



In This Guide

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

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 recognize a second-person narrative.

Resources

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

Summary

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

BUILD VOCABULARY AND CONCEPTS

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

Give each student a copy of the **Vocabulary Assessment Master**. Point out to students that they may have heard some or all of these words before.

Using that background knowledge as a base, instruct students to predict and write a definition for each word. Then have them write a sentence using 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 them 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 contributed to 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. The sentence where the bold word appears says that fish are consumers. 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 four of the other definitions also contain the term *living things*. **Say:** *Using living things as a basis, I can connect the word consumers to several other words. Based on the information I have here, I can conclude that consumers, decomposers, and producers are types of living things that interact in an ecosystem. Consumers eat other living things, so I can conclude that they don't conduct photosynthesis and make their own food. I can also conclude that most consumers are animals. Very few plants eat other living things.*

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

TURN AND TALK

Have students turn and talk to discuss what they learned about the six vocabulary words. Encourage them to compare their results in small groups. Instruct students to discuss how examining the information they collected impacted their understanding of each term.

- **Strengthen Understanding** Remind students that while they may have already been familiar with some of the vocabulary words identified in this article, they may not have been as familiar with the words' scientific definitions. **Say:** *Words can have different meanings depending on the context in which they are used. Good readers examine the context to determine which definition is required. That allows them to use the word correctly when discussing the topic.* 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.

- **Recognizing Second-Person** 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. Challenge students to explain why. Guide them to recognize that this article is written in the second person. Discuss what that means. **Say:** *Most often, articles are written from the first-person or third-person point of view. First person tells what I did. Third person refers to he, she, or they. Once in a while, writers decide to pull readers right into the action. 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 second-person point of view 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 kelp?*
- *Why do scientists study kelp forests?*
- *What surprised you about what you read?*

Kelp Kingdom

SCIENCE

Objectives

- Students will recognize the different parts of kelp that help it grow and survive.
- Students will categorize organisms in a kelp forest.
- Students will note how the amount of kelp in a kelp forest affects the levels of organisms living there.

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

Display pages 2-3 of the projectable magazine. Tell students to examine the photo. Invite a volunteer to describe kelp. Point out that kelp isn't a plant. It's a type of seaweed. But like plants, kelp has parts that work together to help it grow and survive.

Set a Purpose and Read

Have students read the article in order to recognize different parts of kelp that help it grow and survive.

EXPLAIN

Recognizing 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. **Ask:** *How do these parts help kelp survive?* (Gas sacs cause the blades to float in the water. The blades rise to the surface and access the sunlight kelp uses during photosynthesis to make its own food.) *What other parts of kelp does the article mention?* (stem/stalk, holdfast) *What do these parts do?* (Gas sacs connect to the stem, which extends the length of kelp and connects to the holdfast, a tangle of wood structures that anchor kelp to the seafloor.) Give each student a copy of the **Content Assessment Master**. Instruct students to draw a model of kelp, labeling each part. Challenge them to summarize how kelp's parts help it grow and survive.

SCIENCE

EXPLAIN

(continued)

Categorize Organisms in a Kelp Forest

Inform students that in order for any ecosystem to survive, the organisms that live there must be able to find food. An underwater ecosystem is no different. Discuss how energy moves from the sun to producers, consumers, and decomposers in a kelp forest. Challenge students to identify examples of each type of organism in the article.

Tracking Kelp Forests

Display pages 8 and 9 of the projectable magazine. Remind students that kelp forest provide a safe ecosystem for many different marine species. **Ask:** *How is kelp connected to the two organisms you see in these photos?* (Sea urchins chew on the holdfast and destroy kelp forests. Otters eat sea urchins.) Point out that otters are a keystone species. Discuss what this means. **Ask:** *What would happen to this ecosystem if the otters disappeared?* (The ecosystem will fall apart.) *Why?* (Without the otters, sea urchins would eat the anchors off of all of the kelp. The kelp forest would disappear. Animals that eat kelp would have no food. Those that depend on kelp for protection would struggle to survive in the open ocean environment.) Discuss various scenarios for how the amount of kelp in a kelp forest affects the levels of urchins and sea otters in the ecosystem.

ELABORATE

Find Out More

Remind students that the article introduced them to two different types of kelp: giant kelp and bull kelp. As a class, compare and contrast these two different species of seaweed. Instruct students conduct research to learn more about how and where the two types of kelp grow.

Extend Your Thinking About Kelp

Inform students that the kelp forest they read about in the article is located in the Monterey Bay National Marine Sanctuary. Find this location on a map. As a class, 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.

- *How is kelp able to make its own food?* (Gas sacs cause the blades to rise to the surface. They use sunlight to conduct photosynthesis and make their own food.)
- *What would happen to a kelp forest if there were no otters. Why?* (If there were no otters, there would be too many sea urchins. They would destroy the kelp forest and it would disappear.)
- *Why do scientists study kelp forests?* (to make sure they're healthy)

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						
Predicted Definition						
Sentence						
Definition from the Article						
Sentence						

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

Define		Identify
	Word	
Examine		Connect

COMPREHENSION CHECK: Kelp Kingdom

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

1. Which organism is a keystone species in a kelp forest?

- A seal
- B otter
- C sea urchin

2. What type of organism is kelp?

- A producer
- B consumer
- C decomposer

3. Which part of kelp connects to the blade?

- A stem
- B gas sac
- C holdfast

4. What do kelp forests give to the organisms that live there?

- A water and carbon dioxide
- B sunlight and heat
- C food and shelter

5. Explain the connection between otters, sea urchins, and the health of a kelp forest.

Robot Revolution

LANGUAGE ARTS

Objectives

- Students will recognize how vocabulary words are connected.
- Students will recognize explicit statements and draw inferences from a text.
- 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 human problems or meet specific needs.

BUILD VOCABULARY AND CONCEPTS

- caregiver robot
- humanoid robot
- robot
- sensor
- 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 this article is about different types of robots that people have created to solve problems or meet specific needs.

Tell students that as they read, they will come across many facts that are stated clearly in the text. But they will also encounter clues that require them to make inferences. To do this, they must combine what the text says with what they know to reach a logical conclusion.

Display pages 10-11 of the projectable magazine. Read the text aloud. Then identify explicit statements within the text. **Say:** *As I read this text, one thing becomes clear. It was a bad day. The writer even states that in the first sentence. Then he gives examples. The robot responds. The writer says that, too.*

Tell students, however, that some ideas aren't so clear. To interpret this information, readers must examine the clues and make inferences.

Say: *The first paragraph says that it was a lousy day and tells what happened. Although the text doesn't come right out and say it, I can make an inference that the person is upset. Most people would be upset if all of this happened to them in one day.*

Inform students that the second paragraph also requires the reader to make an inference. **Say:** *This paragraph tells about all of the things the robot did to make the person feel better. A robot is a machine. People build machines. I can infer that someone programmed the robot to have this response. I can also infer that the robot would have responded differently if the person had felt happy that day.*

Give each student a copy of the **Language Arts Assessment Master**. Have students read the article on their own. As they do, instruct them to write one explicit statement and make one inference about a robot mentioned in the article.

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.

- **Make Inferences** Remind students that an inference isn't a wild guess. It's a logical conclusion based on information in the text. **Say:** *Writers want readers to understand any inferences they make, so they try to leave a clear path of clues for readers to follow.* Have students share their **Language Arts Assessment Masters** with a partner to evaluate the validity of each inference students made. If any inferences are questionable, encourage partners to reread the article to search for more clues.

- **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 humanoid robots 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.

- *Which type of robot do you think is the most helpful? Why?*
- *Why aren't all robots humanoid robots?*
- *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

Give each student a piece of plain white paper. Instruct students to draw a Venn diagram. Then assign each student a partner. Tell pairs to each select two robots in the article. Tell them to compare and contrast the two robots in as many ways as they can. Encourage students to review the article for details about the robots they selected. Recommend that they use their **Content Assessment Masters** as well. Invite pairs to present their 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 Humanoid Robots

Remind students that a humanoid robot is a robot that looks like a human in some way. Have students review the article's photos in their magazines. As a class, identify which robots have human traits. Challenge students to explain how the human traits help the robots solve the problems they were designed to solve.

EVALUATE

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

- *What is a robot?* (a machine that performs human tasks or imitates human actions)
- *What helps robots detect or measure a physical property and record or respond to it?* (sensors)
- *Which robot in the article is designed to look like an animal?* (Paro)

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

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.

<p>Word:</p> <p>Definition:</p>

<p>Explanation:</p>

LANGUAGE ARTS ASSESSMENT: Robot Revolution

Write an explicit statement and make an inference about each robot in the article.

Explicit Statements	
1.	
2.	
3.	
4.	
5.	
6.	

What the Text Says	What I Already Know	Inferences I Can Make

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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?

COMPREHENSION CHECK: Robot Revolution

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

1. Which type of robot resembles people?

- Ⓐ swarm robots
- Ⓑ sensors
- Ⓒ humanoid robots

2. What does Paro do?

- Ⓐ perform surgery
- Ⓑ provide comfort
- Ⓒ lift people

3. Who uses robots like ROSA?

- Ⓐ caregivers
- Ⓑ surgeons
- Ⓒ children

4. What is the main purpose of all robots?

- Ⓐ to solve a problem
- Ⓑ to create technology
- Ⓒ to build sensors

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

Seeing Eye to Eye

LANGUAGE ARTS

Objectives

- Students will create sketches to understand the meaning of unfamiliar words.
- Students will use information in the text to explain concepts related to the sense of 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**
- **visible**
- **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 variations in eyes that cause humans and animals to see in different ways.

Tell students that asking questions is one strategy good readers use to understand a text. **Say:** *You may not realize this but when you read you are constantly asking yourself questions. Many questions begin with the same six words: Who? What? Where? When? Why? and How? Some answers are easy to find. They could be in a caption, sidebar, or the glossary. To find other answers, you might need to read the entire text.*

Inform students that finding answers is just the first step toward fully understanding what a text says. Next they must make connections between the answers they found. Only then will they fully understand the concepts related in the text.

Give each student a copy of the **Language Arts Assessment Master**. Have students read the article on their own. As they do, instruct them to select three sections from the article. Tell students to write five key questions about each section. Then have them find and record the answers. Instruct students to analyze their findings to explain one key concept related to sight.

LANGUAGE ARTS

TURN AND TALK

Have students turn and talk to discuss what they learned about eyes. **Ask:** *What's the difference between being visible and having vision?* (If something is visible it is able to be seen. If someone has vision, they have the sense of sight.) *How is the human eye like a camera?* (Both have a lens that brings an image into focus. Both have lens openings that can adjust to different levels of light. The eye sends a constant stream of images to the brain by electrical signals, just as a camera stores images.) *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.

- **Explain Concepts** After reading the article, remind students that asking questions is a strategy that people use to better understand what they're reading. Point out that the answers can usually be found somewhere in the text. Have students share their **Language Arts Assessment Masters** in small groups. Instruct students who examined the same sections to compare results. Did they ask the same questions? Did they find the same answers. If not, tell students to review the article to identify the correct response. Invite students to share their explanations of key concepts with the class. Evaluate each to make sure it contains enough information for others to fully understand the topic.

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.

- *Why do people need light to see?*
- *How are some animals' eyes different from others?*
- *What surprised you about what you read?*

Seeing Eye to Eye

SCIENCE

Objectives

- Students will understand the sense of sight.
- Students will identify the rules of light.
- Students will recognize how variations in traits affect how animals see.

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 edition. Read aloud the subhead. Point out that it states that eyes turn light into sight. **Ask:** *How do you know that this statement is true?* (You can only see when it's light out. If it's very dark, you can't see anything—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 sense of sight, identify the rules of light, and recognize how variations in traits affect how animals see.

EXPLAIN

Understand the Sense of Sight

Display the diagram of the eye on page 19 of the projectable magazine. As a class, identify each part of the eye. Review the article for information on what each part does. **Ask:** *How do the parts of the eye work together to give us the sense of sight?* (The cornea, iris, pupil, and lens work together to catch and focus light. They send light to the retina at the back of the eye. The retina sends the information to the brain, which interprets what the eyes see.)

SCIENCE

EXPLAIN

(continued)

Recognizing the Rules of Light

Inform students recognizing what the parts of the eye do is just one part of understanding sight. They must also understand the rules of light. **Say:** *Light follows certain rules. It 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.)* Encourage students to give more examples of how an object can be seen when light reflects from its surface and enters the eyes.

Recognizing Variations in 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 display the **"Light Catchers" poster**. As you review the poster, challenge students to identify unique characteristics of each eye. Then have students select three animals from the article or poster. Instruct them to explain how each animal's eyes are unique.

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.

- *What happens to light when it reflects? (It bounces off objects and is sent back to the eye.)*
- *What does light do when it refracts? (It bends.)*
- *Why do birds of prey have such great distance vision? How does this help them catch prey? (The eyes of these birds are on the front of its head and face forward. This allows both eyes to see much of the same view. The binocular vision helps them figure out distances and zero in on prey.)*

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.

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		
visible		
vision		

Name _____

Date _____

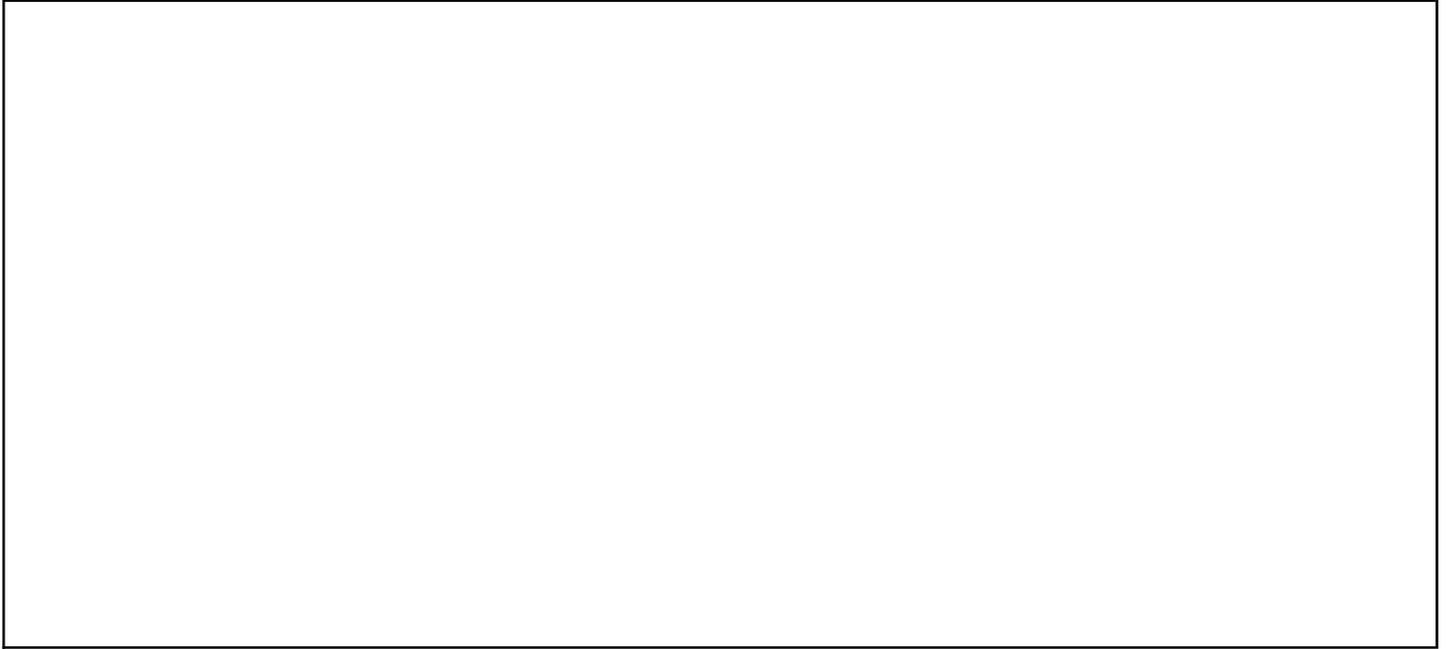
LANGUAGE ARTS ASSESSMENT : Seeing Eye to Eye

Record questions and answers about the text. Analyze the results to explain one key concept about sight..

Section	Questions	Answers
Explain		

CONTENT ASSESSMENT: Seeing Eye to Eye

Draw a diagram of an eye. Label each part.



Identify three animals from the poster or article. Tell how each animal's eyes are unique.

Identify	Explain

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 light do when it passes through a prism?
Ⓐ bounce
Ⓑ split
Ⓒ disappear

2. Why would a shirt look blue?
Ⓐ The shirt reflected blue light waves.
Ⓑ The shirt refracted blue light waves.
Ⓒ The shirt absorbed blue light waves.

3. Why would a shirt look white?
Ⓐ It reflected all light waves.
Ⓑ It refracted all light waves.
Ⓒ It absorbed all light waves

4. What allows some animals to see well at night?
Ⓐ very big eyes
Ⓑ very small eyes
Ⓒ white eyes

5. What is reflection and how does it affect what people see?

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

photosynthesis: the process of living things using sunlight to make food

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

Students' models should depict a complete kelp specimen and include labels identifying the blade, gas sac, stem/stalk, and holdfast.

Summary: Students should note that gas sacs cause the blades to float in the water. The blades rise to the surface and access the sunlight kelp uses during photosynthesis to make its own food. Gas sacs connect to the stem, which extends the length of kelp and connects to the holdfast, a tangle of wood structures that anchor kelp to the seafloor.

Comprehension Check, page 9

1. B; 2. A; 3. B; 4. C; 5: Sea urchins chew on kelp holdfasts, killing the kelp. Otters eat sea urchins. By keeping the sea urchin population in check, otters maintain a healthy kelp ecosystem.

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

humanoid robot: a robot that looks like a human in some ways

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

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 humanoid 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 should select five explicit statements, quoting directly from the text. Their inferences may vary, but should be logical and directly relate to the information in the article.

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. C; 2. B; 3. B; 4: A; 5: Answers will vary depending on which robot students select.

Pathfinder

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: to make a clear image in the eye

reflect: to send back light rays

refract: to bend light rays

visible: able to be seen

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

Answers will vary depending on which sections students select. Summaries should contain accurate information related to a key concept identified in the text.

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. B; 2. A; 3. A; 4. A; 5. Possible response: Reflection is the sending back of light rays as they bounce off a surface. The colors people see are determined by which light waves are reflected and which are absorbed.