TEACHER'S GUIDE

Trailblazer
January-February 2016

In This Guide

In this guide, you will find language arts and science lessons for the stories in the January-February issue of EXPLORER TRAILBLAZER.

Explorer Magazine

EXPLORER magazine is a classroom magazine specifically written for each grade, 2-5. Each grade's magazine contains a grade-appropriate reading experience, develops literacy skills and teaches standards-based science content. Great storytelling and stunning photographs teach your students about our planet and the people, plants, and animals that live on it. Use EXPLORER in your classroom to encourage students to explore our world and make it a better place.

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Kelp Kingdom

LANGUAGE ARTS

Objectives

- Students will predict definitions and then write sentences to better understand unfamiliar words.
- Students will use a variety of techniques to strengthen their understanding of content-related academic terms.
- Students will explore how using the pronoun *you* impacts the telling of a story.

Resources

- Vocabulary Assessment Master (page 6)
- Language Arts Assessment Master (page 7)

Summary

- The article "Kelp Kingdom" takes readers on a journey through the Monterrey Bay kelp forest to examine one of the most productive and dynamic ecosystems on Earth.

BUILD VOCABULARY AND CONCEPTS

- **consumer**
- **decomposer**
- **ecosystem**
- **keystone species**
- **producer**

Give each student a copy of the **Vocabulary Assessment Master**. Invite students to share what they know about each vocabulary word.

Divide the class into pairs. Using what they already know as a base, instruct pairs to write a definition for each word. Then have them write a sentence for each word, based on the definitions they wrote.

Display the Wordwise feature on page 9 of the projectable magazine. Review the definitions as a class. Have students add these definitions to their worksheets. Instruct pairs to write new sentences, using each word as it is defined in the article.

Invite volunteers to read aloud the before and after sentences they wrote for each word. As a class, examine how new knowledge expanded students' understanding of each word.

READ

Inform students that the purpose of this article is to introduce them to one of the most productive and dynamic ecosystems on Earth—a kelp forest off the coast of California.

Point out to students that in order to understand what kelp is and why this underwater forest is so extraordinary, readers must understand the scientific terms used to describe this place and the organisms that call it home.

Give each student a copy of the **Language Arts Assessment Master**. Tell students that they will use this worksheet to explore words in four different ways: define the word, identify examples, connect one word to another, and examine the results.

Display the Wordwise feature on page 9 of the projectable magazine. Highlight the word *consumer*. Instruct students to record its definition. Challenge students to locate the word *consumer* in the article. (page 4, column 2) Then model how to explore the word's meaning. **Say:** *According to the definition in the article, a consumer is a living thing that eats other living things for food. If I scan the article, I can find examples of animals eating. For example, on page 5 it says that a rockfish eats bull kelp. These two bits of information are like pieces of a puzzle. To put the puzzle together, I have to see how these and other pieces of information are connected.*

Point out that three of the other definitions also contain the term *living things*. **Say:** *Using living things as a basis, I can connect these three terms. Based on the information I have here, I can conclude that consumers, decomposers, and producers are three types of living things that interact in an ecosystem. I can also conclude that most consumers are animals. Consumers eat other living things for food. Very few plants do that. Most plants make their own food.*

Have students read the article in on their own. Instruct them to explore the remaining vocabulary words in this same way.

Kelp Kingdom

LANGUAGE ARTS

TURN AND TALK

Have students turn and talk to discuss what they learned about the five vocabulary words. Encourage pairs to compare their results in small groups. Instruct students to discuss how examining the information they collected helped them better understand each word.

• **Strengthen Understanding** Remind students that while they may have heard some of the vocabulary words identified in this article before, they may not have understood the words' scientific definitions. **Say:** *Words can have different meanings depending on how and where they're used. Good readers read the information before and after an unfamiliar word to figure out which definition is needed. Then they can use the word correctly when talking about that subject.* Challenge students to make accurate statements using each of the vocabulary words. Encourage them to use their **Vocabulary Assessment Masters** and their **Language Arts Assessment Masters** as resources. But remind them to be original. Students shouldn't restate sentences from the article. They should create new sentences of their own.

• **Exploring the Pronoun "You"** After reading the article, ask a volunteer to identify the first word in the article. (you) Point out how many times this pronoun was used in the article. Inform students that the writer did this on purpose. **Say:** *When writers write, they often tell about their own experiences. A sentence would say, " I swam in the ocean." Sometimes they tell what someone else did. To do this, they might write, "He swam in the ocean." But once in a while, writers decide to pull readers right into the action. They use the pronoun* you. *For example, in this article, a marine scientist isn't swimming through the kelp, you are! You are the main character as the story unfolds.* Encourage students to explain how using the pronoun *you* affected their enjoyment or interpretation of the article.

WRITE AND ASSESS

You may want students to write about what they learned to assess understanding. Encourage students to reflect upon what they read and how it affected their ideas about the topic.

• *What is a kelp forest?*

• *What did the divers see in the kelp forest?*

• *What surprised you about what you read?*

Kelp Kingdom

SCIENCE

Objectives

- Students will recognize how kelp species are alike and different.
- Students will identify the parts of kelp.
- Students will note the traits of a healthy kelp forest.

Resources

- Content Assessment Master (page 8)
- Comprehension Check (page 9)

Science Background

The Monterey Bay Marine Sanctuary is a protected area covering roughly 15,800 square kilometers off the coast of California. It includes one of the deepest and largest canyons in North America and provides a home for a multitude of plant and animal species.

One important member of this cold, coastal environment is kelp, a type of seaweed. Two types of kelp grow in the sanctuary, giant kelp and bull kelp. Together, they cover about 65 square kilometers, creating a giant kelp forest.

Kelp grows fast. Giant kelp can grow up to 18 inches a day. Each specimen has three main parts: the holdfast, which anchors kelp to the ocean floor; a stipe, which looks like the stem of a plant; and blades, which are similar to leaves and flutter in the ocean currents. Gas-filled sacs allow the blades to float in the water.

Kelp forests are diverse ecosystems. The sheer mass they contain minimizes wave action, creating a safe place for plants and animals to live. In essence, kelp forests protect plants and animals in the ocean just as forests filled with trees do on land.

Also like land forests, kelp forests have layers. The top layer, or canopy, is where most animals live. Snails and other organisms live in the understory in the middle. Sea urchins and brittle stars are two of the more common organisms found near the holdfast on the kelp forest floor.

ENGAGE

Tap Prior Knowledge

Instruct students to close their eyes and imagine that they're walking through a forest thick with trees. They see birds on the branches and small animals on the ground. The wind is blowing gently through the leaves. Suddenly they enter a large clearing where the wind is blowing hard. Challenge them to explain why. (The trees are no longer blocking the wind.) Instruct students to examine the photos in the article. Encourage them to compare this underwater forest to a forest full of trees.

EXPLORE

Preview the Lesson

Instruct students to preview the article in their magazines to examine the photos of kelp. Invite volunteers to describe what they see. Point out to the class that while the kelp in each of the photos may look the same, these photos were taken in different parts of a kelp forest so they most likely show different types of kelp. Inform students that as they read they article, they will learn how these kelp species are alike and how they are different.

Set a Purpose and Read

Have students read the article in order to compare and contrast two different species of kelp.

EXPLAIN

Compare and Contrast Kelp Species

After students read the article, remind them of their earlier descriptions of kelp. **Ask:** *What is kelp?* (a type of seaweed) *What are the two main species of kelp mentioned in the article?* (bull kelp and giant kelp) Give each student a copy of the **Content Assessment Master**. With a partner, instruct students to scan the article for information about each species of kelp. Tell them to record the information on their worksheets, noting how the two kelp species are alike and how they are different. When students are finished compiling information, have them compare their results in small groups.

Kelp Kingdom

SCIENCE

EXPLAIN

(continued)

Identifying Parts of Kelp
Display the diagram of kelp on page 5 of the projectable magazine. **Ask:** *What parts of kelp are identified in this diagram?* (blades, gas sac). Invite volunteers to identify these kelp parts in the photos. *What other parts of kelp does the article mention?* (stem/stalk, holdfast) *What do you think these parts do?* (Possible response: Gas sacs connect to the stem, which extends the length of kelp. The stem connects to the holdfast, which is a tangle of woody structures that ties kelp to the seafloor.)

Recognizing a Healthy Kelp Forest
As a class, identify key traits of a healthy ecosystem. (Possible responses: There is a variety of producers, consumers, and decomposers; There are nonliving things; Organisms can find food, shelter, and protection.) Identify and describe examples of each in a healthy kelp forest. **Ask:** *Why are otters important here?* (They are a keystone species. Other species depend on them to survive.) *What would happen if the otters disappeared?* (The ecosystem would fall apart.) *Why?* (Otters eat sea urchins. Without the otters, sea urchins would chew off the ties that keep the kelp in place. The kelp forest would disappear. Animals that lose their food and protection.)

ELABORATE

Find Out More
Point out to the class that many different plants and animals live in kelp forests. These organisms depend on the kelp to survive. Instruct students to each select one plant or animal that lives here. Encourage them to conduct research to learn how kelp helps this organism survive.

Extend Your Thinking About Kelp
Remind students that the kelp forest they read about in the article is located in the Monterey Bay National Marine Sanctuary. Encourage students to conduct research to learn what a marine sanctuary is and why monitoring the health of these locations is important.

EVALUATE

Have students record their answers to the assessment questions in their science notebooks or on a separate sheet of paper.

- *What is an ecosystem?* (all living and nonliving things in an environment and how they interact)
- *What two species of kelp live in this ecosystem?* (bull kelp and giant kelp)
- *How do you know kelp is a producer?* (It makes its own food.)

If you wish, have students complete the **Comprehension Check** to assess their knowledge of concepts mentioned in the article.

Name ______________________ Date ______________

VOCABULARY ASSESSMENT: Kelp Kingdom

Use this organizer to study each vocabulary word in the article.

Word					
My Definition					
Sentence					
Definition from the Article					
Sentence					

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Name ______________________________ Date ____________________

LANGUAGE ARTS ASSESSMENT: Kelp Kingdom

Use this graphic organizer to explore each vocabulary word from a scientific point of view.

Define | Identify
Word
Examine | Connect

Define | Identify
Word
Examine | Connect

Define | Identify
Word
Examine | Connect

Define | Identify
Word
Examine | Connect

Define | Identify
Word
Examine | Connect

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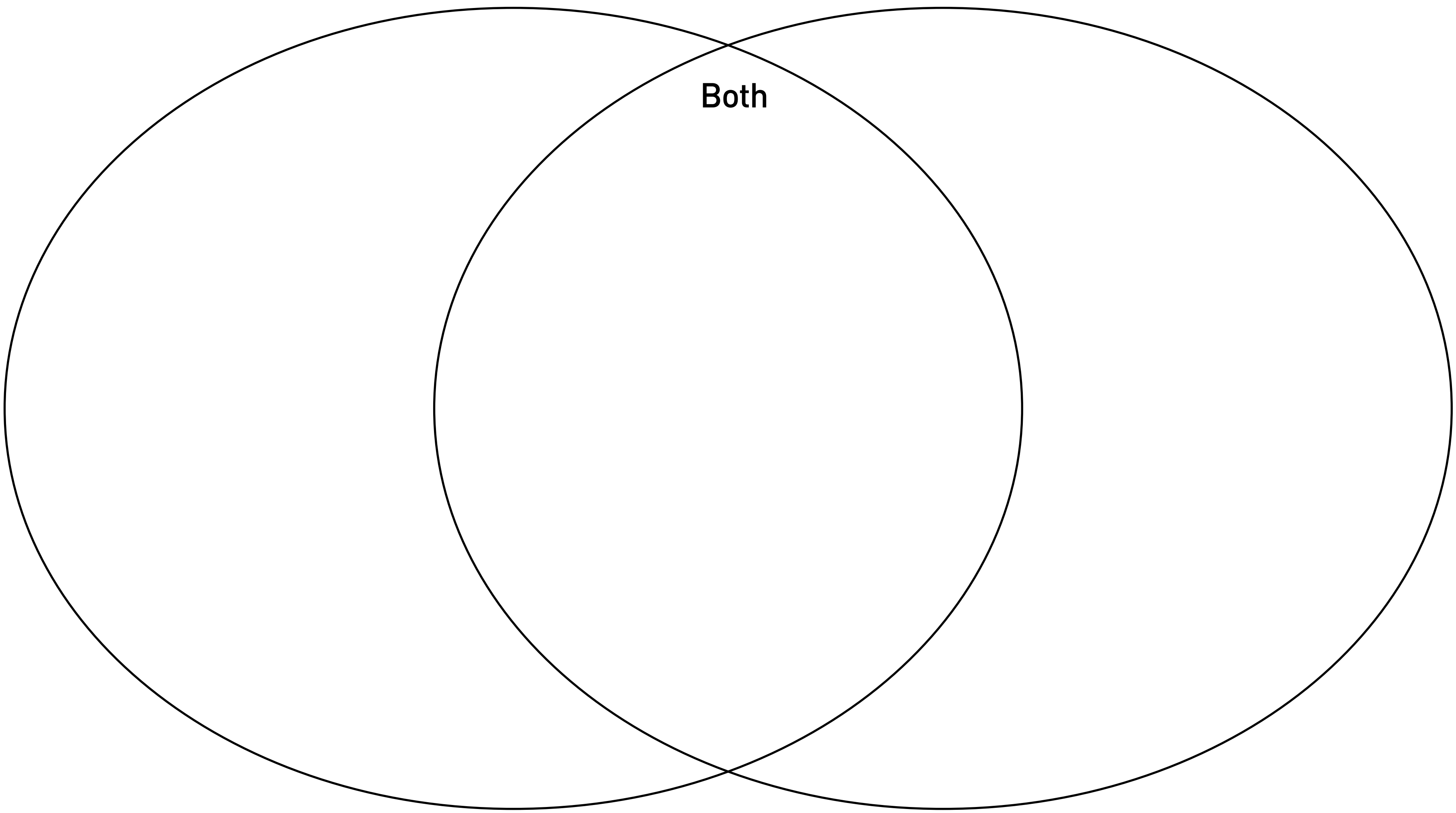
Name ______________________ Date ______________________

CONTENT ASSESSMENT: Kelp Kingdom

Use this diagram to compare and contrast the two main species of kelp mentioned in the article.

Species: ______________________ Species: ______________________



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Name ____ Date ______________________

COMPREHENSION CHECK: Kelp Kingdom

Read each question. Fill in the circle next to the correct answer or write your response on the lines.

1. What is kelp?

Ⓐ a type of tree

Ⓑ a type of seaweed

Ⓒ a type of grass

2. Which type of kelp only grows for one year?

Ⓐ bull kelp

Ⓑ giant kelp

Ⓒ both

3. Which type of kelp needs more space to grow?

Ⓐ bull kelp

Ⓑ giant kelp

Ⓒ both

4. Which type of kelp releases oxygen?

Ⓐ bull kelp

Ⓑ giant kelp

Ⓒ both

5. Why is it important for otters to live in a kelp forest?

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Robot Revolution

National Geographic Explorer

LANGUAGE ARTS

Objectives

- Students will recognize how vocabulary words are connected.
- Students will ask and answer questions about robots.
- Students will explain concepts based on information in the text.

Resources

- Vocabulary Assessment Master (page 14)
- Language Arts Assessment Master (page 15)

Summary

- The article "Robot Revolution" profiles a collection of robots created to address different humans problems or meet specific needs.

BUILD VOCABULARY AND CONCEPTS

- **caregiver robot**
- **robot**
- **sensor**
- **swarm robots**
- **technology**

Instruct students to turn to page 15 of their magazines. Tell them to read the vocabulary words in the Wordwise feature to themselves

Then give each student a copy of the **Vocabulary Assessment Master**. Tell students to look at the diagram and think about the words. Encourage them to write the words and their definitions in the way they think makes the most sense. Instruct them to draw arrows to show how various words are connected. Then challenge them to explain why they organized the words as they did.

Have students compare their results in small groups. Allow students to revise their work if they decide another arrangement works better after consulting with classmates.

READ

Let students know that the purpose of this article is to learn about different types of robots that people have built to solve problems or meet specific needs. Explain to the class that the best way to learn about these robots is to ask themselves questions before, during, and after they read the article. Many of the answers are within the text.

Display pages 10-11 of the projectable magazine. Model how to ask and answer questions. **Say:** *When I look at this page, the first thing I notice is the image. I know from the headline that it's a robot. I know from looking at the image that it resembles a human. But I wonder, what does this robot do? Why does it look like a human? How is this robot different from other robots?*

Invite a volunteer to read aloud the introduction. **Say:** *This text makes me ask more questions about this robot. How does the robot sense a person's mood? How does it know the right way to respond?* Inform students that the only way to find the answers is to read the rest of the article.

Give each student a copy of the **Language Arts Assessment Master**. Inform students that they will use the worksheet to record questions that they have before, during, and after reading the article. They'll also record any answers they find within the text.

Have students read the article and complete the worksheet on their own.

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Robot Revolution

LANGUAGE ARTS

TURN AND TALK

Have students turn and talk to discuss what they learned about robots. **Ask:** *Why is each of these machines considered to be a robot?* (Each one performs a human task or imitates human actions.) *What do they all have in common?* (They help humans.) Encourage students to share what they learned about the different types of robots.

• **Ask and Answer Questions** Remind students that asking and answering questions is a strategy that will help them understand what they read. **Say:** *Even the best readers come across words and ideas they don't understand. Asking questions shows you which answers you need to search for as you reread the text.* Have students share and compare their **Language Arts Assessment Masters** with a partner. Did they have the same questions? Did they find the same answers? If not, encourage partners to compare where in the text they each found the answer to reevaluate the results.

• **Explain Concepts** After reading the article, **say:** *One way to see if you understand information is to try to tell someone else about the topic. If you can't explain the concept, you might need to read the article again.* Have students turn and talk to explain to a partner why some of the robots in the article are like humans and some are not. Prompt discussion with questions.

WRITE AND ASSESS

You may want students to write about what they learned to assess understanding. Encourage students to reflect upon what they read and how it affected their ideas about the topic.

- *What is a robot?*
- *Do you think robots should be made to look like humans? Why or why not?*
- *What surprised you about what you read?*

Robot Revolution

SCIENCE

Objectives

- Students will understand what a robot is.
- Students will recognize that robots are designed to solve problems.
- Students will compare and contrast robots that people use.

Resources

- Content Assessment Master (page 16)
- "Robot Revolution" poster (Teacher's Edition)
- Comprehension Check (page 17)

Science Background

Robots are machines that perform human tasks or imitate human actions. While they may seem like a modern-day invention, the idea for robots has deep roots in history.

Muslim scientists developed simple robotic contraptions more than 1,000 years ago. Ancient Greeks and Romans built machines that moved by themselves. In the late 1400s, Leonardo da Vinci sketched plans for a humanoid robot, though the ability to build a robot like this was far into the future.

Advances in technology are allowing people to create robots as never before. The big, bulky, metal taskmasters of the past now have smaller counterparts that can comfort, carry, and disarm bombs. Some robots help surgeons perform procedures. And engineers are developing robots that work together as they canvas an area to search for survivors, inspect crops, or clean up environmental hazards.

Da Vinci's dream of a humanoid robot has also come true. These robots, which resemble humans, can perform many of the same task as people without the help of a brain. Other robots are designed to resemble animals. In Japan, many people keep these robots as pets.

ENGAGE

Tap Prior Knowledge

Give each student a piece of plain white paper and a pencil. Instruct students to draw a picture of a robot. Invite volunteers to share their sketches with the class. Compare the drawings to identify similarities and differences. Invite students to tell what each of their robots does.

EXPLORE

Preview the Lesson

Instruct students to read the headline and text and examine the photo on pages 10-11 of their magazines. Encourage them to describe the robot they see. **Ask:** *What problem does this robot solve?* (Possible response: It provides a friend for people who need one.) *How does the robot do this?* (It responds to people's moods.) *How might its design help people see it as a friend?* (It looks a little bit like a person.) Ask students if they would like to have a robot like this. Invite students to share their opinions.

Set a Purpose and Read

Have students read the article to learn about different types of robots and the problems they were designed to solve.

EXPLAIN

Understanding What a Robot Is

Display page 15 of the projectable magazine. Zoom in on the Wordwise feature and read aloud the definition for *robot*. Inform students that all robots are machines, but not all machines are robots. To be classified as a robot, a machine must perform a human task or imitate a human action. **Say:** *An oven is a machine, but an oven doesn't do something that a human can. Someone needs to operate the oven. Pepper is a robot. Pepper can sense how people feel. If you're feeling sad, Pepper will respond like a friend would*. Examine the other machines in the article. Challenge students to explain why each one is a robot.

Robot Revolution

SCIENCE

EXPLAIN

(continued)

Recognize How Robots Solve Problems
Inform students that people build many different types of robots. All robots are designed to solve specific problems, but what a robot looks like and how it functions depends upon its purpose. Display the **"Robot Revolution" poster**. Review the information with the class. Then give each student a copy of the **Content Assessment Master**. Encourage students to record information about each robot. Challenge them to analyze that information to identify the purpose of each robot identified in the article.

Compare and Contrast Robots
Divide the class into small groups. Give each group a piece of plain white paper. Tell each group to select a recorder. Instruct recorders to draw a Venn diagram on their papers. Then tell groups to each select two robots in the article. Instruct them to compare and contrast the two robots in as many was as they can. Encourage groups to review the article for details about the robots they selected. Recommend that they use their **Content Assessment Masters** as well. Invite volunteers to present their group's findings to the class.

ELABORATE

Find Out More
Remind students that swarm robots are one of the newest innovations in robot technology. Assign each student a partner. Tell pairs to conduct research to learn more about swarm robots. Challenge them to identify at least five problems swarm robots could help solve.

Extend Your Thinking About Robots
Display pages 12-13 of the projectable magazine. Remind the class that Pepper is a robot designed to act like a friend. Have students the robot's structure. Discuss how Pepper's appearance might help it be accepted as a friend. Then examine Paro. Brainstorm a list of reasons why a robot designed to comfort people would be soft and cuddly.

EVALUATE

Have students record their answers to the assessment questions in their science notebooks or on a separate sheet of paper.

- *Why do people design robots?* (to solve problems)
- *What are swarm robots?* (small robots that act together to do a job)
- *Which robot in the article can lift people?* (Robobear)

If you wish, have students complete the **Comprehension Check** to assess their knowledge of concepts mentioned in the article.

Name ______________________________ Date ____________________

VOCABULARY ASSESSMENT: Robot Revolution

Arrange the vocabulary words in a way that you think makes sense. Draw arrows to show different ways the words are connected. Explain your results.

Word:

Definition:

Word:

Definition:

Word:

Definition:

Word:

Definition:

Word:

Definition:

Explanation:

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Name ______________________________ Date ____________________

LANGUAGE ARTS ASSESSMENT: Robot Revolution

Write questions you have before, during, and after reading the article. Search for answers in the text.

	Questions	Answers
Before		
During		
After		

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Name ______________________________ Date ____________________

CONTENT ASSESSMENT: Robot Revolution

List the robots in the article. Record information about each. Identify the problem each robot solves.

Identify the Robot	What does it look like?	What does it do?	What problem does it solve?

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Name ______________________________ Date ____________________

COMPREHENSION CHECK: Robot Revolution

Read each question. Fill in the circle next to the correct answer or write your response on the lines.

1. What is a robot?

   Ⓐ a person

   Ⓑ a machine

   Ⓒ a sensor

2. What can robots do?

   Ⓐ perform human tasks

   Ⓑ imitate human actions

   Ⓒ both A and B

3. What do all robots do?

   Ⓐ create science

   Ⓑ solve problems

   Ⓒ design technology

4. Which type of robot needs other robots to do a job?

   Ⓐ Robobear

   Ⓑ Pepper

   Ⓒ swarm robots

5. Pick a robot from the article. Describe what it does. Tell how that helps humans.

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Seeing Eye to Eye

LANGUAGE ARTS

Objectives

- Students will create sketches to understand the meaning of unfamiliar words.
- Students will describe how eyes turn light into sight.

Resources

- Vocabulary Assessment Master (page 22)
- Language Arts Assessment Master (page 23)

Summary

- The article "Seeing Eye to Eye" examines the anatomy of an eye and explains how eyes work. In addition, the article explores how the changes in the structure of the eye affects how people and animals see.

BUILD VOCABULARY AND CONCEPTS

- **focus**
- **reflect**
- **refract**
- **vision**

Display the vocabulary words on a word wall or on the white board. Point out to students that when they read they will encounter words they don't know. Remind them that using context clues such as the sentences before and after an unknown word and photographs on the page can help them figure out what the unfamiliar word means.

Invite a volunteer to read the definition of *focus* in the Wordwise feature on page 23 of the article. Examine this word in context. Then give each student a copy of the **Vocabulary Assessment Master**. Instruct students to write the word's definition and create a detailed sketch showing what it means. Inform students that their drawings won't all be the same. The point is for students to draw the word in a way that will help them remember its definition. Examine the other words in this way, too.

READ

Inform students that the purpose of this article is to explain how eyes work. As they read, they'll learn about parts of the eye, how those parts turn light into sight, and about differences in eyes that cause humans and animals to see in different ways.

Inform students that as they read, they will notice relationships between ideas in the text. For example, processes have a beginning, middle, and end. Events in those processes occur in a specific order. In another type of relationship, one thing can cause something else to happen. Explain to students that finding and interpreting these relationships is the key to fully understanding how concepts are related in a text.

Have students read the article on their own. After reading, give each student a copy of the **Language Arts Assessment Master**. Instruct students to describe what happens when eyes turn light into sight. Remind them to list the events in the proper order! Then have students complete three cause/effect statements about sight. Instruct students to write a "C" above the cause in each sentence and an "E" above each effect.

Seeing Eye to Eye

LANGUAGE ARTS

TURN AND TALK

Have students turn and talk to discuss what they learned about eyes. **Ask:** *Why is sight important?* (Sight provides about two-thirds of all the information the human brain takes in.) *How is the human eye like a camera?* (Both have a lens that brings an image into focus. Both have lens openings that adjust to light.) *What does an eye need to see?* (light)

• **Interpret Visual Information** Explain to students that reading definitions tells people what words mean. But sometimes readers have to "see" words to really understand them. Point out that this is exactly what they did when they drew sketches of the vocabulary words in the article. They drew the words in a way that had meaning to them. Instruct students to turn and share the sketches they created on their **Vocabulary Assessment Masters** with a partner. Encourage them to explain how their drawings reflect the meaning of each word.

• **Describe Relationships in Concepts** Invite volunteers to describe a sequence of events and a cause/effect relationship. Review instances when writers might use either technique. Then have students review their **Language Arts Assessment Masters** in small groups. Encourage students to compare the information they recorded with one another as well as the text in the article. Instruct students to add any steps they missed in their sequence of events. Clear up any confusion regarding causes and effects related to sight.

WRITE AND ASSESS

You may want students to write about what they learned to assess understanding. Encourage students to reflect upon what they read and how it affected their ideas about the topic.

• *How does the cornea help eyes see?*

• *Why do some people have trouble seeing far away?*

• *What surprised you about what you read?*

Seeing Eye to Eye

SCIENCE

Objectives

- Students will understand the rules of light.
- Students will recognize that animals develop traits that enable them to see well in different environments.

Resources

- Content Assessment Master (page 24)
- "Light Catchers" poster (Teacher's Edition)
- "Seeing Eye to Eye" Interactive Whiteboard (optional)
- Comprehension Check (page 25)

Science Background

At just 2.5 centimeters long and about seven grams, the human eye isn't large. Yet it's extremely powerful. An eye can capture light and transform it into an image for the brain to interpret. Eyes are our windows to the world.

An eye has several important parts. The cornea is a see-through dome that helps focus light. It lies in front of the iris, which is the colored part of the eye. Muscles attached to the iris help it change shape and control how much light enters the pupil, the black circle in its middle.

About two-thirds of an eye is filled with a gel-like material that gives the eye its shape.

The lens lies behind the iris. It focuses light onto the retina at the back of the eyeball. The retina contains millions of light-sensitive cells. It captures light and sends messages to the brain.

Eyes can do amazing things, but not all eyes are the same. Often, the differences have a purpose. For example, cats have an extra part in their eyes that lets them catch light twice. They can see up to eight times better in the dark than humans can. Birds of prey use their binocular vision to spot prey up to three kilometers away. And while humans can only see light in the visible spectrum, rattlesnakes can detect electromagnetic radiation in the infrared range. This helps them find prey.

ENGAGE

Tap Prior Knowledge

Instruct students to take out a sheet of paper. Give them 30 seconds to make a list identifying everything they can see. Then turn off the lights. If this doesn't make the room dark, ask students to close their eyes instead. Instruct students to make a list of things they can see now. Compare the lists. Discuss why it was impossible to see as many things in the dark. Invite students to share what they know about eyes.

EXPLORE

Preview the Lesson

Display pages 16-17 of the projectable magazine. Read aloud the subhead. Point out that it states that eyes turn light into sight. **Ask:** *How do you know this statement is true?* (You can only see when it's light out. You can't see anything in the dark—even if your eyes are open.) Tell students that they'll learn how the sense of sight works as they read the article.

Set a Purpose and Read

Have students read the article in order to understand the rules of light and recognize that animals develop traits that allow them to see well in different environments.

EXPLAIN

Understanding the Rules of Light

Inform students that we see the environment as we do for a good reason. Light follows rules. **Say:** *There are specific rules of light. For example, light reflects, or bounces off of objects. It also refracts, or bends. And, light can be absorbed.* Explain to students that light appears to be white. But when it refracts we can see that it is actually made up of a rainbow of colors. The color we see depends on which light rays an object reflects and which ones it absorbs. **Ask:** *Why would a shirt look black?* (It absorbs all of the light rays.) *Why would it look white?* (It reflects all of the light rays.) *What would cause a shirt to look blue?* (It reflects blue light rays and absorbs the others.)

Seeing Eye to Eye

SCIENCE

EXPLAIN

(continued)

Recognizing Variations in Traits
Display the **"Light Catchers" poster**. Zoom in on the top left image, covering the caption. Poll the class to see if students can identify the animal shown in the image. Invite a volunteer to describe the animal's eyes. Challenge the class to explain how the animal's eyes help it survive in its environment. Then reveal the caption and invite a volunteer to read the information aloud. Learn about the other animals' eyes in this same way. When applicable, encourage students to identify an animal from the article that depicts similar traits.

Give each student a copy of the **Content Assessment Master**. Instruct students to draw a diagram of an eye and label its parts. Then instruct students to select three animals mentioned in the article or from the poster. Challenge them to identify unique traits of each animal's eyes and tell how those traits help the animal survive where it lives.

ELABORATE

Find Out More
Display page 21 of the projectable magazine. Zoom in on the optical illusion at the bottom of the page. Review with students what an optical illusion is. Challenge them to explain why this one works. Then assign each student a partner. Invite pairs to find another optical illusion they like. Instruct them to conduct research to learn why the image causes people to see something that's not really there. Invite partners to share their results with the class.

Extend Your Thinking About Sight
Remind students that not all eyes are perfect. People can have trouble seeing close up or far way. Discuss how people can correct these problems. (contact lenses, glasses, surgery) **Ask:** *What do you think would happen to an animal with vision problems? Why?* Invite students to share their opinions.

EVALUATE

Have students record their answers to the assessment questions in their science notebooks or on a separate sheet of paper.

- *How do big eyes help animals see better at night?* (Big eyes let in more light. Animals use all of this light to see.)

- *Why is it an advantage for crabs to have eyes set on the end of stalks, high above their bodies?* (Eyes in this position allow crabs to look in all directions.)

- *What do multiple eyes help jumping spiders do?* (detect motion)

If you wish, have students complete the **Comprehension Check** to assess their knowledge of concepts mentioned in the article. You may also wish to examine the optional **Interactive Whiteboard** lesson that accompanies this article.

Name ______________________________ Date ____________________

VOCABULARY ASSESSMENT: Seeing Eye to Eye

Record the definition of each vocabulary word. Create a sketch to help you remember what each word means.

Word	Definition	Sketch
focus		
reflect		
refract		
vision		

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Name ______________________________ Date ____________________

LANGUAGE ARTS ASSESSMENT: Seeing Eye to Eye

Describe what happens when eyes turn light into sight.

First,
Next,
Then,
Finally,

Complete each sentence. Write a "C" above each cause. Write an "E" above each effect.

If an eyeball is too long, ______________________________

______________________________.

If an eyeball is too short, ______________________________

______________________________.

People wear eyeglasses or contact lenses because ______________________________

______________________________.

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Name ______________________________ Date ____________________

CONTENT ASSESSMENT: Seeing Eye to Eye

Draw a diagram of an eye. Label each part.

Identify three animals from the poster or article. Describe each animal's eyes. Tell how each animal's eyes help it survive. .

Identify	Describe	Tell

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Name ______________________________ Date ____________________

COMPREHENSION CHECK: Seeing Eye to Eye

Read each question. Fill in the circle next to the correct answer or write your response on the lines.

1. What does the eye do when it makes a clear image?

   Ⓐ reflect

   Ⓑ refract

   Ⓒ focus

2. Why do larger eyes help animals see better at night?

   Ⓐ They have more color.

   Ⓑ They see optical illusions.

   Ⓒ They catch more light.

3. Why can a ghost crab see in all directions?

   Ⓐ It has four eyes.

   Ⓑ Its eyes are above its body

   Ⓒ It can close its pupils tightly.

4. Which part of the eye looks like a black dot?

   Ⓐ iris

   Ⓑ pupil

   Ⓒ retina

5. Pick one animal from the article or poster. Tell how its eyes help it survive.

____

____

____

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Trailblazer

ANSWER KEY

Kelp Kingdom

Assess Vocabulary, page 6
Students predicted definitions and sentences will vary. They should record the words and definitions from the Wordwise feature on page 9.

consumer: a living thing that eats other living things for food
decomposer: a living thing that breaks down wastes and remains of other organisms
ecosystem: all living and nonliving things in an environment and how they interact
keystone species: a species on which other species in an ecosystem depend
producer: a living thing that makes its own food

Assess Language Arts, page 7
Students should record words and definitions from the Wordwise feature on page 9 of the article. (see above) They should identify examples, make connections between vocabulary words, and examine the information to reach conclusions related to a kelp forest. For **photosynthesis**, students should include examples of plants that conduct photosynthesis to make food.

Assess Content, page 8
Bull kelp: needs less space to grow; only grows for one year
Giant kelp: needs more space to grow; grows quickly; lives for years at a time
Both: have blades, gas sacs, stems, and holdfast; float in ocean currents; a type of seaweed; producer; make own food and release oxygen

Comprehension Check, page 9
1. A; 2. A; 3. B; 4: C; 5: Otters are a keystone species. They keep kelp forests healthy by eating sea urchins.

Robot Revolution

Assess Vocabulary, page 14
Students should record the words and definitions from the Wordwise feature on page 15.

caregiver robot: a robot that provides care or comfort to patients
robot: a machine that performs human tasks or imitates human actions
sensor: a device that detects or measures a physical property and records or responds to it
swarm robots: small robots that act together to do a job
technology: the use of science to solve problems or invent useful things

Students may arrange the words in various ways. The most logical organization is: row 1: technology; row 2: sensor and robot; and row 3: caregiver robot and swarm robots. Students should draw arrows to show relationships between terms, such as arrows pointing from technology to sensor and robot. This is logical because robot and sensors are both types of technology.

Assess Language Arts, page 15
Students questions will vary. Answers should come from the text.

Assess Content page, 16
Students should identify the six robots in the article: Pepper, Robo Sally, ROSA, Paro, Robobear, and swarm robots. Descriptions, function, and problems solved should be based on information in the text and photos.

Comprehension Check, page 17
1. B; 2. C; 3. B; 4: C; 5: Answers will vary depending on which robot students select.

Trailblazer

ANSWER KEY

(continued)

Seeing Eye to Eye

Assess Vocabulary, page 22
Students should record the words and definitions from the Wordwise feature on page 23.

focus: a state in which the eye makes a clear image
reflect: to send back light rays
refract: to bend light rays
vision: sense of sight, or seeing

Sketches will vary depending on students' interpretations of each word. Evaluate each response for accuracy.

Assess Language Arts, page 23
Description: (Possible response) First, light hits the cornea. The cornea refracts or bends the light, helping it focus. Next, muscles attached to the iris change its shape. This allows the iris to control how much light goes through the pupil. Then, light travels to the lens, which focuses light on the retina. The retina forms an upside down image. Finally, the brain "sees" the image right side up.

If an eyeball is too long (C), the light focuses before it reaches the retina. (E)
If an eyeball is too short (C), the light focuses past the retina. (E)
People wear eyeglasses and contact lenses (E) because they are nearsighted or farsighted. (C)

Assess Content, page 24
Students' diagrams should match the diagram on page 19 of the article. Examples will vary but should be based on information from the text or poster.

Comprehension Check, page 25
1. C; 2. C; 3. B; 4: B; 5: Possible response: Answers will vary depending on which animal students select.