

In This Guide

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

Explorer Magazine

EXPLORER classroom magazines are written for each grade, 2-5. Through great storytelling and stunning photographs, the magazines develop literacy skills and teach standards-based content aligned with the Common Core State Standards (CCSS), Next Generation Science Standards (NGSS), or National Council for the Social Studies (NCSS). The activity on the magazine's back cover is tailored to the NG Learning Framework. (see page 2)

EXPLORER magazines offer engaging reading opportunities for students with different ability levels in the same class. All articles have been measured using the Lexile® Framework for Reading. Articles in EXPLORER PATHFINDER will be within the 450-850L range.

For additional resources to extend your students' learning, visit EXPLORER's website, natgeo.org/explorermag-resources.

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INTRODUCTION

BACKGROUND

Since 1888, the National Geographic Society has funded scientists and explorers and shared their findings with the world. To support educators who use our resources, we have created a Learning Framework, which lays out what we believe students should learn from their experiences with the Society.

PURPOSE

The Learning Framework was designed to convey the Society's core beliefs and values. It is built around a set of attitudes, skills, and knowledge that embody the explorer mindset.

To determine the learning outcomes within the Learning Framework, we dug deep into national standards in key subject areas. We also sought advice from subject matter and child development experts, along with the combined expertise of NG instructional designers, researchers, and content developers. To learn more, go to: <https://www.nationalgeographic.org/education/learningframework/>.

IMPLEMENTATION

Each article in this magazine has a knowledge-based link to the Learning Framework. Students will use the skills and attitudes as they do the activity on the back cover. The activity relates to the article "Clever Levers."

MINDSET OF AN EXPLORER

KEY FOCUS AREAS



Attitudes

National Geographic kids are:

CURIIOUS about how the world works, seeking out new and challenging experiences throughout their lives.

RESPONSIBLE, with concern for the welfare of other people, cultural resources, and the natural world. NG kids are respectful, considering multiple perspectives, and honoring others regardless of differences.

EMPOWERED to make a difference. NG kids act on curiosity, respect, and responsibility. They are adventurous and persist in the face of challenges.



Skills

National Geographic kids can:

OBSERVE and document the world around them and make sense of those observations.

COMMUNICATE experiences and ideas effectively through language and media. They are storytellers!

COLLABORATE with others to achieve goals.

SOLVE PROBLEMS by generating, evaluating, and implementing solutions after identifying alternatives, weighing trade-offs, and making well-reasoned decisions.



Knowledge

National Geographic kids understand:

THE HUMAN JOURNEY is all about where we have been, where we live now (and why), and where we are going.

OUR CHANGING PLANET encompasses all that coexists on our planet—interconnected through systems that generate and nurture each other.

WILDLIFE AND WILD PLACES inhabit our planet—from the butterflies in our backyards to the lions in Africa.

Standard Supported

- Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (CCSS.RI.4.3)
- Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (CCSS.W.4.1)

Resources

- Vocabulary Assessment Master (page 7)
- Language Arts Assessment Master (page 8)

Summary

- The article "Pollination Nation" introduces students to unusual pollinators that are keys to keeping some flowering plants alive.

BUILD VOCABULARY AND CONCEPTS

- **anther**
- **nectar**
- **ovule**
- **pistil**
- **pollen**
- **pollinate**
- **pollinator**
- **stamen**

Display the vocabulary words on page 9 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. Discuss how the words are related. For example, the anther is at the top of the stamen. Have students write four sentences telling how the words are connected, using two or more vocabulary words in each sentence.

After reading the article, divide the class into small groups. Instruct students to share the connections they predicted. If necessary, have them revise their responses based on what they've learned.

READ

Inform students that the purpose of this article is to examine pollination and introduce them to some unusual pollinators that are keys to keeping some flowering plants alive.

Display pages 2-3 of the projectable magazine. Give students a few minutes to examine the photo and describe what they see. Then invite a volunteer to read aloud the headline and text. Challenge students to explain how the text and photo are connected. (The bee is pollinating the flower. And pollination is necessary for flowering plants to reproduce.) Then read aloud the comprehension strategy in the upper right corner. **Say:** *The text explains why plants depend on pollinators.* **Ask:** *But why do pollinators depend on plants?* Encourage students to share their ideas.

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 record facts that explain why plants need pollinators and why pollinators need plants. Instruct students to record the facts they find on the top half of their worksheets.

TURN AND TALK

Have students turn and talk to discuss what they learned about pollination. **Ask:** *What is pollination?* (the act of transferring pollen from one flower to another) *What happens during pollination?* (Pollen from the male part of one flower is moved to the female part of another flower.) *What happens after this is done?* (The plant can make seeds.) Invite students to share what else they learned about pollination.

- **Explain Connections** After reading the article point out to students that nature is full of interesting connections. This article explains the connection between pollinators and plants. Have students share their **Language Arts Assessment Masters** in small groups. Instruct them to compare the information they recorded. If group members overlooked any important facts, encourage them to add those details to their worksheets. Rejoin as a class. Invite groups to explain what they learned

- **Writing Opinions** Point out to students that learning about science is more than just collecting facts. Scientists must also interpret the facts to understand what they mean. Once they do that, they can form an opinion to help others understand why what they learned is important. In small groups, have students discuss reasons why the connection between plants and specific pollinators is important. Encourage them to use information on their **Language Arts Assessment Masters** or review the article for new facts that bolster their ideas. Then instruct students write a brief essay explaining whether or not they think pollination is an important process on the lower portion of their **Language Arts Assessment Masters**. Encourage students to include facts and details from 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.

- *How do bees pollinate plants?*
- *Why is the subhead "A Budding Relationship" a good description of the connection between plants and pollinators?*
- *What surprised you about what you read?*

Standard Supported

- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (NGSS.4-LS1-1)

Resources

- Content Assessment Master (page 9)
- Comprehension Check (page 10)

Science Background

The goal of every living organism is to reproduce. One way plants reproduce is to make seeds. And in order for plants to make seeds, they must undergo pollination.

During pollination, pollen grains are transferred from the anther, which is the male part of a flower, to the stigma, which is the female part. Sometimes, pollen is moved from the anther to the stigma on the same plant. Other times, it must be moved from one plant to another. Either way, if pollination occurs between plants of the same species, new seeds are produced.

Since plants can't move by themselves, they need help to move pollen. Some plants rely on wind or water. But most—up to 90%—get help from animals. These animals that transfer pollen from one flower to another are called "pollinators."

Pollinators don't visit flowers with the intent of helping the plants make seeds. They go there for the food. Lured by brightly colored petals or sweet smells, animals go to flowers so they can feast on the plant's fruit, nectar, or pollen. As they eat, pollen sticks to their bodies. As they move, they take the pollen with them.

More than 200,000 different animals pollinate plants. About 1,500 of these pollinators are birds, mammals, or reptiles. The rest are insects. Working together, they ensure that the next generation of plants is able to grow.

ENGAGE

Tap Prior Knowledge

Give each student a piece of plain white paper. Instruct students to draw and color a picture that shows what they think of when they hear the word "pollination." Compare and contrast the results. How many students' drawings showed a flower? How many included a bee visiting that flower? Did any drawings show different animals with the flower? Based on what these drawings show, challenge students to explain what pollination is.

EXPLORE

Preview the Lesson

Display the cover of the projectable magazine. Invite volunteers to identify the animal they see. (bee) Then point out the yellow blob on the bee's leg. **Ask:** *What is this yellow stuff? (pollen) What is it doing on the bee's leg?* (The bee is either collecting pollen from the flower in the photo or carrying pollen from another flower to this flower.) **Ask:** *Why?* (That is how bees pollinate flowers.) Tell students that as they read the article they will learn more about pollination and the unusual variety of animals that pollinate flowers.

Set a Purpose and Read

Have students read the article in order to understand what pollination is and recognize unusual animals that pollinate flowers.

EXPLAIN

Understanding Pollination

Display the Wordwise feature on page 9 of the projectable magazine. Highlight the vocabulary words *pollen*, *pollinate*, and *pollinator*. Challenge students to explain how these three words are connected. (Pollinators transfer pollen from one flower to another when they pollinate flowers.) Guide students to recognize that this process is called "pollination." Display the diagram "Inside a Flower" on pages 4-5 of the projectable magazine. Review the parts of a flower with the class. Using the diagram as a guide, have students explain what happens during pollination. (A flower's petals attract pollinators. When pollinators visit, they pick up pollen from the anther, which is at the tip of the stamen. They take pollen to another flower's stigma, which is at the tip of the pistil. This transfer of pollen pollinates the flower. Seeds grow in the ovule, which is at the bottom of the vase-shaped pistil.)

Compare and Contrast Pollinators

Display pages 2-3 of the projectable magazine. Highlight the deck. Emphasize that people often think of bees and other insects when they picture pollinators. But other types of animals—including birds, reptiles, and mammals—pollinate flowers, too. **Say:** *The result might be the same—the animal transfers pollen from one flower to another—but different types of animals pollinate flowers in different ways. That's because the animals are built differently.* Instruct students to take another look at the bee on the screen. Challenge students to explain how the bee's body helps it pollinate the flower. (Its body and legs are covered with bristles. Pollen sticks to those bristles. This helps the bee carry pollen from one flower to another.) **Say:** *Other animals have long faces, curved beaks, or skinny tongues. Often, these body parts help animals pollinate specific types of flowers.* Give each student a copy of the **Content Assessment Master**. Then divide the class into small groups. Instruct groups to review the article. Challenge them to compare and contrast how four different types of animals pollinate flowers.

ELABORATE

Find Out More

Point out to students that the article identifies several animals that pollinate flowers. But lots of other animals do this, too. Divide the class into small groups. Have groups conduct research to identify another animal that pollinates flowers. Challenge them to identify the types of flowers the animal pollinates and describe how the animal's body parts help it collect pollen in specific ways. Invite groups to present their findings to the class.

Extend Your Thinking About Pollination

Remind students that some animals are built to collect pollen from certain types of flowers. But some flowers are also built to attract specific pollinators. As a class, discuss how flowers use shape, color, and smell to attract the right kinds of pollinators.

EVALUATE

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

- *What are the male parts of a flower?* (anther and stamen)
- *What are the female parts of a flower?* (pistil, stigma, ovule)
- *How do both plants and animals benefit from pollination?* (As pollen is moved from one plant to another, plants can make new seeds. Animals eat fruit and nectar when they visit the plants.)

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

VOCABULARY ASSESSMENT: Pollination Nation

Record each vocabulary word and its definition.

Word	Definition

Write four sentences showing how the vocabulary words above are connected.
Use two different vocabulary words in each sentence.

1. _____
2. _____
3. _____
4. _____

LANGUAGE ARTS ASSESSMENT: Pollination Nation

Record facts from the article. Explain why plants and pollinators need each other.

Why do plants need pollinators?	Why do pollinators need plants?

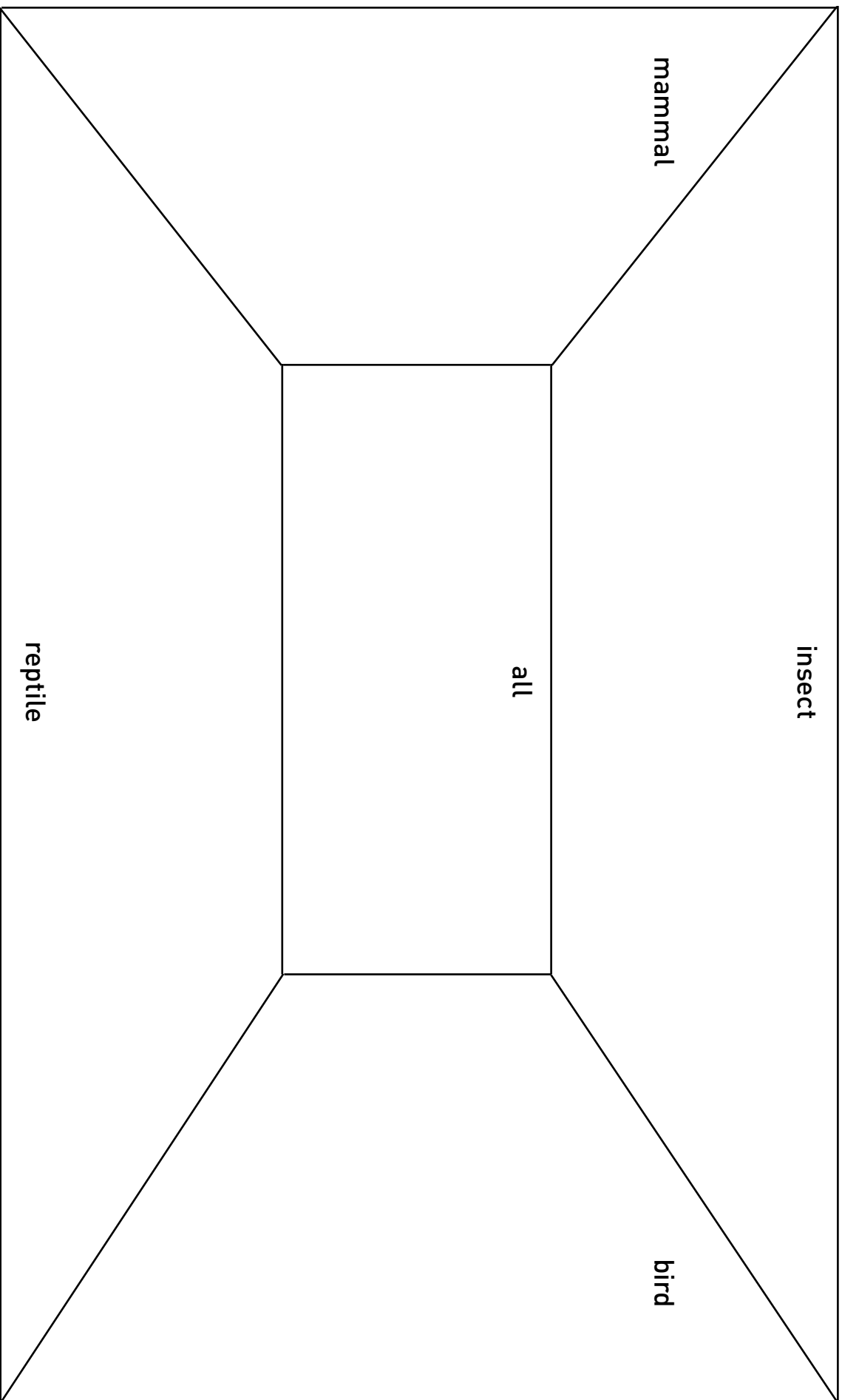
Do you think pollination is an important process? Why? Write about it.
Use facts from the article to support your opinion.

Name _____

Date _____

CONTENT ASSESSMENT: Pollination Nation

Pick an insect, a bird, a reptile, and a mammal from the article. Compare and contrast how they pollinate flowers.



COMPREHENSION CHECK: Pollination Nation

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

- 1. What are pollinators looking for when they visit flowers?
Ⓐ nectar
Ⓑ pollen
Ⓒ seeds

- 2. Which plant part attracts pollinators?
Ⓐ stigma
Ⓑ petals
Ⓒ pistil

- 3. Which of these is a mammal that pollinates flowers?
Ⓐ rainbow lorikeet
Ⓑ saguaro
Ⓒ kinkajou

- 4. Which body part helps a honey possum get nectar from flowers?
Ⓐ strong fingers
Ⓑ a curved beak
Ⓒ a long, narrow face

5. How do plants and pollinators depend on each other to survive?

A New Twist on Tornadoes

LANGUAGE ARTS  LEXILE 670L

Standard Supported

- Describe the overall structure of events, ideas, concepts, or information in a text or part of a text. (CCSS.RI.4.5)

Resources

- Vocabulary Assessment Master (page 15)
- Language Arts Assessment Master (page 16)

Summary

- The article "A New Twist on Tornadoes" examines the link between tornadoes and El Niño and La Niña, weather patterns that span the world.

BUILD VOCABULARY AND CONCEPTS

- **air mass**
- **El Niño**
- **La Niña**
- **supercell**
- **tornado**

Give each student a copy of the **Vocabulary Assessment Master**. Instruct students to record each vocabulary word as you read it aloud from the Wordwise feature on page 15.

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 for each word, based on the definitions they wrote.

Display the Wordwise feature on page 15 of the projectable magazine. First, instruct students to make sure they spelled each word correctly. Then review the definitions as a class. Have students add these definitions to their worksheets. Instruct them to write a new sentence for each word that accurately reflects how it was defined in the article.

READ

Give students a few minutes to scan the article's images in their student magazines. Then have them read the subheads. As a class, discuss how the images and subheads are related and how they connect with the article's headline and deck.

Guide students to recognize that the images show and tell what we already know about what tornadoes look like and what they can do. The headline and deck point out that scientists have learned something new.

Explain to students that there are four basic types of text structure: chronology, comparison, cause/effect, and problem/solution. Review the basics of each. **Then say:** *When you're reading an article about natural phenomena, such as tornadoes, chances are good that the author will use more than one type of text structure. For example, the author will probably explain what caused something to happen. He may identify problems and explain how to solve them. He might even tell you about someone's personal experience with a natural disaster event. As you read the article, be on the lookout for the different types of text structure. Challenge yourself to identify its central focus. If you look closely, you will recognize that the writer used one type of text structure to make the main point. That is the overall structure of the text.*

Give each student a copy of the **Language Arts Assessment Master**. Have students read the article on their own. As they read, instruct students to identify sections where the writer used each type of text structure. Instruct them to explain how the text structure helps the writer relay information in each case. Then have them circle what they think is the overall text structure used in the article. Challenge them to explain why.

A New Twist on Tornadoes

LANGUAGE ARTS

TURN AND TALK

Have students turn and talk to discuss what they learned about tornadoes. **Ask:** *What is a tornado?* (a rotating column of air that extends from a cloud to the ground) *In what parts of the U.S. do tornadoes usually occur?* (the Midwest and South) During what time of year can tornadoes strike? (They can strike at any time but are most common in the spring.) Invite students to share what else they learned about tornadoes.

- **Predicting Definitions** Have students turn and talk to discuss what they learned about the article's vocabulary words. Encourage them to compare the before and after sentences they wrote for each word. As a class, examine how new knowledge contributes to students' understanding of each word.

- **Identify Text Structure** Review with students the different types of text structure. Have students turn and talk to share their **Language Arts Assessment Masters** with a partner. Did they identify the same sections for each type of text structure? If so, did they explain the writer's choice in the same way? If students identified different sections, do both of their selections make sense? If not, instruct partners to read the section again. Then, encourage students to share what they identified as the overall text structure of this article. Challenge them to explain why they chose that particular format.

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 happens during a tornado?*
- *How can you stay safe during a tornado?*
- *What surprised you about what you read?*

A New Twist on Tornadoes

SCIENCE

Standard Supported

- A variety of natural hazards result from natural processes. Humans cannot eliminate the hazards but can take steps to reduce their impacts. (NGSS.4-ESS3-2)

Resources

- Content Assessment Master (page 17)
- Comprehension Check (page 18)

Science Background

A tornado is a vertical funnel of rapidly rotating air that is born out of a thunderstorm. The funnel extends from the clouds to the ground. Its winds can swirl up to 480 kilometers (300 miles) per hour.

Tornadoes form when warm, humid air collides with cold, dry air. As the warm air rises through the cold, an updraft forms. It begins to rotate and gains speed. Most tornadoes strike in the spring. And while they can occur at any time of day, they are most common in late afternoon. This is, not coincidentally, also prime time for thunderstorms.

Thanks to Doppler radar, meteorologists can usually warn people about 13 minutes before a tornado strikes. But researchers are constantly searching for better ways to predict when tornadoes will occur. One method is to study El Niño and La Niña, which are global weather patterns connected to the temperature of waters in the eastern tropical Pacific Ocean.

During El Niño, ocean currents are unusually warm. This brings heavy rain, flooding, and more tornadoes in Florida, south Texas, and the Gulf Coast. La Niña is the opposite. Its cold ocean temperatures push warm surface water further west than usual. As the warm, moist air flows into the Midwest, more tornadoes form there. Studying global weather patterns like these could help people predict the likelihood of tornadoes in any given season.

ENGAGE

Tap Prior Knowledge

Instruct students to imagine that they are outside and see a tornado approaching. Then read aloud the following quote: "...The great shaggy end of the funnel hung directly overhead. Everything was as still as death. There was a strong gassy odor and it seemed that I could not breathe." Encourage students to describe what they would do if they ever found themselves in a situation like this.

EXPLORE

Preview the Lesson

Display pages 10-11 of the projectable magazine. Give students a moment to examine the headline and photo. **Ask:** *Besides the headline, what leads you to think that this is a photo of a tornado?* Encourage students to share their ideas. Then read aloud the deck. As a class, brainstorm ideas about how a weather pattern that spans the world could be linked to tornadoes.

Set a Purpose and Read

Have students read the article in order to understand what tornadoes are, when and where they occur, and how they could be impacted by global weather patterns.

A New Twist on Tornadoes

SCIENCE

EXPLAIN

Understanding How Tornadoes Form

Display pages 12-13 of the projectable magazine. Guide students to recognize similarities between the tornado in the photograph on page 12 and the one in the illustration on page 13. Then review the diagram "How a Tornado Forms" with the class. **Ask:** *What must happen for a tornado to form?* (Warm air and cold air must meet.) *What happens when warm and cold air meet?* (The air forms a spinning tube that rotates and tilts upright.) *Why does the warm air move upward?* (Warm air always rises as cold air sinks.) *What is a tornado shaped like?* (a funnel) *Why?* (As the warm and cold air currents spiral, they squeeze the rotating winds into a funnel.)

Recognizing When and Where Tornadoes Occur

Remind students that spring is the peak season for tornadoes and most tornadoes occur in the Midwest and the South. Discuss why. (Tornadoes occur when warm and cold air meet. During spring, cold, dry air comes down from the North. Warm, moist air comes up from the Southeast. Hot, dry air comes up from the Southwest. All of these winds meet in the Midwest and South.)

Linking Tornadoes to Global Weather Patterns

Display pages 14-15 of the projectable magazine. Review the section "Wicked Weather." Have students compare and contrast El Niño and La Niña. (Compare: Both are global weather patterns linked to ocean temperature. Contrast: During El Niño, ocean water is warmer than usual. During La Niña, ocean water is cooler than usual.) Explain to the class that during La Niña, the cold ocean temperatures push warm surface water further west than usual. **Say:** *This could explain why more tornadoes occur in the Midwest in La Niña years. More warm air is moving up to that area. During El Niño, the warm air stays along the southern coast so more tornadoes occur there.* Assign each student a partner and give each student a copy of the **Content Assessment Master**. Instruct students to identify each sentence as true or false. If a statement is false, challenge them to explain why.

ELABORATE

Find Out More

Display page 14 of the projectable magazine. As a class, discuss what it would have been like to have been in this house when the tornado struck. **Ask:** *What could you have done to stay safe?* Invite students to share their responses. Guide students to understand that their options would vary depending on how much notice they had that the tornado was coming. Divide the class into small groups. Instruct groups to conduct research to learn more about how scientists predict tornadoes. Invite them to share what they learned with the class.

Extend Your Thinking About Tornadoes

Display page 15 of the projectable magazine. Review the diagram "The Tornado Scale" with the class. Then remind students about Will Keller, who they read about at the beginning of the article. **Ask:** *Based on Keller's experience, how likely is it that he saw an EF5 tornado?* Encourage students to share what they think.

EVALUATE

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

- *What is a supercell?* (a severe thunderstorm that rotates and may produce tornadoes)
- *What causes a supercell to form?* (Different air masses hit one another.)
- *How can this cause a tornado?* (If one air mass is warm and the other is cold, they can form a spinning tube of air that can rotate, tilt upright, start to spiral, and form a tornado.)

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

Name _____

Date _____

VOCABULARY ASSESSMENT: A New Twist on Tornadoes

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

Word					
Predicted Definition					
Sentence					
Definition from the Article					
Sentence					

LANGUAGE ARTS ASSESSMENT: A New Twist on Tornadoes

Identify sections that use each type of text structure. Explain how the text structure helps the writer make a point.

Text Structure	Section	Explanation
Chronology		
Comparison		
Cause/Effect		
Problem/Solution		

Circle what you think is the article's overall text structure. Tell why.

CONTENT ASSESSMENT: A New Twist on Tornadoes

Make a checkmark to show if you think each sentence is true or false.
If a statement is false, use information from the article to explain why.

Sentence	True	False	Explanation
1. Tornadoes occur when air masses of different temperatures meet.			
2. November is usually one of the worst months for tornadoes in the U.S.			
3. El Niño and La Niña are the same thing.			
4. If the water in the eastern Pacific Ocean is warmer than usual, there will be more tornadoes in the Midwest.			
5. El Niño is always present when deadly tornadoes strike the South.			

COMPREHENSION CHECK: A New Twist on Tornadoes

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

1. What is the safest place to be during a tornado?
Ⓐ next to a tree
Ⓑ on top of a house
Ⓒ underground

2. Which parts of the U.S. are most likely to have tornadoes?
Ⓐ Northeast and Northwest
Ⓑ Midwest and South
Ⓒ Southwest and North

3. Why are southern tornadoes especially deadly?
Ⓐ They're stronger.
Ⓑ They usually last longer.
Ⓒ They often strike at night.

4. El Niño and La Niña are created by the condition of waters in which ocean?
Ⓐ Pacific
Ⓑ Atlantic
Ⓒ Indian

5. What impact could a La Niña weather pattern have on tornadoes in the U.S.? Why?

Standard Supported

- Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area. (CCSS. RI.4.4)

Resources

- Vocabulary Assessment Master (page 23)
- Language Arts Assessment Master (page 24)

Summary

- The article "Clever Levers" introduces students to levers, a type of simple machine, and explores how levers help people do work.

BUILD VOCABULARY AND CONCEPTS

- **effort**
- **fulcrum**
- **lever**
- **load**
- **simple machine**

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 21 of the projectable magazine. Have students record those definitions and compare them with the definitions they wrote.

READ

Inform students that the purpose of this article is to introduce them to a type of simple machine called a lever and explain how they help people do work.

Give each student a copy of the **Language Arts Assessment Master**. Tell students that they have already been introduced to the article's vocabulary words. They will use this worksheet to explore the words in different ways.

Display the Wordwise feature on page 21 of the projectable magazine. Highlight the word *effort*. Instruct students to write *effort* in the center box of one of their word diagrams. Then have them record its definition. Encourage students to scan the article to find the bold word *effort* in the text. (page 19, column 2) Highlight the word on the screen.

Model how to explore the word's meaning. **Say:** *According to the definition, effort is the force that makes a simple machine do work. I know that a force is a thing and a noun is a person, place, or thing. That means that the correct part of speech to list here is noun.* Instruct students to write *noun* in the "Part of Speech" section of their diagrams.

Invite a volunteer to read aloud the paragraph in which the word "effort" appears. Highlight the last three sentences of the paragraph. **Say:** *If you connect the dots between these sentences, you can learn a lot about effort. For example, a push is a force. That force is effort. So, a push is effort. And with effort, you can lift a rock! Both of these statements are facts.* Have students record the facts on their diagrams.

Have students read the article on their own. As they do, instruct them to record additional facts about effort. Tell them to record information about the other vocabulary words as well. Then have them select one word from the article that isn't in the Wordwise feature and investigate that word, too. After reading the article, challenge students to write at least one way each vocabulary word is connected to the others.

Clever Levers

LANGUAGE ARTS

TURN AND TALK

Have students turn and talk to discuss what they learned about levers. **Ask:** *What is a simple machine?* (a machine with only a few parts) *What do simple machines like levers help us do?* (They help us move things faster, farther, or more easily than we could move things without them.) *What are some examples of levers?* (Possible responses: crowbars, screwdriver, seesaw, scissors, doorknob, wheelbarrow, bat) Encourage students to share other interesting facts they learned about levers.

- **Understand Definitions** Poll the class to see how many students feel that they are more familiar with the article's vocabulary words now that they have studied the definitions. **Say:** *One way to see if you fully understand a new word or idea 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 define each vocabulary word in their own words to a partner. Encourage them to go a step further by giving details and examples related to each word. Prompt discussion with questions such as: *What is a fulcrum? Why is it important to have a fulcrum when using a lever?*

- **Strengthen Understanding** Inform students that it is essential for readers to understand technical terms when studying science-related topics. Without that knowledge, it's very difficult to understand the text. **Say:** *Once you do understand what scientific terms mean, you follow along with the text. You can also use the words correctly in sentences of your own.* 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 should not restate sentences from the article. They should create new sentences of their own.

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 is a lever considered to be a simple machine?*
- *Identify one lever you have used. How did it help you do work more easily?*
- *What surprised you about what you read?*

Standard Supported

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (NGSS.3-5-ETS1-1)

Resources

- Content Assessment Master (page 25)
- Comprehension Check (page 26)

Science Background

When people think of machines, they generally picture complicated gadgets with lots of moving parts. But not all machines are this complex. Some, called "simple machines," only have a few parts. And they are extremely helpful when you want to get work done.

In this article, the first of a six-part series about simple machines, students will learn about levers. A lever is a bar, rod, or other object that turns on a fixed point called a "fulcrum."

When someone or something pushes or pulls on a lever, that force, or effort, is transferred. This allows a relatively small force to lift a heavy load.

There are three types, or classes, of levers. With first-class levers, such as a seesaw, the fulcrum is located between the effort and the load. Effort and load move in opposite directions. Second-class levers, like wheelbarrows, place the load in the middle. Effort and load move in the same direction.

A baseball bat is a third-class lever when you swing it. The end of the bat you hold is the fulcrum. The effort is in the middle. The point at which the ball strikes the bat is the load. The force you apply moves the ball a long distance.

ENGAGE

Tap Prior Knowledge

Poll the class to see how many students think you can lift a dictionary with one finger. Once the tally has been taken, lay a fat marker on a desk at the front of the room. Center another book horizontally across the marker to create a seesaw. Place the dictionary on one end of the book. Press down on the other end of the book with one finger. Encourage students to discuss how you lifted the dictionary with one finger.

EXPLORE

Preview the Lesson

Display pages 16-17 of the projectable magazine. Read aloud the headline and deck. Inform students that this article is about levers. **Ask:** *What clues on these pages show or tell you what a lever is?* (The diagram on the left side of the screen contains a basic illustration of a lever. The caption at the top of the diagram states that a lever is a type of simple machine. The comprehension strategy in the top right corner says that a lever is something people use to make work easier.) Challenge students to find the lever in the photo of the boat (the oars). Brainstorm ideas about how the oars help the rowers do work.

Set a Purpose and Read

Have students read the article in order to understand what levers are and identify how different types of levers help people do work.

EXPLAIN

Understanding Levers

Display pages 18-19 of the projectable magazine. Invite volunteers to read aloud the problem and solution in the yellow box. Then have students compare what they heard to what they see in the illustration. Challenge them to identify the lever (crowbar), fulcrum (brick), effort (woman pushing down on the crowbar), and load (rock). Encourage students to explain in their own words why a lever is a simple machine and how the lever in this example helped the woman do work more easily. (Possible response: A lever is a simple machine because it is a machine with only a few parts. Using the lever made it very easy for the woman to lift the heavy rock.)

Identifying Different Types of Levers

Display pages 20-21 of the projectable magazine. As a class, review the three types of levers. Using the illustrations as a guide, challenge students to identify the load, effort, and fulcrum in each photo. Have students review the article to identify other examples of each type of lever. Make a list. (first-class: oars on boat, crowbar, screwdriver, seesaw, scissors; second-class: door, wheelbarrow; third-class: shovel, backhoe, baseball bat, tennis racket)

As a class, brainstorm more examples to add to each list. Then give each student a copy of the

Content Assessment Master. Instruct students to draw a picture of each type of lever, identifying the load, effort, and fulcrum in each example. Then have them describe a problem that could be solved using a lever, pick the best lever for the job, and explain how the lever would make the work easier to do.

ELABORATE

Find Out More

Divide the class into small groups. Provide the necessary supplies as students complete the activity on pages 22-23 of their student magazines. Once all catapults are complete, discuss the results. **Ask:** *What happened when you moved the position of the fulcrum?* (It should have changed the distance the marshmallows traveled.) Brainstorm ideas about other ways the catapult could be changed. Challenge students to explain how those changes would affect the catapult's ability to do work.

Extend Your Thinking About Curiosity

Display the National Geographic Learning Framework feature on the back cover of the magazine. Discuss what curiosity is. Tell students that curious people want to know how the world works. To figure things out, they can either read what other people have to say or go out and find the answers on their own. Point out to students that they may not have known a lot about levers before reading the article "Clever Levers." Now that they do, they can appreciate the tools they use each day. Instruct students to make a list of all the levers they use. Then give them time to either draw or take pictures to show the many different ways levers help them do work.

EVALUATE

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

- *What is a simple machine?* (a machine with only a few parts)
- *How many classes of levers are there?* (three)
- *Why is a seesaw classified as a first-class lever?* (The fulcrum is between the effort and the load.)

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

Name _____

Date _____

VOCABULARY ASSESSMENT: Clever Levers

Record what you know about each vocabulary word and how the word is used in the article.

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: Clever Levels

Use this organizer to explore each vocabulary word from a scientific point of view.
 Pick one more word from the article and investigate it, too.

Definition	Part of Speech
Word	
Connections	Facts

Definition	Part of Speech
Word	
Connections	Facts

Definition	Part of Speech
Word	
Connections	Facts

Definition	Part of Speech
Word	
Connections	Facts

Definition	Part of Speech
Word	
Connections	Facts

Definition	Part of Speech
Word	
Connections	Facts

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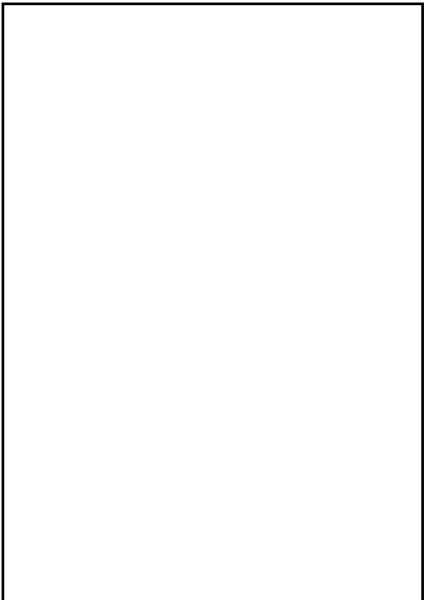
Name _____

Date _____

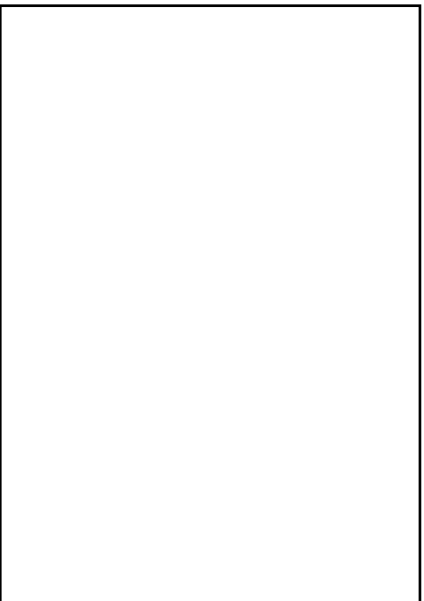
CONTENT ASSESSMENT: Clever Levers

Draw a picture of each type of lever. Label the effort, fulcrum, and load in each example.

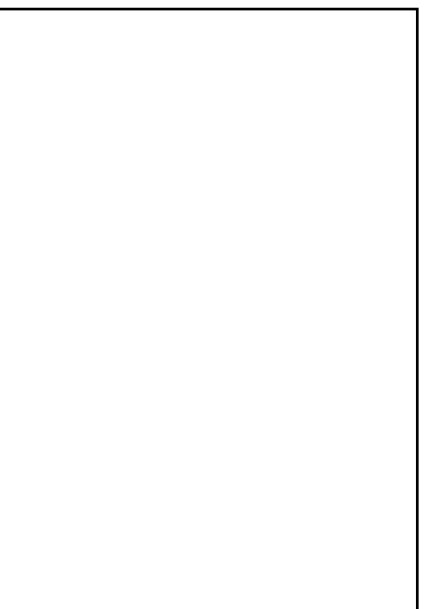
first-class



second-class



third-class



What is a problem you could solve using one of these levers? _____

Which lever should you use? _____

How would that lever make it easier for you to do the work? _____

COMPREHENSION CHECK: Clever Levers

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

1. What do you call the force that makes a simple machine do work?
Ⓐ effort
Ⓑ fulcrum
Ⓒ load

2. Which of these objects is a first-class lever?
Ⓐ seesaw
Ⓑ tennis racket
Ⓒ door

3. What is in the middle when you use a second-class lever?
Ⓐ effort
Ⓑ fulcrum
Ⓒ load

4. Where is the fulcrum located when you use a shovel?
Ⓐ at the bottom, where you dig up soil
Ⓑ at the top, where you hold the handle
Ⓒ in the middle of the handle

5. Give an example of a lever. Tell what kind of lever it is. Describe how it helps you do work.

Understanding Maps

ASIA

Standard Supported

- Use maps of different scales to describe the locations of cultural and environmental characteristics. (NCSS.D2.Geo.3.3-5)

Resources

- Content Assessment Master (page 28)
- Comprehension Check (page 29)
- Asia Physical Map poster (teacher's edition)
- Asia Political Map poster (teacher's edition)

Social Studies Background

Spatial thinking is an essential skill for students to develop as they learn about geography and Earth and environmental sciences. Developing spatial concepts takes time and practice. Recognizing that, each month Explorer magazine will introduce students to a new set of physical and political maps. Use the accompanying lessons to guide students as they learn to recognize spaces and places in the natural world.

ENGAGE

Tap Prior Knowledge

Instruct each student to draw a picture of something they would expect to see in Asia. Invite students to share their drawings with the class. Discuss how the drawings relate to Asia.

EXPLORE

Preview the Lesson

Display the **Asia Physical Map poster** and the **Asia Political Map poster**. Cover the captions. Have students examine the photos. Discuss what each photo tells about Asia.

Set a Purpose and Read

Have students examine the posters in order to understand that physical and political maps can be used to describe the cultural and environmental characteristics of a location.

EXPLAIN

Explore the Physical Map

Display the **Asia Physical Map poster**. Read aloud the text in the "Landforms" box on the left side of the poster. As a class, examine the map to see which desert is in eastern Asia (Arabian Desert) and which is in the west (Gobi). Review the other boxes, photos, and captions. **Ask:** *What is special about Mount Everest?* (It's the tallest mountain on Earth.) Encourage students to share what the map taught them about the physical characteristics of Asia.

Explore the Political Map

Display the **Asia Political Map poster**. Invite volunteers to read aloud the captions and the text in the boxes on the left side of the poster. Have them find each location mentioned on the map. Invite students to share interesting facts they know about other cities and countries shown on the map.

ELABORATE

Find Out More

Inform students that people use maps to see where things are located. **Say:** *But in order to read a map correctly, you need to know how to follow directions.* **Ask:** *What other feature could the designer have included on these maps to help people follow directions?* (a compass rose) Discuss what a compass rose is and how it helps people read maps.

Extend Your Thinking About Asia

Give each student a copy of the **Asia Maps Content Assessment Master**. Have students identify each country in Asia. Then, using the map and compass rose as resources, challenge students to identify the correct direction or country name to complete each sentence.

EVALUATE

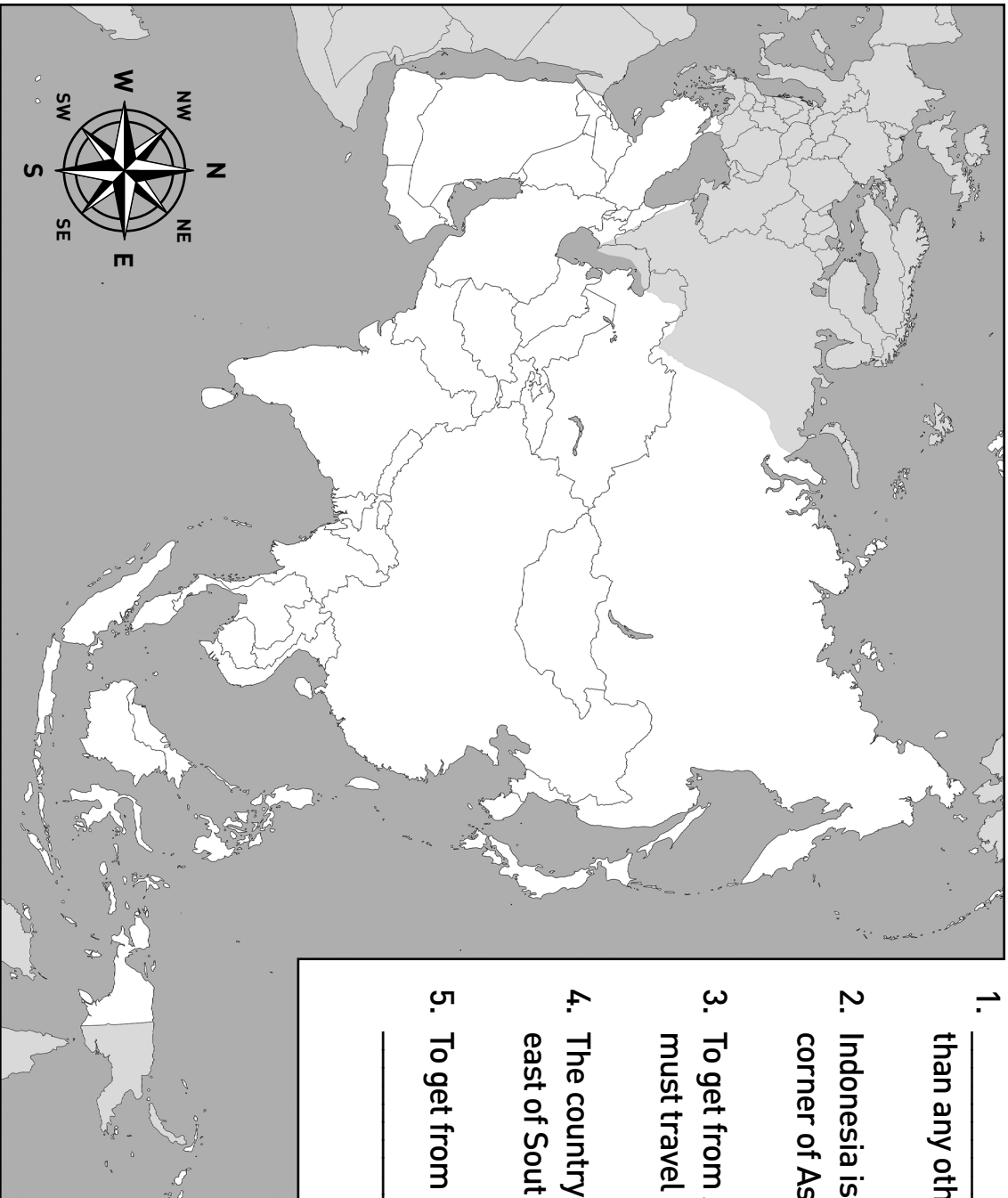
Have students ask and answer questions about the physical and political maps. If you wish, have them complete the **Comprehension Check** to assess their knowledge of Asian geography.

Name _____

Date _____

CONTENT ASSESSMENT: Asia Maps

Identify each country in Asia. Then add a country name or direction to complete each sentence.



1. _____ is farther north than any other country in Asia.
2. Indonesia is in the _____ corner of Asia.
3. To get from Afghanistan to Saudi Arabia, you must travel _____.
4. The country of _____ is east of South Korea.
5. To get from India to Turkey, you must travel _____.
6. Two countries that touch Vietnam's western border are _____ and _____.

COMPREHENSION CHECK: Asia Maps

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

1. What is the longest river in Asia?
Ⓐ the Ural River
Ⓑ the Ganges River
Ⓒ the Yangtze River
2. What are the four most common languages spoken in Asia?
Ⓐ Mandarin, Hindi, Russian, and Arabic
Ⓑ French, English, Spanish, and German
Ⓒ Chinese, Japanese, Korean, and Vietnamese
3. What is the smallest country in Asia?
Ⓐ Russia
Ⓑ the Maldives
Ⓒ Sri Lanka
4. What kind of landform is the Gobi?
Ⓐ desert
Ⓑ tundra
Ⓒ grassland
5. Summarize one political fact and one physical fact you learned about Asia.

Pollination Nation

Assess Vocabulary, page 7

Students should record the words and definitions from the Wordwise feature on page 9.

anther: a part of a flower that produces and contains pollen

nectar: a sweet liquid found in many flowers

ovule: a part of a flower that will become a seed

pistil: a part of a flower that holds the ovules

pollen: the substance that causes plants to form seeds

pollinate: to transfer pollen from one flower to another

pollinator: an animal that transfers pollen from flower to flower

stamen: a part of a flower that is tipped with pollen

Sentences will vary depending on the connections students identify.

Assess Language Arts, page 8

Possible responses:

Plants Need Pollinators: Some plants need pollinators to move pollen from one flower to the ovule of another. In some cases, specific animals pollinate specific plants.

Pollinators Need Plants: Many plants produce a sweet liquid called nectar in their flowers. Animals feed on the nectar.

Students should write a short essay explaining whether or not they think pollination is an important process. Their essays should include facts from the article that support their opinions.

Assess Content, page 9

Students should select one insect, bird, reptile, and mammal from the article and describe how they pollinate flowers. Answers will vary, depending on which animals students select. For similarities, students should note that all animals eat nectar as they transfer pollen from one flower to another.

Comprehension Check, page 10

1. A; 2. B; 3. C; 4. C; 5. Possible response: Flowers must be pollinated to reproduce. Pollinators get food (fruit and nectar) from the plants.

A New Twist on Tornadoes

Assess Vocabulary, page 15

Students' predictions and the sentences they write will vary. They should record the words and definitions from the Wordwise feature on page 15.

air mass: a large region of air having similar properties

El Niño: the condition when the surface waters of the eastern tropical Pacific Ocean are warmer than usual

La Niña: the condition when the surface waters of the eastern tropical Pacific Ocean are cooler than usual

supercell: a severe thunderstorm that rotates; may produce tornadoes

tornado: a rotating column of air that extends from a cloud to the ground

Assess Language Arts, page 16

Sections that students identify for each type of text structure may vary. All choices should be supported with valid reasons. Students are most likely to identify cause/effect as the overall text structure because the text explains what causes tornadoes to occur and what happens when they do. If they select another option, they should explain their choice.

Assess Content, page 17

1. True.
2. False: Most tornadoes in the U.S. occur in spring. That's when air masses of different temperatures are most likely to meet. November is in the fall.
3. False: During El Niño, ocean water is warmer than usual. During La Niña, it's colder than usual.
4. False: There will be more tornadoes in the Midwest when ocean temperatures are cooler.
5. False: In 2017, neither El Niño or La Niña was present when deadly tornadoes struck the South. Waters in the Gulf of Mexico were just warmer than usual.

Comprehension Check, page 18

1. C; 2. B; 3. C; 4. A; 5. Possible response: During La Niña, there could be more tornadoes in the Midwest because more warm, moist air from the Gulf of Mexico reaches that part of the U.S.

(continued)

Clever Levers

Assess Vocabulary, page 23

Students should record the vocabulary words from the Wordwise feature on page 21, 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.

effort: the force that makes a simple machine do work

fulcrum: a fixed point on which a lever rests and moves

lever: a bar, rod, or other object that turns on a fixed point

load: an object that is to be moved or the work that is to be done by a lever

simple machine: a machine with only a few parts

Assess Language Arts, page 24

Students should record words and definitions from the Wordwise feature on page 21 of the article. They should note the part of speech for each word, list facts, and make logical connections between vocabulary words. Students should investigate one word from the article that is not included in the Wordwise feature in this same way. All information should come from the article.

Assess Content, page 25

Students should draw one example of each type of lever and identify the effort, fulcrum, and load in each illustration. Other answers will vary depending on the problem students choose to solve.

Comprehension Check, page 26

1. A; 2. A; 3. C; 4. B; 5. Answers will vary.

Asia Maps

Assess Content, page 28

1. Russia; 2. southeast; 3. west; 4. Japan; 5. northwest; 6. Laos and Cambodia

Comprehension Check, page 29

1. C; 2. A; 3. B; 4. A; 5. Answers will vary.