CONTENT & COMPREHENSION GOALS

Foster a discussion about the selections in Exploring Coral Reefs. Ask:

In this book, what did you learn about coral reefs? (Possible responses are given in the concept map. Students may have more or different information.)

The four selections in Exploring Coral Reefs are one reference article, one science article, one personal narrative, and one opinion piece. Life science concepts (biodiversity, coral reef, and ecosystem) thread through the selections. Guide a discussion about these science concepts.

What makes the selections especially interesting, though, is the interdisciplinary context—real-life stories and events that include not only life science but also geography, Earth science, and current events. Explain what interdisciplinary means, and then have students turn and talk about the interdisciplinary nature of the selections. You might ask: How is reading Exploring Coral Reefs different from reading a textbook about coral reefs? Also ask them to consider differences in the ways the selections were written (such as genre, text structure, and point of view) and how the writing style helps the science concepts come alive.
DISCUSS

Have students collaboratively answer the questions on page 32 as you move about the room and listen in to support and scaffold student conversations and clarify misconceptions.

1. What information in “Coral Reef Adventure” helped you better understand the other three pieces in the book? (“Coral Reef Adventure” describes the three types of coral reefs and how coral reefs form. It also describes the biodiversity of a coral reef ecosystem and adaptations that coral reef animals have. This information gives me the background I need to fully understand the other three pieces.)

2. Describe the differences between an atoll, a fringing reef, and a barrier reef. (An atoll is a reef that forms around a shallow lagoon. The round shape of an atoll is different from the long, straight edge of a fringing reef or a barrier reef. A fringing reef forms along the shore. A barrier reef stretches along the coast too, but unlike a fringing reef, it forms away from the shore.)

3. Describe how energy from sunlight is transferred through a food web in the Great Barrier Reef. (Energy from sunlight is transferred to algae, plankton, and plants. Energy is transferred from the food that these organisms make to the animals that eat them.)

4. In “Snorkeling in Belize,” what are some details that make the two snorkeling experiences different from each other? (Possible response: Samantha Brown was afraid of diving into the water and of the ray and shark at first; she had a film crew with her. Joe Baron was not afraid at all; he took his own photos of what he saw.)

5. What are some types of pollution that affect coral reefs? How are coral reefs affected by these types of pollution? (Burning fossil fuels produces greenhouse gases, which help cause global climate change and warm the oceans; warmer ocean water causes corals to lose their algae partners and turn white, or bleach. Soil that washes into the ocean can settle on coral reefs and block sunlight. Pollution from fertilizers increases the population of crown-of-thorns sea stars, which eat coral polyps.)

6. What do you still wonder about coral reefs and how to protect them? What research could you do to find out more? (Answers will vary, but students should describe a variety of references, such as book and magazine articles, reliable Internet sites, and talking with experts.)
In small groups or individually, offer students the chance to explore questions they have or ideas they still wonder about, based on their reading in *Exploring Coral Reefs*. Use question 6 on the Discuss page of the student book as a springboard for student questions and ideas for further research.

**EXPLORE**

Encourage students to express their curiosity in their own way. The questions students have matter. You might have students talk with peers, write about they wonder, or create drawings based on what they learned from reading the different selections in *Exploring Coral Reefs*. Guide them to immerse themselves in resources related to what they are most interested in learning more about. They might ask questions or make statements about their interests, for example:

- What other animals live in coral reefs, and how do they interact?
- How are different types of coral polyps alike and different?
- What steps are being taken to save coral reefs now? What might happen if they are not taken?

**GATHER INFORMATION**

After students explore, they should arrive at a question that will drive their research. Students may want to read, listen to, and view information with their question in mind. Guide students to use resources, such as reliable sites on the Internet, science texts and articles, library books, and magazines, that address the question they posed. Collecting information may lead students to revise or narrow their question.

You may want students to follow a specific note taking system to keep track of their thinking and findings as they gather information. In addition to taking notes, ask students to make a list of their sources. You may want to model how to take notes by interacting with text, jotting down your thoughts in the margins or on sticky notes, and demonstrating how to summarize the most important information. Remind students that their question will drive their research and note taking.
ANALYZE & SYNTHESIZE

Guide students to carefully and thoughtfully review their notes to determine the big ideas related to their question. As students prepare to use the information they’ve gathered to formulate an answer to their question, support them as they analyze and synthesize. Be sure they do the following:

• Revise any misconceptions.
• Notice incongruities in their information.
• Evaluate all the various pieces of information.
• Pull together the most pertinent information that addresses their question.

While analyzing and synthesizing their research, students may realize that the more they learn, the more they wonder. To help focus their thinking, students may want to talk with classmates or write in a research notebook. Remind them that just as in real-world scientific research, there may not be a final answer to the question they posed.

SHARE

When students share their research, they become teachers, consider how their ideas were shaped by the investigation, and pose new questions. Students may express their knowledge by writing, speaking, creating a visual piece, or taking action in the community. The best culminating projects are ones with authentic purposes. For example, a student who is interested in different coral polyps and other reef animals might take an audience on a virtual snorkeling experience, presenting images with narration, perhaps accompanied by taped sound effects of breathing through a snorkeling tube.

When students are given the time to gather information about a topic that interests them, they will find unique and individual ways to share what they learned. Some options you can suggest might include the following:

• eBooks with photos and text to share with other students who want to know more about coral reefs
• An information pamphlet about coral reefs that emphasizes the need for conservation
• An in-depth profile of a local aquarium that features a coral reef ecosystem
### Grade 4 Common Core State Standards for English Language Arts and A Framework for K–12 Science Education correlated to National Geographic Ladders Science

<table>
<thead>
<tr>
<th>Reading Standards for Informational Text</th>
<th>Exploring Coral Reefs Teacher’s Guide</th>
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<tbody>
<tr>
<td><strong>Key Ideas and Details</strong></td>
<td></td>
</tr>
<tr>
<td>1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.</td>
<td>Pages 7-8, 11-12, 15-16</td>
</tr>
<tr>
<td>2. Determine the main idea of a text and explain how it is supported by key details; summarize the text.</td>
<td></td>
</tr>
<tr>
<td>3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.</td>
<td>Pages 7-10</td>
</tr>
<tr>
<td><strong>Craft and Structure</strong></td>
<td></td>
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<tr>
<td>4. Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.</td>
<td></td>
</tr>
<tr>
<td>5. Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.</td>
<td>Pages 13-14</td>
</tr>
<tr>
<td>6. Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in focus and the information provided.</td>
<td>Pages 11-12, 15-16</td>
</tr>
<tr>
<td><strong>Integration of Knowledge and Ideas</strong></td>
<td></td>
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<tr>
<td>7. Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.</td>
<td>Pages 9-10</td>
</tr>
<tr>
<td>8. Explain how an author uses reasons and evidence to support particular points in a text.</td>
<td>Pages 13-14</td>
</tr>
<tr>
<td>9. Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.</td>
<td>Pages 15-16</td>
</tr>
<tr>
<td><strong>Range of Reading and Level of Text Complexity</strong></td>
<td></td>
</tr>
<tr>
<td>10. By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.</td>
<td>If the entire NG Ladders Science grade 4 program is used throughout the year, students will have had exposure to multiple genres, multiple levels, and appropriate scaffolding.</td>
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<table>
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<tr>
<th>Writing Standards</th>
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<tbody>
<tr>
<td><strong>Text Types and Purposes</strong></td>
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</tr>
<tr>
<td>1. Write opinion pieces on topics or texts, supporting a point of view with reasons and information.</td>
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<tr>
<td>2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.</td>
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<tr>
<td>3. Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.</td>
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(cont. on p. 20)
Production and Distribution of Writing

4. Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.

5. With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.

6. With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting.

Research to Build and Present Knowledge

7. Conduct short research projects that build knowledge through investigation of different aspects of a topic.

8. Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

Range of Writing

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

A Framework for K–12 Science Education

Core Idea LS1: From Molecules to Organisms: Structures and Processes

LS1.A: Structure and Function
How do the structures of organisms enable life’s functions?

Pages 4–10, 13–16

Core Idea LS1: From Molecules to Organisms: Structures and Processes

LS1.D: Information Processing
How do organisms detect, process, and use information about the environment?

Pages 4–10, 13–14

Core Idea LS2: Ecosystems: Interactions, Energy, and Dynamics

How and why do organisms interact with their environment and what are the effects of these interactions?

Pages 4–10, 13–16

Core Idea LS4: Biological Evolution: Unity and Diversity

LS4.D: Biodiversity and Humans
What is biodiversity, how do humans affect it, and how does it affect humans?

Pages 4–6, 13–14

Core Idea ESS3: Earth and Human Activity

ESS3.C: Human Impacts on Earth Systems
How do humans change the planet?

Pages 13–16
adaptation  (noun) a characteristic that helps an organism survive in its environment; adapt (verb) to have characteristics that aid in survival
atoll  (noun) a coral reef surrounding a lagoon
barrier reef  (noun) a long, narrow coral reef that runs parallel to the ocean shore
biodiversity  (noun) the variety of living things in a region on Earth
coral polyp  (noun) a small animal with a hollow, tube-like body and a mouth surrounded by tentacles; related to sea anemones
coral reef  (noun) an ocean ridge made up of coral skeletons and living coral
ecosystem  (noun) all the living and nonliving things in an area and their interactions
food web  (noun) a model of feeding relationships and the flow of energy in an ecosystem
fringing reef  (noun) a coral reef that grows attached to or close to the shore

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Glossary

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