

# TEACHER'S GUIDE

Pathfinder

Vol. 16 No. 6



## In This Guide

This guide contains language arts and science lessons for articles in this issue of EXPLORER PATHFINDER.

## Explorer Magazine

EXPLORER classroom magazines are specifically written for each grade, 2-5. Through great storytelling and stunning photographs, the EXPLORER magazines develop literacy skills and teach standards-based science content.

The EXPLORER magazines strive to offer a variety of reading experiences for students with different ability levels in the same class. Thus, all articles have been measured using the Lexile® Framework for Reading. Some articles will be easier to read than others, but all articles in EXPLORER PATHFINDER will be within the 450-850L range.

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# Quest for the Quetzal

## LANGUAGE ARTS 640L

### Objectives

- Students will predict definitions and then write sentences to better understand unfamiliar words.
- Students will explain how the writer uses reasons and evidence to support key points in the text.
- Students will use what they learned to write an opinion piece stating their views on why people should work together to help the quetzal.

### Resources

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

### Summary

- The article “Quest for the Quetzal” introduces readers to the resplendent quetzal, a beautiful bird once revered by ancient civilizations. Now, the bird struggles to survive in a changing world.

## BUILD VOCABULARY AND CONCEPTS

- **Aztec**
- **culture**
- **fragmentation**
- **Mayan**

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 8 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

Write the words reasons and evidence on the board.

**Then ask:** *What's the difference between these two words?* Invite students to share their ideas. Guide the class to understand that a reason tells why something happened. Evidence shows how.

Tell students that valid reasons and solid evidence are crucial elements of any text. Writers use them to support key points on the topic.

Display pages 2-3 of the projectable magazine. Instruct students to examine the images of the quetzal. Then invite a volunteer to read aloud the headline and text. **Say:** *Sometimes when you read an article, you have to get a paragraph or two into the text before you can identify the key point the writer is trying to make. Not here. In this article, the writer has stated his main point loud and clear in the headline: Central America's most beautiful bird needs our help. As a class, brainstorm ideas about why the quetzal might need help.*

Give each student a copy of the **Language Arts Assessment Master**. Instruct students to record the writer's main point. Have students read the article on their own. As students read, encourage them to search for reasons and evidence that support the writer's main point. Instruct them to record what they find on the top half of their worksheets.

# Quest for the Quetzal

## LANGUAGE ARTS

### TURN AND TALK

Have students turn and talk to discuss what they learned about quetzals. **Ask:** *What do quetzals look like?* (Their necks, backs, and wings have a metallic green sheen. Golden-green feathers on their heads form a bristly crest. The feathers on their chests are bright red. Males have two long tail feathers.) *Where do quetzals live?* (throughout Central America) *Why do quetzals need help?* (There are many threats, but the most serious one is loss of habitat.) Invite students to share what else they learned about quetzals.

- **Predicting Definitions** Have students turn and talk to discuss what they learned about the four 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.

- **Writing Opinions** Remind students that the writer stated that the quetzal needs our help. Guide students as they discuss the following question: How can people help quetzals? Then have students write a brief essay expressing their opinions. Instruct students to introduce the topic clearly and state their opinions in an organized way. Encourage them to use the reasons and evidence they found in the article to support their views. Tell students to begin writing on the front of their **Language Arts Assessment Masters** and finish on the back.

### 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 does the writer call the quetzal Central America's most beautiful bird?*
- *What is the quetzal's important in Central American culture?*
- *What surprised you about what you read?*

# Quest for the Quetzal

## SCIENCE

### Objectives

- Students will examine the structure and function of the quetzal's body parts.
- Students will recognize how changing habitats affect quetzals.

### Resources

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

### Science Background

The resplendent quetzal—one of the five quetzal species—is a colorful bird found in the mountainous tropical forests of Central America. Many people consider it to be one of the most beautiful birds in the world.

The quetzal has metallic green feathers on its neck, back, and wings. And its chest feathers are bright red. But the tail feathers on the male are what really make this bird stand out. During mating season, mature males can grow tail feathers that are up to a meter long.

The quetzal's beauty has not been lost on people. For thousands of years, the quetzal has held an honored place in Central American culture. Long ago, it was an important part of both Aztec and Mayan cultures. Today, it is the national bird of Guatemala.

But the bird's beauty has also made it a target. Both hunters and collectors have preyed on the bird for its beautiful feathers.

Today, the resplendent quetzal may be one of the most threatened birds of its kind. This is chiefly because as people cut trees and clear land for livestock and crops, the bird's natural habitat is disappearing. Restoring habitats or connecting those that still exist can help ensure the survival of this beautiful species.

## ENGAGE

### Tap Prior Knowledge

Instruct students to each think of a bird. Invite volunteers to describe the birds they are thinking of. Compare and contrast the results. As a class, discuss how all of the birds are alike. Challenge students to identify interesting ways that the birds are different.

## EXPLORE

### Preview the Lesson

Display pages 2-3 of the projectable magazine. Invite volunteers to describe the bird they see. **Ask:** *How is this bird different from other birds you've seen?* (Students will most likely note the bird's bright blue coloring and its very long tail feathers.) Read aloud the headline. Point out the word *quest*. **Say:** *A quest is a search. You'd think that a bird that looks like this would be easy to find.* **Ask:** *Why do you think people have to search to find it?* Invite students to share their ideas. Tell students that they will learn more about the bird and its plight as they read the article.

### Set a Purpose and Read

Have students read the article in order to examine the structure and function of the quetzal's body parts and to understand how changes to a habitat can affect quetzals.

# Quest for the Quetzal

## SCIENCE

### EXPLAIN

#### Examine the Quetzal's Body Parts

Display page 4 of the projectable magazine. Invite volunteers to read aloud the section "1524, Guatemala." Then read aloud the first paragraph of the next section, "A Stunning Bird." **Ask:** *Do you think this is the real reason that quetzal's have red feathers on their chests. (no) Why? (It's just a story.)* Zoom in on the last paragraph of the section. **Say:** *Quetzals hide their chests when they sense danger. So they must be aware of the bright red feathers.* **Ask:** *What do you think is the real purpose of these feathers?* Invite students to share their ideas. Then display page 5 of the projectable magazine. **Say:** *Every part of an animal's body has a function. These tail feathers do, too.* **Ask:** *What is their function?* (They help male birds attract females.) Give each student a copy of the **Content Assessment Master**. Instruct students to draw a picture of a male quetzal and then tell how they think a male's tail feathers help it attract females.

#### Recognize the Impact of Changing Habitats

Display pages 8-9 of the projectable magazine. Have students review the text in small groups. Rejoin as a class and **ask:** *What have people done to destroy the quetzal's habitat? (cut down trees and cleared land) Why is this a problem? (Areas where quetzals live are separated from each other, making it hard for them to find food or mates.) What can people do to help? (Connect the habitats.)* Discuss other things people can do to help the quetzal survive.

### ELABORATE

#### Find Out More

Display pages 6-7 of the projectable magazine. As a class, review how quetzals have been celebrated in Central American cultures throughout time. Divide the class into small groups. Instruct groups to conduct research. Challenge them to find additional examples that show how quetzals are honored in Central America.

#### Extend Your Thinking About Quetzals

Remind students that the quetzal is legally protected in Mexico, Guatemala, Costa Rica, and Panama. Even so, people do things that harm them every day. People cut trees and clear land. This destroys the quetzal's habitat. Some people hunt the birds for their feathers or as food. Others capture them to sell as pets. As a class, discuss the importance of protecting species like the quetzal. Guide students to understand that people's actions can have long-term consequence on nature.

### EVALUATE

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

- *What is fragmentation and how does it harm quetzals?* (Fragmentation is the division of large, continuous habitats into smaller, more isolated places. It causes quetzal habitats to become separated from each other. This makes it hard for the birds to find food or mates.)
- *Which ancient cultures included the quetzal as an important part of their cultures?* (Aztec and Mayan)
- *How long can a male quetzal's tail feathers grow?* (up to a meter in length)

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

**VOCABULARY ASSESSMENT: Quest for the Quetzal**

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

Word				
Predicted Definition				
Sentence				
Definition from the Article				
Sentence				



**LANGUAGE ARTS ASSESSMENT: Quest for the Quetzal**

Record the writer's main point. Record reasons and evidence that support that point.

Main Point	
Reasons	Evidence

How do you think people can help quetzals? Write about it.  
Use what you learned to support your opinion.

Date \_\_\_\_\_

Draw a picture of a male quetzal. Tell how you think the male's tail feathers help it attract females.

## Write

[illegible]



**COMPREHENSION CHECK: Quest for the Quetzal**

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

1. Where might you find a quetzal?  
☐ A Canada  
☐ B Honduras  
☐ C Argentina
  
2. What do you know when you see a quetzal with long tail feathers?  
☐ A It is very old.  
☐ B It can't fly.  
☐ C It is male.
  
3. How does fragmentation affect quetzal habitats?  
☐ A It brings them together.  
☐ B It splits them apart.  
☐ C It rebuilds them.
  
4. Which country named the quetzal as its national bird?  
☐ A Mexico  
☐ B Panama  
☐ C Guatemala
  
5. Identify one way people harm quetzal habitats. Identify one way they help restore them.

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# Out on a Limb

## LANGUAGE ARTS 670L

### Objectives

- Students will identify and explain connections between vocabulary words.
- Students will interpret and explain information visually, orally, and quantitatively to quickly answer questions about the text.

### Resources

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

### Summary

- The article "Out on a Limb" examines trees, exploring both the life cycle of trees and how trees use photosynthesis to survive.

## BUILD VOCABULARY AND CONCEPTS

- carbon dioxide
- leaf
- oxygen
- photosynthesis
- root
- seed

Display the Wordwise section on page 17 of the projectable magazine. Invite volunteers to read aloud the words and their definitions. Encourage students to share what they know about each word.

Give each student a copy of the **Vocabulary Assessment Master**. Instruct students to record each word and its definition. Have them think about how the vocabulary words are related. Tell them to record five connections they see. For example: Roots, seeds, and leaves are all parts of plants.

After reading the article, divide the class into small groups. Have students share the connections they predicted before reading the article. Instruct them to reevaluate each connection based upon what they have learned. If necessary, have students rewrite their ideas to more accurately reflect connections between different vocabulary words.

### READ

Display pages 2-3 of the projectable magazine. Tell students to look at the photo. **Say:** *When people read, they usually focus on the words. But photos can tell you a lot, too. For example, when I look at this photo, I see a plant with a lot of limbs. If the photographer was lying on the ground when this photo was taken, this could be a close-up image of a bush. But if you look closely at the center of the photo, you'll find a clue that tells you that isn't the case. There are people in this photo—and they look really small. This plant isn't a bush. It's a giant tree!* **Ask:** *What else can you learn by looking at the photo?* Encourage students to share their ideas

Inform students that the purpose of this article is to teach them about trees. They will learn all about a tree's life cycle as well as how trees use photosynthesis to survive. **Say:** *As you read, you'll learn much about trees from the text. But you'll get information from photos, captions, diagrams, and other items in an article, too. That information can quickly answer some of the questions you have.*

Give each student a copy of the **Language Arts Assessment Master**. Review the questions on the worksheet with the class. Then have students read the article on their own. As they do, instruct them to record each answer and find four additional facts about trees. Tell students to record where they found each answer or fact in the article.

## LANGUAGE ARTS

### TURN AND TALK

Have students turn and talk to discuss what they learned about trees. **Ask:** *How are evergreens different from other trees?* (Their leaves are green needles. Their seeds grow in cones.) *How can you figure out a tree's age?* (Count the rings in its trunk.) *Why would the article call plants "food factories?"* (Plants make their own food.) Invite students to share what else they learned about trees.

- **Finding Connections** Explain to students that reading definitions tells people what words mean. But readers can get a more thorough understanding if they recognize how words are connected. Point out that this is exactly what they did when they wrote sentences about the vocabulary words in the article. Instruct students to turn and share the sentences they wrote on their **Vocabulary Assessment Masters** with a partner. Tell them to discuss similarities and differences in their sentences to get an even deeper understanding of the vocabulary words.

- **Interpreting Information** After reading the article, remind students that articles contain much more than text. They often contain photos, diagrams, captions, and other text elements, too. These text elements usually highlight important points in the text. Because of that, readers can often find answers to questions more quickly if they study the text elements on the page. Have students share their **Language Arts Assessment Masters** in small groups. Instruct students to compare the answers they recorded for each question. If their answers differ, suggest that they revisit the text they elements identified as sources and reevaluate their responses.

### 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 tree featured in the article did you like best? Why?*
- *How does a dead tree bring new life to a forest?*
- *What surprised you about what you read?*

## SCIENCE

### Objectives

- Students will identify the structure and function of a tree's parts.
- Students will understand the process of photosynthesis.
- Students will recognize that trees are a very diverse group of organisms.

### Resources

- Content Assessment Master (page 16)
- "Solar Powered!" poster (Teacher's Edition)
- "Tree Tales" poster (Teacher's Edition)
- Comprehension Check (page 17)
- Out on a Limb" Interactive Whiteboard (optional)

### Science Background

A tree is a type of plant with a woody stem. As the stem grows, it turns into a trunk. The trunk is covered with a protective layer of bark. This allows the tree to live for a long time.

Most trees grow from seeds, and there are two main types of trees that produce seeds: gymnosperms and angiosperms. Gymnosperms grow seeds inside cones. Angiosperms produce flowers. The flowers grow into fruits, which are full of seeds.

All trees have the same basic parts: roots, trunk, branches, bark, and leaves. Roots bring up water and nutrients from the soil. They also anchor the tree into the ground. Branches and the trunk provide additional support. They also create a network for the tree to transport water and nutrients up from the roots. Bark provides protection. And the leaves are where the tree makes its own food.

The process in which a tree or other plant makes food is called photosynthesis. During photosynthesis, the leaves use the energy from sunlight to combine water and carbon dioxide. This reaction creates sugar and oxygen. The sugar provides energy so the tree can live.

## ENGAGE

### Tap Prior Knowledge

Write the word "tree" on the board. Select volunteers, one student at a time, to say the first word they think of when they see that word. Invite another volunteer to record each response. After you've accumulated at least 10 responses, lead a class discussion. Using the recorded words as a base, encourage students to expand upon their prior knowledge of trees.

## EXPLORE

### Preview the Lesson

Display pages 12 of the projectable magazine. Zoom in on the four images of the tree parts. **Ask:** *What tree part or parts do you see in each photo?* (leaf and seed, branches and trunk, bark, roots) *Do all trees have these parts?* (yes) *Do the parts look the same on every single tree?* (no) *Why?* (There are many different kinds of trees. The parts on each kind of tree look different.) Tell students that they'll learn more about what tree parts look like and what they do as they read the article.

### Set a Purpose and Read

Have students read the article to identify the structure and function of a tree's parts, understand the process of photosynthesis, and recognize that trees are a very diverse group of organisms.

### EXPLAIN

#### Identify Structure and Function

Display page 12 of the projectable magazine. Zoom in on the introduction. Invite a volunteer to read aloud the second paragraph. **Ask:** *What tree parts are named in this paragraph?* (roots, leaves, bark, branches, trunks) As a class, match each part to the correct photo below the text. Discuss the structure of each part and what each part does to help the tree survive. **Say:** *This paragraph names several tree parts. And it gives a quick summary of what each part does. But it doesn't tell you everything there is to know about these parts.* In small groups, have students review the article to find additional information about the structure and function of each plant part.

#### Understand Photosynthesis

Display page 12 of the projectable magazine. Zoom in on the diagram. Discuss what happens during the process of photosynthesis. Then display the **"Solar Powered!" poster**. Invite volunteers to read aloud the information in the box as you review the diagram on the poster. **Ask:** *What did you see in the diagram in the article that you don't see on the poster?* (The diagram shows that water enters the leaf and sugar exits the leaf. The poster does not.) *What did you learn on the poster that wasn't shown in the article?* (Chlorophyll is a pigment that traps sunlight; There are small holes in leaves; Roots take in water from the soil; When carbon dioxide and water combine, using energy from the sun, a reaction takes place; Sugar is the plant's food.) Give each student a copy of the **Content Assessment Master**. Challenge students to create their own original diagrams to illustrate the process of photosynthesis.

#### Recognize Diversity in Trees

Display the **"Tree Tales" poster**. Invite students to read aloud the blocks of text. Discuss how the parts of each tree are unusual. Review the article as a class. Invite volunteers to identify and describe other trees with unusual parts. Discuss reasons why all trees are alike but also different. (They have the same parts. The parts have different structures and functions.)

### ELABORATE

#### Find Out More

Display pages 16-17 of the projectable magazine. Point out to students that the trees shown here are just three examples of trees with unusual parts. Divide the class into small groups. Instruct groups to conduct research to identify more trees with unusual parts. Challenge students to find photos and write captions describing the unusual parts of each tree they find.

#### Extend Your Thinking About Trees

Display page 15 of the projectable magazine. As a class, discuss reasons why location and availability of sunlight, water, and nutritious soil would be critical for trees to grow this big. Discuss the impact a changing climate could have on the trees.

### EVALUATE

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

- *What is oxygen?* (a gas in the air that humans and animals need to breathe)
- *Where does oxygen come from?* (It is released from leaves as they conduct photosynthesis.)
- *What else happens during photosynthesis?* (Leaves take in water, carbon dioxide, and sunlight. They produce sugar and oxygen.)

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: Out on a Limb**

Record each vocabulary word and its definition.

Word	Definition

Write five sentences to tell how different words are connected.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

**LANGUAGE ARTS ASSESSMENT: Out on a Limb**

Answer each question about trees. Record where you found the information in the article.

	Answer	Source
What happens during the life cycle of an evergreen?		
What is a nurse log?		
Why is the sun important to trees?		
List four other facts you learned about trees.	1.  2.  3.  4.	1.  2.  3.  4.

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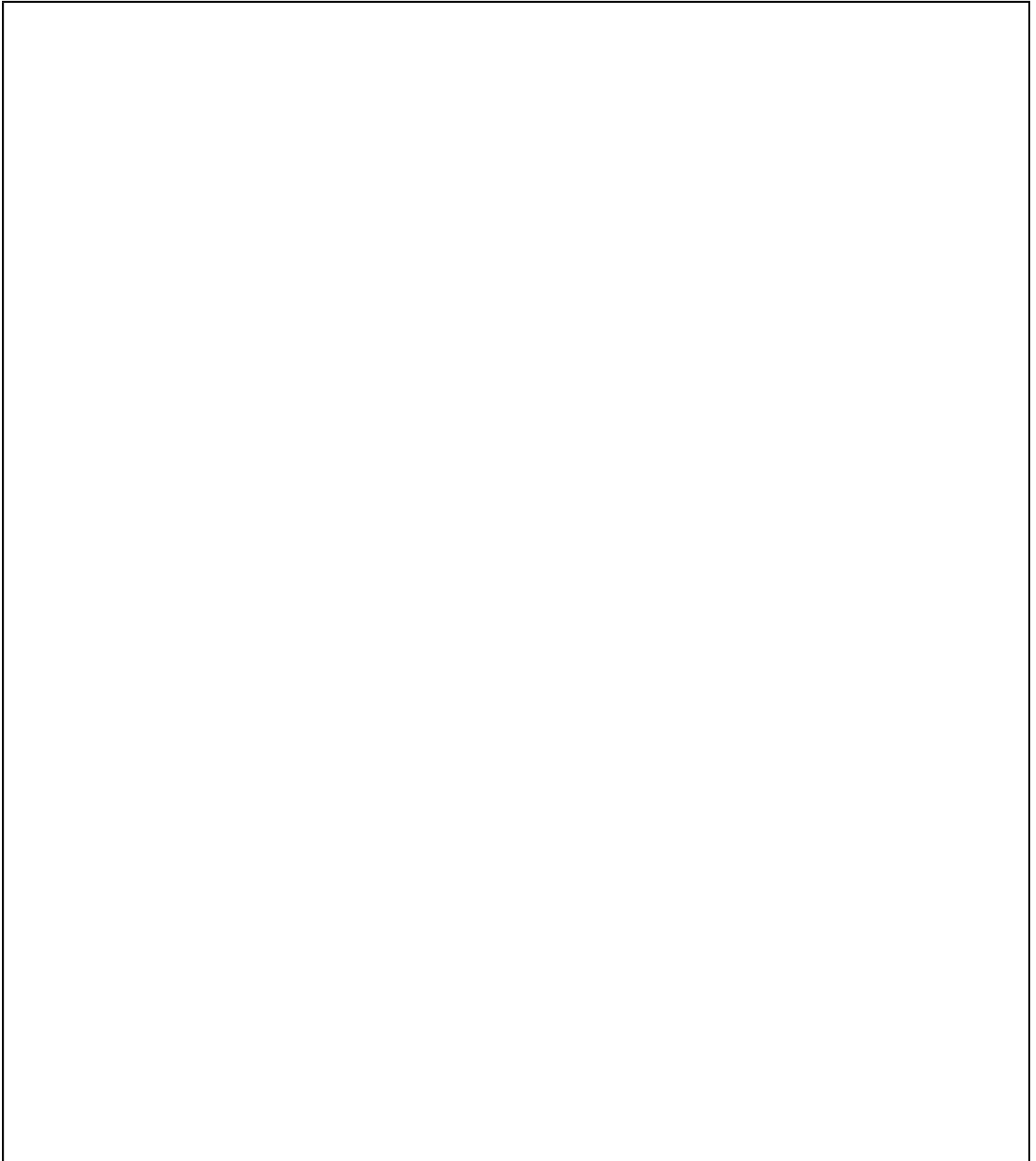


Name \_\_\_\_\_

Date \_\_\_\_\_

## CONTENT ASSESSMENT: Out on a Limb

Create an original diagram that shows the process of photosynthesis.



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**COMPREHENSION CHECK: Out on a Limb**

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

1. Where do leaves get the water they use during photosynthesis?

- Ⓐ The leaves absorb rain.
- Ⓑ Roots pull up water from the soil.
- Ⓒ The plant makes water in its trunk.

2. Which tree part can grow hundreds of meters tall?

- Ⓐ a leaf
- Ⓑ a seed
- Ⓒ a trunk

3. What do chloroplasts absorb?

- Ⓐ sunlight
- Ⓑ sugar
- Ⓒ oxygen

4. Where are chloroplasts located?

- Ⓐ in leaves
- Ⓑ in roots
- Ⓒ in trunks

5. Explain how plants make their own food.

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# Signs of Life?

## LANGUAGE ARTS 610L

### Objectives

- Students will assess their familiarity with and knowledge of vocabulary words.
- Students will use a variety of techniques to strengthen their understanding of content-related academic terms.

### Resources

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

### Summary

- The article “Signs of Life?” introduces students to National Geographic Young Explorer Joe Cutler, who braves the wilds of west Africa in search of new species of fish.

## BUILD VOCABULARY AND CONCEPTS

- **aquatic invertebrate**
- **crater lake**
- **ichthyologist**
- **speciation**

As a class, discuss the difference between familiarity and knowledge. Guide students to recognize that the more familiar you are with something, the more knowledge you have. Challenge students to explain how this concept applies to words when they read.

Display the vocabulary words on a word wall or on the whiteboard. Give each student a copy of the **Vocabulary Assessment Master**. Instruct students to write each word on their papers. Review the categories under the header “Familiarity with the Word.” Tell students to make a checkmark to indicate how well they know each word.

Instruct students to write what they think each word means on their worksheets. Then display the Wordwise feature on page 22 of the projectable magazine. Have students write those definitions on their worksheets and compare them with the definitions they wrote.

### READ

Inform students that in this article, they will trek through the wilds of west Africa with National Geographic Young Explorer Joe Cutler. Cutler is exploring crater lakes in Cameroon. He is searching for new species of fish. Point out that in order to understand the details of Cutler's work, readers must understand certain scientific terms.

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: writing definitions, identifying parts of speech, recording facts, and making connections between vocabulary words.

Display the Wordwise feature on pages 22-23 of the projectable magazine. Highlight the word *aquatic invertebrate*. Instruct students to write the word *aquatic invertebrate* in the center box on one of their word diagrams. Then have them record its definition. Instruct students to scan the article to locate the bold term *aquatic invertebrate* in the text. (page 23, column 2) Highlight the word on the screen.

Model how to explore the word's meaning. **Say:** *Identifying the part of speech for this vocabulary word might seem confusing because it contains two words. But if you look at the definition, it's pretty easy to figure out. The definition says an aquatic invertebrate is a type of small animal. An animal is a thing, and I know that all things are classified as nouns. Instruct students to write *noun* in the “Part of Speech” section of their diagrams.*

Invite a volunteer to read aloud the paragraph in which *aquatic invertebrate* appears. Point out that the paragraph reveals two important facts: 1) There are thousands of different kinds of aquatic invertebrates and 2) They all live in water. Have students record these facts. Then have them read the article on their own. Instruct them to explore the remaining vocabulary words. Then challenge students to use what they learned to make logical connections between the vocabulary words.

## LANGUAGE ARTS

### TURN AND TALK

Have students turn and talk to discuss what they learned about Joe Cutler and his search for new fish species. **Ask:** *Why did Cutler want to search for fish in the west African lakes?* (Nobody had ever studied most of the lakes before.) *Why did he expect to find new species of fish?* (Most of the lakes are completely isolated from each other. They could have developed their own species.) *Why did he want to study the lakes sooner rather than later?* (None of the lakes are protected and many are threatened by human encroachment. He thought that if he could teach people about the organisms living in the lakes, they might want to protect them.) Encourage students to share other facts they learned about Cutler's expedition as they read the article.

- **Strengthen Understanding** Say: *Once you understand what a word means, it's easier to use it correctly in a sentence. A little bit of background knowledge is all you need.* Challenge students to make accurate statements using each of the vocabulary words. Encourage them to use their two vocabulary worksheets as resources. But remind them to be original. Students shouldn't restate sentences from the article. They should create new sentences of their own.

- **Explain Concepts** 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 how different features form inside caves. Prompt discussion with questions such as: *What is speciation? Why would a scientist be interested in speciation? How could speciation impact what lives in an isolated lake?*

### 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 an ichthyologist?*
- *Cutler found fish in some of the lakes he studied but not in others. Why do you think that happened?*
- *What surprised you about what you read?*

## SCIENCE

### Objectives

- Students will understand how crater lakes form.
- Students will understand why crater lakes can contain unique biodiversity.

### Resources

- Content Assessment Master (page 24)
- Comprehension Check (page 25)

### Science Background

National Geographic Young Explorer Joe Cutler is a Ph.D. student at the University of California, Santa Cruz. He is an ichthyologist who studies speciation. Or, in other words, he's a scientist who studies fish and specializes in the development of new species.

In 2015, Cutler traveled to the remote volcanic crater lakes found in the southwest region of Cameroon. His quest was to develop a baseline of the area for further scientific study. He also hoped to identify any endemic species that might have developed in the isolated lakes.

Over a six month period, Cutler collected samples from both crater lakes and rivers. He ended up with more than 3,500 fish specimens, representing more than 80 different species. He also collected about 10,000 aquatic invertebrates. Cutler's work is the most extensive scientific study ever conducted in this part of the world.

## ENGAGE

### Tap Prior Knowledge

Tell students to imagine that they're going on a field trip to study fish. The fish are in a lake. Poll the class to see how many students would want to go on a field trip like this. Then tell the class that in order to get to the lake, they have to hike through a jungle and wade through water that's filled with blood-sucking leeches. Poll the class again. Did the numbers go down? Discuss reasons why a scientist might undertake a trip like this to get to a specific lake where he could study fish.

## EXPLORE

### Preview the Lesson

Display pages 18-19 of the projectable magazine. Point out the photo of the man. **Say:** *This photo shows Joe Cutler. He is the National Geographic Young Explorer who wrote this article.* Invite a volunteer to read aloud the headline and text. **Ask:** *Why did Cutler go through all of this to find fish?* (He was looking for new species of fish.) Brainstorm ideas about why he might have thought he could find new species of fish in western Africa.

### Set a Purpose and Read

Have students read the article in order to understand how crater lakes form and why crater lakes can contain unique biodiversity.

## EXPLAIN

### How Crater Lakes Form

Display pages 20-21 of the projectable magazine. Instruct students to examine the two lakes in the photo. Explain to students that crater lakes are formed by volcanic explosions. **Ask:** *What shape is a volcano's crater?* (round) *What shape are these lakes?* (round) Discuss how the lakes could form over time as the craters fill with water. Challenge students to also explain why most of the lakes are isolated from each other. (The tops of the volcanoes don't touch, so neither do the crater lakes that form in them.)

# Signs of Life?

## SCIENCE

### EXPLAIN

(continued)

#### Why Crater Lakes Are Biodiverse

Continue displaying the photo of the two crater lakes on pages 20-21 of the projectable magazine. Point out that these two lakes are not touching. Because of how they formed, they never have touched and they never will. **Say:** *Some animals, such as frogs or insects, could travel between the lakes. But fish live in water. There is no way for a fish in one of these lakes to swim over to the other.* **Ask:** *Knowing that, why do you think Joe Cutler came to these lakes hoping to find new species of fish?* [The lakes are self-contained. It's quite possible that new species developed in the lakes. Unable to spread, it's also possible that a species found in one of these lakes is not found anywhere else in the world.] Give each student a copy of the **Content Assessment Master**. Instruct students to draw pictures to show how a crater lake forms, how it fills with water, and how it becomes home to new species of fish. Tell them to write a caption for each picture.

### ELABORATE

#### Find Out More

Remind students that Joe Cutler is an ichthyologist, or a scientist who studies fish. Point out that in the article he identifies several pieces of equipment that he uses to do his work, such as cameras, gill nets, dip nets, traps, and a jug of ethanol. Instruct students to conduct research to learn more about these supplies and how Cutler may have used them. Challenge them to identify additional supplies an ichthyologist might have taken on a trip like this.

#### Extend Your Thinking About Communication

Explain to students that scientists don't just collect and analyze data. They also communicate their results. That's how people learn more about nature. Point out that this article is one way Joe Cutler communicated the results of his expedition. Brainstorm ideas about other ways he could teach others what he learned.

### EVALUATE

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

- *What is a crater lake?* (a body of water filling a circular, steep-sided volcanic crater)
- *What is speciation?* (the formation of new species)
- *What did Cutler find in the crater lakes besides fish?* (frogs, dragonflies, diving birds, freshwater shrimp, and crabs)

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

Name \_\_\_\_\_

Date \_\_\_\_\_

VOCABULARY ASSESSMENT: Signs of Life?

Record information from the article about each vocabulary word.

Word	Familiarity with the Word			Knowledge of the Word	
	I know the word very well.	I've seen or heard the word before.	I don't know the word.	What I think the word means:	How the article defines the word:



**LANGUAGE ARTS ASSESSMENT: Signs of Life?**

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

<b>Definition</b>	<b>Part of Speech</b>
<div>Word</div>	
<b>Connections</b>	<b>Facts</b>

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Name \_\_\_\_\_

Date \_\_\_\_\_

**CONTENT ASSESSMENT: Signs of Life?**

Draw pictures to show how crater lakes form, fill with water, and become homes to new species of fish. Write a caption for each picture.

Captions		
Pictures		

**COMPREHENSION CHECK: Signs of Life?**

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

1. Where did Joe Cutler go to study fish?  
☐ Ⓐ Europe  
☐ Ⓑ Africa  
☐ Ⓒ Asia
2. Why did he want to study crater lakes?  
☐ Ⓐ There were lots of fish in the lakes.  
☐ Ⓑ The lakes are remote.  
☐ Ⓒ No scientists had ever studied some of these lakes.
3. What did Cutler discover after he studied crater lakes?  
☐ Ⓐ There were no fish in some of the lakes.  
☐ Ⓑ The lakes were formed by volcanic explosions.  
☐ Ⓒ The lakes are in Cameroon.
4. Which of these statements is true?  
☐ Ⓐ The crater lakes form an ecosystem.  
☐ Ⓑ Crater lakes are long and narrow.  
☐ Ⓒ Crater lakes contain no living organisms.

5. Explain how crater lakes form.

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## ANSWER KEY

### Quest for the Quetzal

#### Assess Vocabulary, page 6

Students' predictions and the sentences they write will vary. They should record the words and definitions from the Wordwise feature on page 8.

**Aztec:** American Indian people dominant in Mexico before the Spanish conquest of the 16th century

**culture:** the customs, beliefs, laws, and ways of living that belong to a people

**fragmentation:** the division of large, continuous habitats into smaller, more isolated pieces

**Mayan:** American Indian people inhabiting southeast Mexico, Guatemala, El Salvador, Belize, and Honduras whose civilization reached its height around AD 300-900

#### Assess Language Arts, page 7

Main point: Central America's most beautiful bird needs our help. Reasons and evidence may vary, but students should note that quetzals are threatened because of disappearing habitat, fragmentation, predators, and people who hunt and collect them. Students should use the reasons and evidence they listed to support their opinions.

#### Assess Content, page 8

Students' drawings should resemble the photos of quetzals in the article. Explanations will vary. Students may choose to write a logical account based on facts in the article. Or they may choose to write a mythical explanation, such as the one in the introduction.

#### Comprehension Check, page 9

1. B; 2. C; 3. B; 4. C; 5: Students may note that people harm quetzal habitats when they chop down trees or clear land for livestock and crops. They may note that people can help if they create wildlife preserves and national parks to connect quetzal habitats.

### Out on a Limb

#### Assess Vocabulary, page 14

Students should record the words and definitions from the Wordwise feature on page 17.

**carbon dioxide:** a gas, made up of carbon and oxygen, that is present in the air

**leaf:** the main part of a plant needed for photosynthesis

**oxygen:** a gas in the air that humans and animals need to breathe

**photosynthesis:** the process of plants using sunlight to make their own food

**root:** the part of a plant that attaches it to the ground and draws water and nutrients from the soil

**seed:** a part of a plant from which a new plant can grow

Sentences will vary depending on the connections students identify.

#### Assess Language Arts, page 15

**1. Answer:** Pollen from male cones is carried by wind to female cones. Seed are produced. The cone opens and seeds fall to the ground. They sprout and grow into seedlings, which grow into evergreen trees. These trees produce cones and the cycle starts again. **Source:** section "Circle of Life," p. 12

**2. Answer:** A nurse log is the trunk of a fallen tree on which new trees sprout. **Source:** section "Life After Death," p. 12

**3. Answer:** The sun is important to trees because they use its light during photosynthesis, the process in which they make their own food. **Source:** section "Solar Power," p. 14

Students' facts will vary but should come from the article. A source should be cited for each.

#### Assess Content page, 16

Diagrams should resemble but not be exactly like those on page 14 of the article or the "Solar Powered!" poster.

#### Comprehension Check, page 17

1. B; 2. C; 3. A; 4. B; 5: Students should outline the process of photosynthesis. Plants take in water, oxygen, and sunlight. They produce oxygen and sugar, which is their food.

(continued)

### Signs of Life?

#### Assess Vocabulary, page 22

Students should record the vocabulary words from the Wordwise feature on page 22, make checkmarks to show how familiar they are with each word, and write definitions in their own words. Then they should record the definitions from the article.

**aquatic invertebrate:** small animals, such as insects, crustaceans, mollusks, and worms that live in water

**crater lake:** a body of water filling a circular, steep-sided volcanic crater

**ichthyologist:** a person who studies fish

**speciation:** the formation of new species

#### Assess Language Arts, page 23

Students should record words and definitions from the Wordwise feature on page 22 of the article. (see above) They should recognize that all four words are nouns. They should record facts about each word and then identify logical connections between the vocabulary words.

#### Assess Content, page 24

Students show draw pictures showing a volcano with a circular crater exploding, the crater filling with water, and a new species of fish developing in the crater lake. Captions should explain what is happening in each picture.

#### Comprehension Check, page 25

1. B; 2. C; 3. A; 4: A; 5: Volcanic explosions form circular craters. Over time, the craters fill with water. Students may add that unique life forms can develop in the craters.