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Science Readers: Content and Literacy in Science— Grade 4

This sample includes the following:

Teacher's Guide Cover (1 page)

Table of Contents (2 pages)

How to Use This Product (5 pages)

Lesson Plan (11 pages)

Reader (17 pages)

To Create a World ⁱⁿ which
Children Love to Learn!

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SCIENCE READERS

Content *and* Literacy *in* Science

Grade 4

Teacher's
Guide



Teacher Created Materials
PUBLISHING



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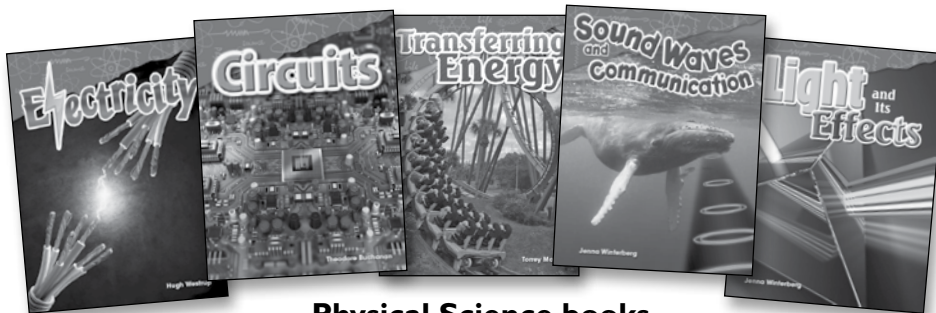
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Kit Components



Life Science books

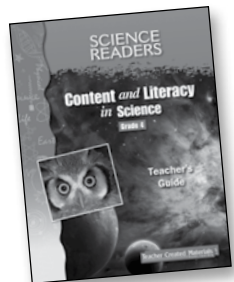


Physical Science books

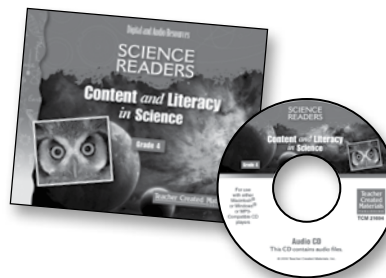


Earth and Space Science books

Scientific Practices book



Teacher's Guide



Digital and Audio Resources

Unit Organization

Overview Page

The Nutrient Cycle

Learning Objectives

Students will:

- explain the steps in Earth's cycles based on information from the text.
- write a narrative about one of Earth's cycles.
- describe several key parts of the nutrient cycle.

Standards

- Reading:** 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.
- Writing:** Write narratives to develop real or imagined experiences or events using effective techniques, descriptive details, and clear event sequences.
- Content:** Know that the transfer of energy is essential to all living organisms.
- Language:** Communicate information, ideas, and concepts necessary for academic success in the content area of Science.

Lesson Timeline

Day 1	Day 2	Day 3
Task: Introductory and Lab Activities (page 84)	Task: Before Reading (page 85)	Task: During Reading (page 86)
Summary of Student Learning Activities	Summary of Student Learning Activities	Summary of Student Learning Activities

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Science strand

Learning objectives

Standards

Suggested timeline for lesson

Introductory and Lab Activities

The Nutrient Cycle (cont.)

Materials

- copies of the Chemicals in Groundwater activity sheet (page 88)
- vegetable oil
- soil, sand, and pebbles
- water
- food wrappers and other trash
- clear plastic cups
- food coloring

Introductory Activity Engage

- Ask students where their drinking water comes from. Explain how all the water we drink is part of the water cycle and that much of our drinking water comes from groundwater.
- Tell students they will experiment to see what happens when groundwater becomes polluted. Note: You may wish to show students the illustration of the water cycle on pages 6-7 of The Nutrient Cycle book.

Lab Activity Explore & Explain

- Place students in small groups. Distribute a plastic cup, food coloring, vegetable oil, sand, pebbles, water, and small pieces of trash to each group. Note: You may wish to set up stations with sand, soil, pebbles, and water for the whole class to use.
- Have students add a layer of sand, then a layer of soil, and then a layer of pebbles into the cup. Then, have them fill the cup halfway with water to create a model of groundwater.
- Have students add food coloring (to represent pesticides and fertilizers) and trash into their cups as a team. Distribute copies of the Chemicals in Groundwater activity sheet (page 88) to students. Have students record their observations on the activity sheet as they add the items.
- Have students remove the items from the water. Have them record on their activity sheets whether items were easy or difficult to remove.
- As students work, ask questions to guide them to the idea that humans can negatively impact Earth's cycles.
 - Which items are naturally occurring and which are added by people?
 - How do these items affect groundwater?
 - How might the effect plants and animals bring to the soil?
- Bring the class together for instruction. Clarify misconceptions by having students explain their understanding using logic and evidence to support their ideas.

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Materials

Engage students with the Introductory Activity

Explore and Explain the new concept with the Lab Activity

Before Reading

During Reading

After Reading

Materials list

Vocabulary Word Bank

Elaborate on the concept with a vocabulary and a prereading activity

The Nutrient Cycle (cont.)

Materials

- copies of the Before Reading activity sheet (page 85)
- copies of the Vocabulary Word Bank (page 85)

Before Reading Engage

- Write the vocabulary words on the board. Have students read each word and write a definition. Then, have students write a sentence using each word. Have students share their sentences with the class.
- Ask students which sentence was most interesting. Have students identify any words they may have used in the sentence.

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The Nutrient Cycle (cont.)

Materials

- copies of the During Reading activity sheet (page 86)

During Reading Engage

- Read the text aloud to students. Have students follow along and take notes on the text. Have students identify any words they do not understand.
- Have students read the text aloud to themselves. Have students identify any words they do not understand.
- Have students read the text aloud to themselves. Have students identify any words they do not understand.

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The Nutrient Cycle (cont.)

Materials

- copies of the After Reading activity sheet (page 87)
- copies of the Vocabulary Word Bank (page 85)

After Reading Engage

- Write students' names on the board. Have students write a sentence using each word. Have students share their sentences with the class.
- Ask students which sentence was most interesting. Have students identify any words they may have used in the sentence.

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Materials list

Elaborate with an After Reading activity on Day 4

Evaluate with Assessments on Day 5

Student Reproducibles and Assessments

Chemicals in Groundwater

Many Cycles

Cycle Narrative

Explaining a Cycle

The Nutrient Cycle Quiz

Trapping Greenhouse Gases

Clear directions

Multiple-choice quiz

Data Analysis activity

Pacing Plan

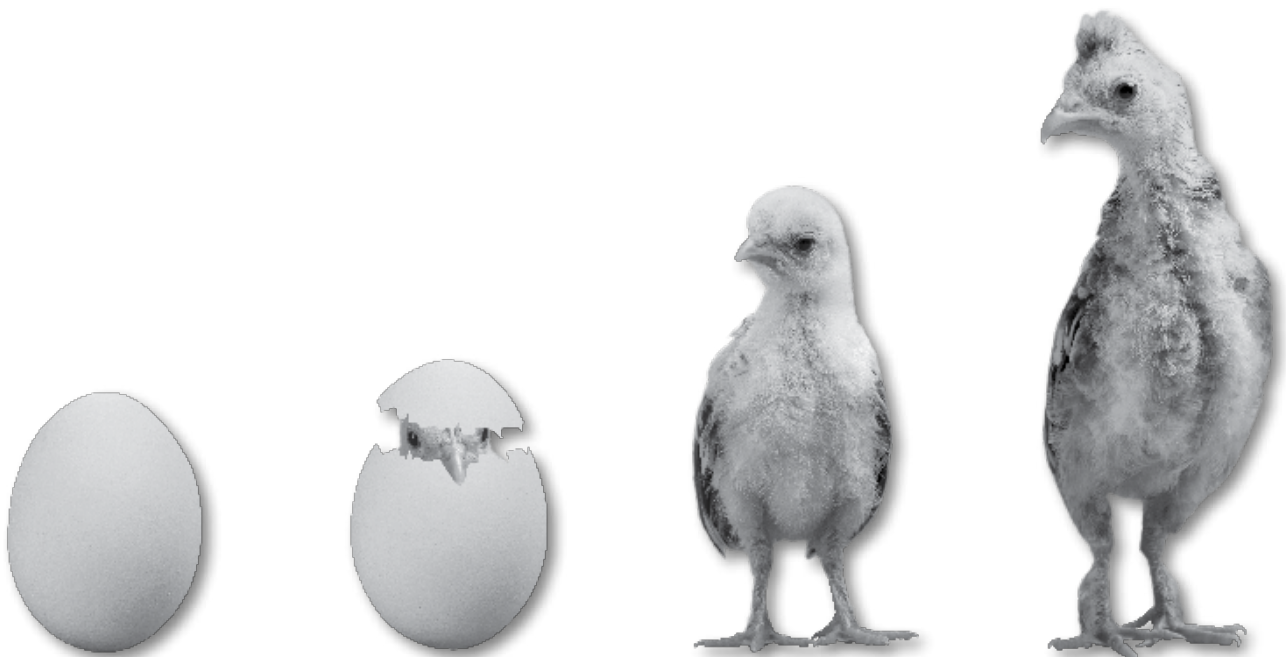
The following pacing plan shows an option for using this product. Teachers should customize this pacing plan according to their students' needs. One lesson has been included for each of the 16 books. Each day of the lesson requires 30 to 45 minutes of time and spans 5 instructional days, for a total of approximately 40–60 hours over the course of 80 days.

Instructional Time	Frequency	Setting
30–45 min/day	5 days/week	Whole-class, small-group or one-on-one instruction

Day 1	Day 2	Day 3	Day 4	Day 5
Introductory and Lab Activities	Before Reading	During Reading	After Reading	Activity from the Book and Assessments

Lab Safety

To ensure safety in the science classroom, a Science Safety Contract has been provided in the Digital Resources ([safety.pdf](#)). Distribute copies of this contract to students prior to beginning any science instruction. Discuss with students how to be respectful and responsible during science activities. Ask students and their parents/guardians to sign and return the contract for your records.



Science Strands

The books and lessons in this kit cover the three strands of science which encompass the Disciplinary Core Ideas. The icons in the lessons and on the back of the books denote each strand. One book in this kit is devoted completely to scientific practices. This book describes how to think like a scientist and study the natural world.

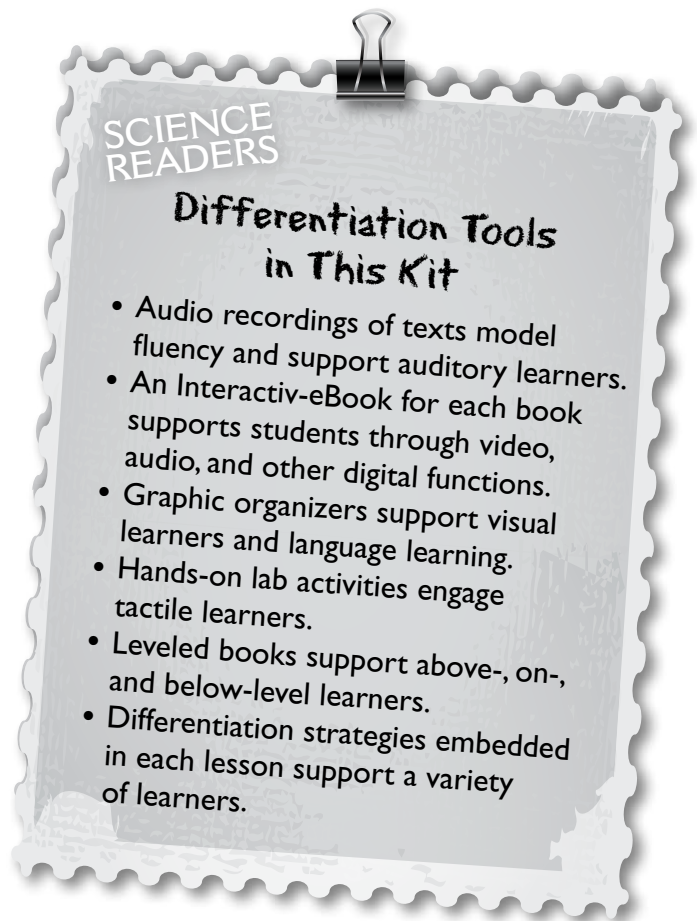


Differentiation

Students learn best when material is scaffolded appropriately. If a student is confronted with material that is too difficult, he or she may become frustrated and give up. However, if a student is not challenged enough, he or she may become bored and lose interest in the subject. Differentiation is not about making the work easy for students. Instead, it is about challenging all students appropriately.

The books in this kit are leveled to target and support different groups of learners. The chart on page 26 contains specific information on the reading levels of the books included in this kit. The lesson plans for these books have **differentiation strategies** to help **above-, on-, and below-level learners** comprehend the material. These strategies will ensure that students are actively engaged in learning while receiving the support or enrichment that they need.

English language learners have different instructional needs. Although these students may struggle with reading, that is not always the case. English language learners need different support depending on their level of English proficiency. The lesson plans in this kit offer suggestions to differentiate instruction for the unique needs of English language learners.



Assessment

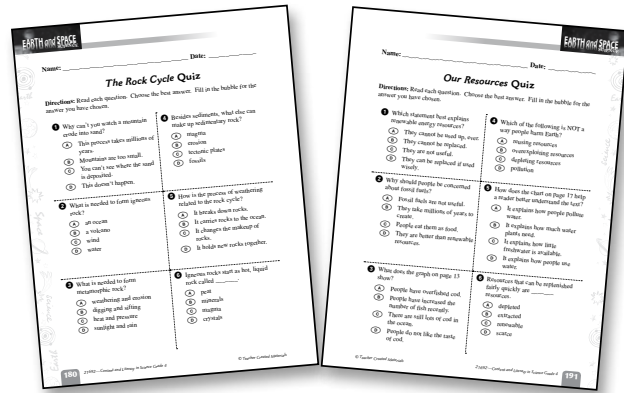
Assessment is an important part of this unit of study. The Science Readers series offers multiple assessment opportunities. You can gain insight into students' learning through multiple-choice quizzes, small-group observations, analysis of written assignments, and a culminating activity. These formal and informal assessments provide you with the data needed to make informed decisions about what to teach and how to teach it. This is the best way for you to know who is struggling with various concepts and how to address the difficulties that students are experiencing with the curriculum.

Multiple-Choice Quizzes—At the end of each book's lesson in this Teacher's Guide is a short quiz with multiple-choice questions. These short assessments may be used as open-book evaluations or as review quizzes in which students read and study the content prior to taking the quiz. Additionally, the quizzes may be used as a more formal assessment to provide evidence of learning.

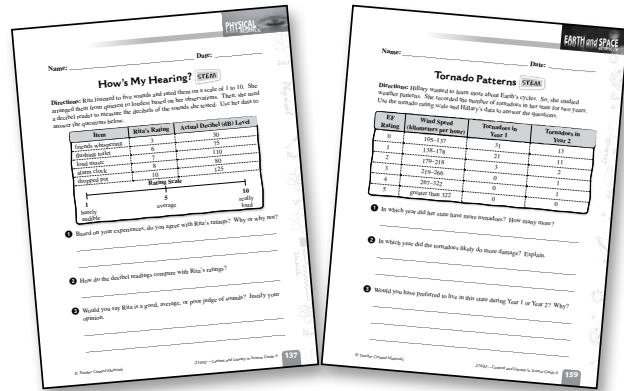
Data Analysis Activities—Each activity includes content-related data and text-dependent questions. These questions help students develop and strengthen critical thinking skills.

Culminating Activity—The culminating activity asks students to apply what they have learned throughout the units in an engaging and interactive way. Students use what they have learned to create new ideas in a real-life context.

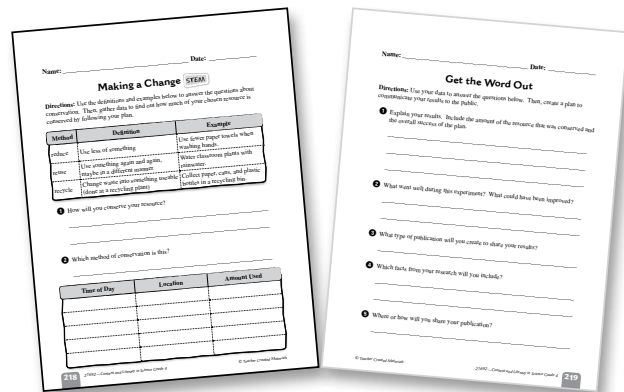
Progress Monitoring—There are several points throughout each lesson where useful evaluations can be made. These evaluations can be made based on group, paired, and individual discussions and activities.



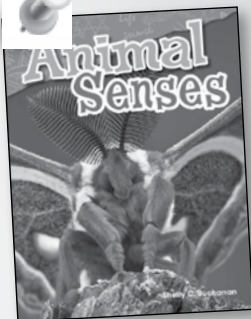
Multiple-Choice Quizzes



Data Analysis Activity



Culminating Activity



Learning Objectives

Students will:

- identify when the author uses a compare-and-contrast text structure in the book.
- write and edit a paragraph using a compare-and-contrast text structure.
- describe how animals use their senses to receive and respond to information.

Standards

- **Reading:** Describe the overall structure of events, ideas, concepts, or information in a text or part of a text.
- **Writing:** With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.
- **Content:** Use a model to describe that animals receive information through their senses, process the information in their brain, and respond to the information in different ways.
- **Language:** Communicate information, ideas, and concepts necessary for academic success in the content area of Science.

Lesson Timeline

<p>Day 1</p> <p>Task</p> <p>Introductory and Lab Activities (page 62)</p> <p>Summary of Student Learning Activities</p> <p>Explore the senses of sight and hearing with modifications.</p>	<p>Day 2</p> <p>Task</p> <p>Before Reading (page 63)</p> <p>Summary of Student Learning Activities</p> <p>Make a list of compare-and-contrast signal words.</p>	<p>Day 3</p> <p>Task</p> <p>During Reading (page 64)</p> <p>Summary of Student Learning Activities</p> <p>Identify the compare-and-contrast text structure, and write and edit a paragraph about how two animals use one sense.</p>
<p>Day 4</p> <p>Task</p> <p>After Reading (page 65)</p> <p>Summary of Student Learning Activities</p> <p>Identify compare-and-contrast signal words.</p>	<p>Day 5</p> <p>Task</p> <p>Activity from the Book (page 65) and Assessments (pages 70–71)</p> <p>Summary of Student Learning Activities</p> <p>Write a story about a nocturnal animal using its senses, and take the assessments.</p>	



Materials

- copies of the *My Senses* activity sheet (page 66)
- shoebox
- scissors
- pennies
- tape
- felt
- paper
- music

Day 1

Explore the senses of sight and hearing with modifications.

Introductory Activity

Engage

1. Before the lesson, prepare a sensory box for students. Cut a hole in the side of a shoebox, large enough to reach through. Place pennies inside the box, tape the lid shut, and tape a piece of felt over the hole.
2. Have students use their senses to guess what is inside the box. Tell students that animals use their senses to survive. Tell students that an animal's senses can be different from a human's senses.

Lab Activity

Explore & Explain

1. Place students in small groups. Distribute four sheets of paper, scissors, tape, and copies of the *My Senses* activity sheet (page 66) to each group. Have students complete the activity sheet while they experiment with ear and eye shapes.
2. Have students roll a sheet of paper into a cone, tape it together, and fit the smaller end around their ears. Tell students that the cone represents a different ear shape. Have students listen to music through their cones. Then, have students turn the cone around so that the wider end faces their ear and listen again. Tell students to experiment with other ear shapes.
Note: You may wish to have students cut the paper in half to allow for more experiments.
3. Have students hold two sheets of paper on either side of their faces and look around without moving their heads.
4. Have students cut long slits in sheets of paper and look through the slits. Have students cut wider slits and look through them. Explain that this represents different eye shapes. Have students experiment with other eye shapes.
5. Ask questions to guide students to the idea that animals have specialized senses that help them survive.
 - *How did your senses change?*
 - *How might each change be more or less helpful for an animal?*
 - *What kind of animal do you think has some of these adaptations?*
 - *Why might different animals have different, or specialized, senses?*
6. Discuss how the different eye and ear shapes modified students' senses. Clarify misconceptions by having students explain their understandings using logic and evidence to support their ideas.

STEM



Materials

- *Animal Senses* books
- copies of the *Word Sort* activity sheet (page 67)
- chart paper

Day 2

Make a list of compare-and-contrast signal words.

Vocabulary Word Bank

- adapted
- antennae
- organs
- receptors
- sensors
- vibrations

Before Reading

Elaborate

1. Write the vocabulary words on the board, and discuss their definitions as a class. Distribute copies of the *Word Sort* activity sheet (page 67) to students. Have students use the boxes on the activity sheet to sort the words into categories. Categories may include parts of speech, function, how familiar they are with the words, or others. Have students sort the words two times into different categories. Once finished, discuss each grouping with students and their rationale behind it. Discuss any types of groupings students may not have mentioned.
 - Challenge **above-level learners** to sort the words into three categories instead of two.
2. Display the *Animal Senses* book for students. Explain that this book compares and contrasts animals by how they use their senses and their sensory organs. Explain that a sensory organ is what allows an animal to have a sense, such as eyes and ears.
3. Tell students that a compare-and-contrast text structure explains how two or more things are similar and different. Have students brainstorm words that might indicate that a compare-and-contrast text structure is being used. Examples include: *instead, but, although, however, as well, too, and both*.
4. Distribute the *Animal Senses* books to students. Have them look through the book to find compare-and-contrast signal words. List the words on a sheet of chart paper as students share them. Add any words students may have missed. Tell students that they will use this list to help them identify the compare-and-contrast text structure as they read. **Note:** Save the list for later use.

Day 3

Identify the compare-and-contrast text structure, and write and edit a paragraph about how two animals use one sense.

Materials

- *Animal Senses* books
- copies of the *Writing to Compare* activity sheet (page 68)
- list of signal words from the Before Reading activity

During Reading

Elaborate

1. Review the list of compare-and-contrast signal words from the Before Reading activity. Distribute the *Animal Senses* books to students. For the first reading, read the book as a whole class. Pause periodically to discuss how the author uses a compare-and-contrast text structure to discuss animals, their senses, and how they use their sensory organs. For example, the author compares humans and animals (pages 4–5), humans and birds (page 6), and predators and prey (page 8).
 - You may choose to display the Interactiv-eBook for a more digitally enhanced reading experience.
2. For the second reading, have students read the text independently. Tell students to find words that signal when the author uses a compare-and-contrast text structure.
 - You may wish to have students digitally annotate the PDF of the text by highlighting compare-and-contrast signal words.
 - For **below-level learners** and **English language learners**, you may choose to play the audio recording as students follow along to serve as a model of fluent reading. This may be done in small groups or at a listening station. The recording will help struggling readers practice fluency and aid in comprehension.
3. As a class, choose two animals and a sense (sight, hearing, smelling, taste, or touch) to compare and contrast. Have students use the book to find similarities and differences between how the two animals use this sense. Record student responses on the board.
4. Distribute copies of the *Writing to Compare* activity sheet (page 68) to students. Remind students to use a compare-and-contrast text structure and incorporate signal words for the reader. Have them trade papers with a partner.
5. Tell students to make suggestions for how their partners could more effectively use the compare-and-contrast text structure and signal words. After a few minutes, have students make appropriate edits to their own work in a different color.
 - Have **below-level learners** and **English language learners** write their paragraphs in outline format. Help them add signal words in appropriate places in their outlines.



Materials

- *Animal Senses* books
- copies of the *Text Structure*, *Animal Senses Quiz*, and *The Nose Knows* activity sheets (pages 69–71)
- list of signal words from the Before Reading activity

Days 4&5

Identify compare-and-contrast signal words. Write a story about a nocturnal animal using its senses, and take the assessments.

After Reading

Elaborate & Evaluate

1. Write vocabulary words and definitions on the board. In small groups, have students create a movement or a gesture to represent each word. Give students 30 seconds to create each representation. Then, have students practice saying the words while doing the movements.
2. Review the list of compare-and-contrast signal words students created in the Before Reading activity. Discuss why this text structure was a good choice for the *Animal Senses* book.
3. Distribute copies of the *Text Structure* activity sheet (page 69) to students. Have students use the book to complete the activity sheet, as needed. Review the answers as a class. Discuss how students got their answers.

Activity from the Book

Read the Your Turn! prompt aloud from page 32 of the *Animal Senses* book. Have students write a story as if they were a nocturnal animal using their senses to find food and to stay safe.

1. A short posttest, *Animal Senses Quiz* (page 70), is provided to assess student learning from the book.
2. A data analysis activity, *The Nose Knows* (page 71), is provided to assess students' understanding of how to analyze scientific data. Explain to students that the chart shows which food each dog sniffed first.
3. The Interactiv-eBook activities may be used as a form of assessment (optional).

Name: _____ Date: _____

My Senses STEM

Directions: Draw each type of ear or eye you create. Record the change in hearing or sight that you notice.

Hearing			
Cone	Reversed Cone	Other	Other
Change	Change	Change	Change

Sight			
Paper on Sides	Small Slit	Large Slit	Other
Change	Change	Change	Change



Name: _____ Date: _____

Word Sort

Directions: Sort the words below into two categories. Then, sort the words a different way. Label how you sorted the words on the lines below.

receptors adapted antennae vibrations sensors organs

--	--

--	--

Life



Science



Life



Science



Science



Name: _____ Date: _____

Text Structure

Directions: Circle the compare-and-contrast signal words in each sentence. Underline what the author is comparing or contrasting. Then, write a sentence using a signal word that compares or contrasts two things of your choice.

- 1 Many animals, however, see the world very differently than we do. (page 6)
- 2 Cats and owls have more rods than cones. They see well in the dark. But they don't see much color. (page 8)
- 3 Just like humans, many animals are very sensitive to sound. (page 10)
- 4 The human brain is 10 times larger than a dog's brain. But a dog has an olfactory bulb that is 3 times larger than a human's. (page 15)
- 5 You probably talk to or e-mail your friends to see how they're doing. But do you ever sniff your friends to catch up? This is one way animals talk to one another. (page 16)

- 6 _____

Life



Science



Life



Science



Science

Name: _____ Date: _____

Animal Senses Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen.

- 1** How do some animals use their sense of smell?
- (A) finding mates
 - (B) sending and receiving information
 - (C) finding prey or predators
 - (D) all of these
- 2** Which sentence compares a catfish to a butterfly?
- (A) Catfish have 175,000 taste buds.
 - (B) Butterflies walk on flowers.
 - (C) Catfish and butterflies both use organs other than tongues for tasting.
 - (D) Catfish live in dark water.
- 3** Which of the following describes how some animals use sound to find their way?
- (A) echolocation
 - (B) navigation
 - (C) vibration
 - (D) concentration
- 4** Which animal has better sight during the night than in the day?
- (A) shark
 - (B) owl
 - (C) elephant
 - (D) salamander
- 5** Which sentence compares two things?
- (A) Animals have developed a variety of touch organs to help them survive.
 - (B) Taste buds are sensory organs.
 - (C) Like the star-nosed mole, the water shrew relies entirely on touch to hunt.
 - (D) Humans have two to eight thousand taste buds on their tongues.
- 6** Many animals have sense organs that are _____ to help them.
- (A) adapted
 - (B) sensors
 - (C) communicate
 - (D) avoided



Name: _____ Date: _____

The Nose Knows

Directions: Samantha and Carlos tested which smell their dogs prefer. They placed three types of food in airtight containers and set the containers on the floor. Then, they let the dogs inside and recorded the food each dog sniffed first. Use their data to answer the questions.

Dogs	Day 1	Day 2	Day 3
Wiggles	bacon	peanut butter	peanut butter
Madam McScruffy	peanut butter	cheese	peanut butter

- 1 Which food do you think the dogs prefer? Why do you think so?

- 2 How might the results be different if they had covered the foods with a cloth instead?

- 3 How might the results be different if they had recorded how long each dog sniffed each food instead?

Life



Science



Life



Science



Science



The book cover features a vibrant green top section with faint white icons of a leaf, a DNA helix, and a molecular structure. The words "Life" and "Science" are written in a light green, cursive font. The main title "Animal Senses" is prominently displayed in the center, with "Animal" in orange and "Senses" in red, both with a white outline. Below the title is a close-up photograph of a large, hairy caterpillar with orange and white fur, perched on a dark, mossy rock. The caterpillar has large, dark, circular eyes and is surrounded by the intricate, feathery structure of a fern frond.

Animal Senses

Shelly C. Buchanan

Consultant

Leann Iacuone, M.A.T., NBCT, ATC
Riverside Unified School District

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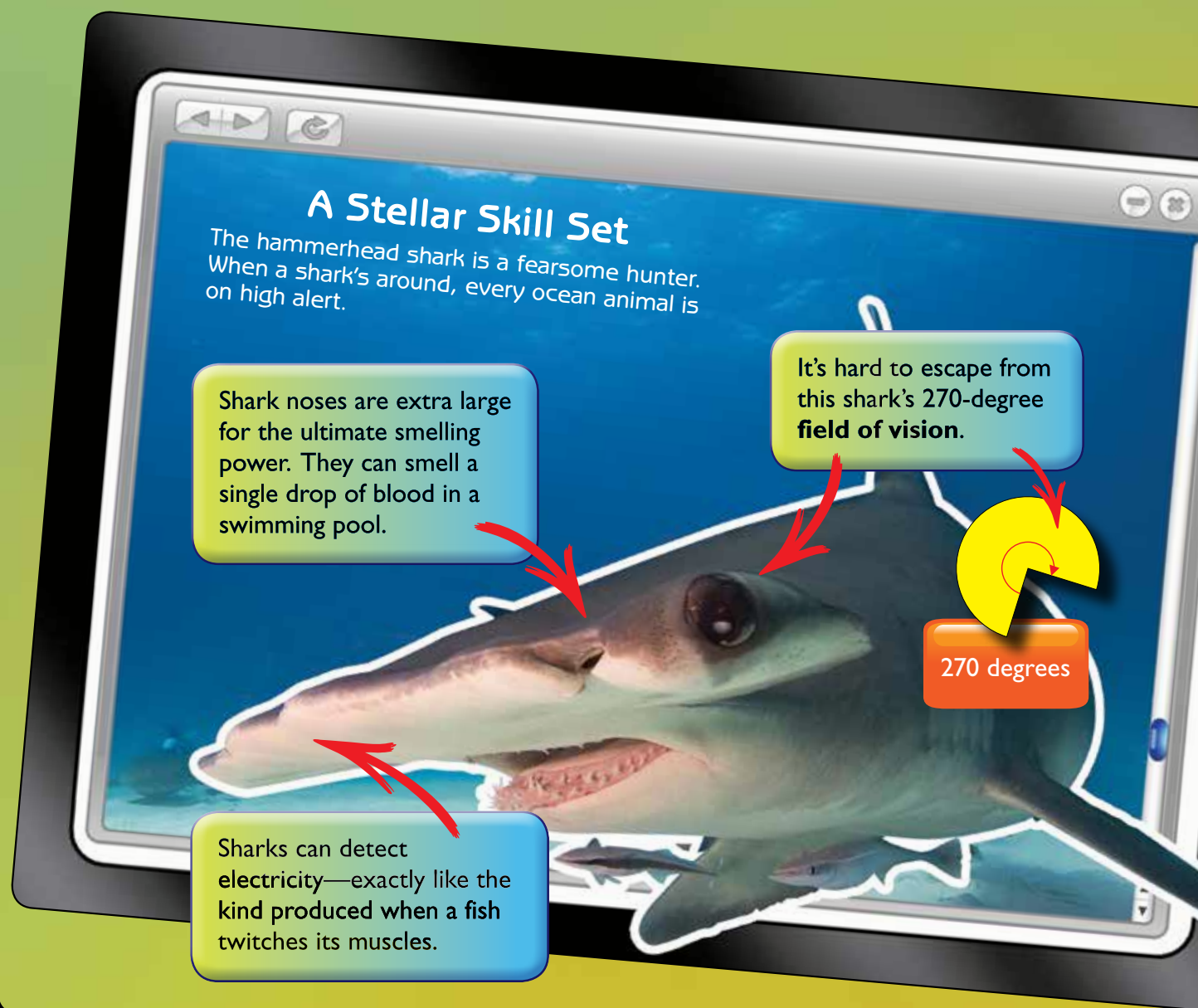
Amazing Abilities

Have you ever wished you could smell an apple pie from miles away? What if you could use your feet to listen to your favorite song on the radio? Well, grizzly bears can smell a dead animal up to 20 kilometers (12 miles) away! And African elephants can use their feet to feel **vibrations** over 10 km (6 mi.) away! But don't despair. Even though you can't do those things, you have something in common with these animals.

Humans have five senses. We use our noses to smell food, and our mouths taste it. We use our hands to touch and feel if objects are sharp or soft. Our ears let us hear if danger is coming or if someone is singing a song. Our eyes let us see how amazing our world is. We use our senses to take in information about the world. Our brains process this information, and then our bodies respond to it. Our five senses help us understand and live in the world. Our senses have **adapted** to receive the information we need most.



A grizzly bear's sense of smell is seven times better than a bloodhound's.



A Stellar Skill Set

The hammerhead shark is a fearsome hunter. When a shark's around, every ocean animal is on high alert.

Shark noses are extra large for the ultimate smelling power. They can smell a single drop of blood in a swimming pool.

It's hard to escape from this shark's 270-degree field of vision.

270 degrees

Sharks can detect electricity—exactly like the kind produced when a fish twitches its muscles.

Most animals have the same five senses. Some even have more! But animals live in environments very different from our own. So their senses have developed to help them survive where they live. The results are amazing!

Eyes Have It

Sight is the most powerful human sense. We use it to move through the world during our waking hours. Most animals enjoy the use of sight, too! They use this sense to capture prey, escape predators, find mates, and move around. This all sounds familiar, right? Many animals, however, see the world very differently than we do.

To see, we open our eyes and move them in their sockets. But birds' eyes work differently. They don't move at all. To see beyond what's right in front of them, birds move their necks instead of their eyes.

This is how they increase their field of vision. And this is why birds have twice as many bones in their necks as we do. Some animals, like the horse, have eyes on the sides of their heads. They don't need to turn their heads to see what's behind them. This helps them detect danger.

Shrimp Shades

The mantis shrimp sees life differently than people do. Not only can it see more colors than people but it can also see heat and ultraviolet light.

6



Owls can turn their heads around 270 degrees. They can turn their heads almost completely upside down!

Seeing Things Differently

Chameleons have eyelids that cover most of their eye with only a small hole for them to see through. Not only do these eyes have a 360-degree field of vision that allows them to see in every direction, but they can also move on their own. The chameleon can look forward with one eye...and backward with the other!



7



Most predatory animals, such as wolves, have eyes at the front of their head, which allow them to see straight ahead. This is called *binocular vision*. Both eyes look at the same thing, at the same time. This placement of the eyes is especially suited for predators who are attempting to capture prey. Other animals, like rabbits, have eyes on the sides of their heads. This allows them to have a wider field of vision so they can see incoming predators. This is called *monocular vision*. One eye sees one view and the other eye sees another view.

Some animals, like cats and owls, are able to see better in the dark than humans do. These animals are nocturnal. They sleep in the day and are awake at night. Their eyes have adapted to the dark so they can hunt prey. Most animals have two kinds of **cells** in their eyes: rods and cones. The rods are good for seeing in the dark. The cones are good for seeing color. Cats and owls have more rods than cones. They see well in the dark. But they don't see much color.

Rods and Cones

Dogs have more rods than cones in their eyes. They're missing the cones to see certain colors—so they can't see red or bright green!



human's vision



dog's vision

The Perfect Pupil?

The shape of an animal's eyes often reflects where it lives, when it is active, and what it's looking for.

A long, thin dark line lies at the center of a nocturnal gecko's eye. A small slit blocks out sunlight so these creatures aren't blinded during the day. The shape of their pupil gives them clearer vision—like a sharp TV screen. At night, their pupils expand to let in more light.



Owls have big, round pupils. Since owls are active at night, they need to be able to see in the dark.



The pupil grows larger at night to let in light. Their large eyes are filled with rods, so they can see and hunt in the dark. During the day, owls usually keep their eyes half closed.

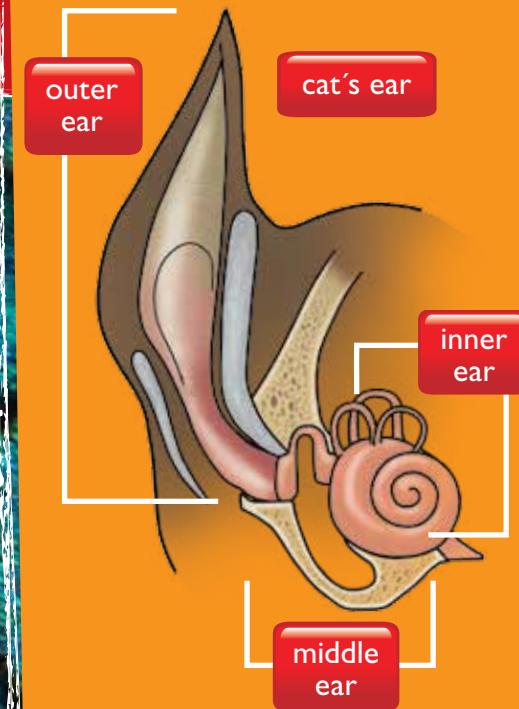
Hear Ye! Hear Ye!

Roar! The living world is a noisy place. People use sound to communicate and share ideas. We sing, laugh, and shout. Just like humans, many animals are very sensitive to sound. They use it to detect approaching predators, locate food and water, and communicate with other animals. Sound is made up of waves of energy moving through air, water, and other objects. Animals sense this energy as vibrations they feel or sounds they hear.

Animal ears come in all shapes and sizes in order to hear certain vibrations. There are teeny-tiny feather-covered holes on birds and gigantic earflaps on elephants. It's important for rabbits to hear if a predator is coming, so they have very long ears. Jackrabbit ears measure half the length of the rabbit's body. Ears can be found in some unusual places, too. Some insects, such as crickets, have ears on their legs. Some, such as hawk moths, have ears in their mouths!

To help them hear, fish use small hairs on their scales (shown here magnified) to feel the pressure in water created by sound waves.

Many animals can hear sounds that are too low or too high for our ears. Have you ever heard a dog bark for no apparent reason? It probably heard something you couldn't. Many animals can also move their ears in several directions. This allows them to better direct sounds into their ears—and to their brains.



Keep Your Balance

A cat has canals in its ears lined with hairs and liquid. The liquid in the canals allows the cat to know which direction it's facing, even if it's upside down! Its ears, combined with its flexible spine, allow it to land on its feet after most falls.

For some animals, hearing is even more important than seeing. Bats hunt for food at night. They catch most of the insects they eat in the air. Despite poor eyesight, these creatures spin and swerve nimbly. They avoid obstacles like trees and wires as they speed after their prey. Echolocation (ek-oh-loh-KEY-shuhn) helps bats know where they are and what's around them. Bats give off sound too high for people to hear. This sound bounces off nearby objects and animals. The echo helps bats know what's around, including their prey. They can even hear an echo bouncing off a mosquito's wing!

Dolphins and whales use echolocation, too. These ocean creatures send out whistles, squeaks, and clicks. Dolphins and whales have two to three times more nerves in their ears than humans. This allows them to be super-listeners. They hear sounds we can't.

The clicks made by sperm whales are the loudest and deepest made by any animal. The sounds bounce off obstacles, fish, and other creatures. These creatures of the deep use echolocation to travel, hunt, and avoid danger.

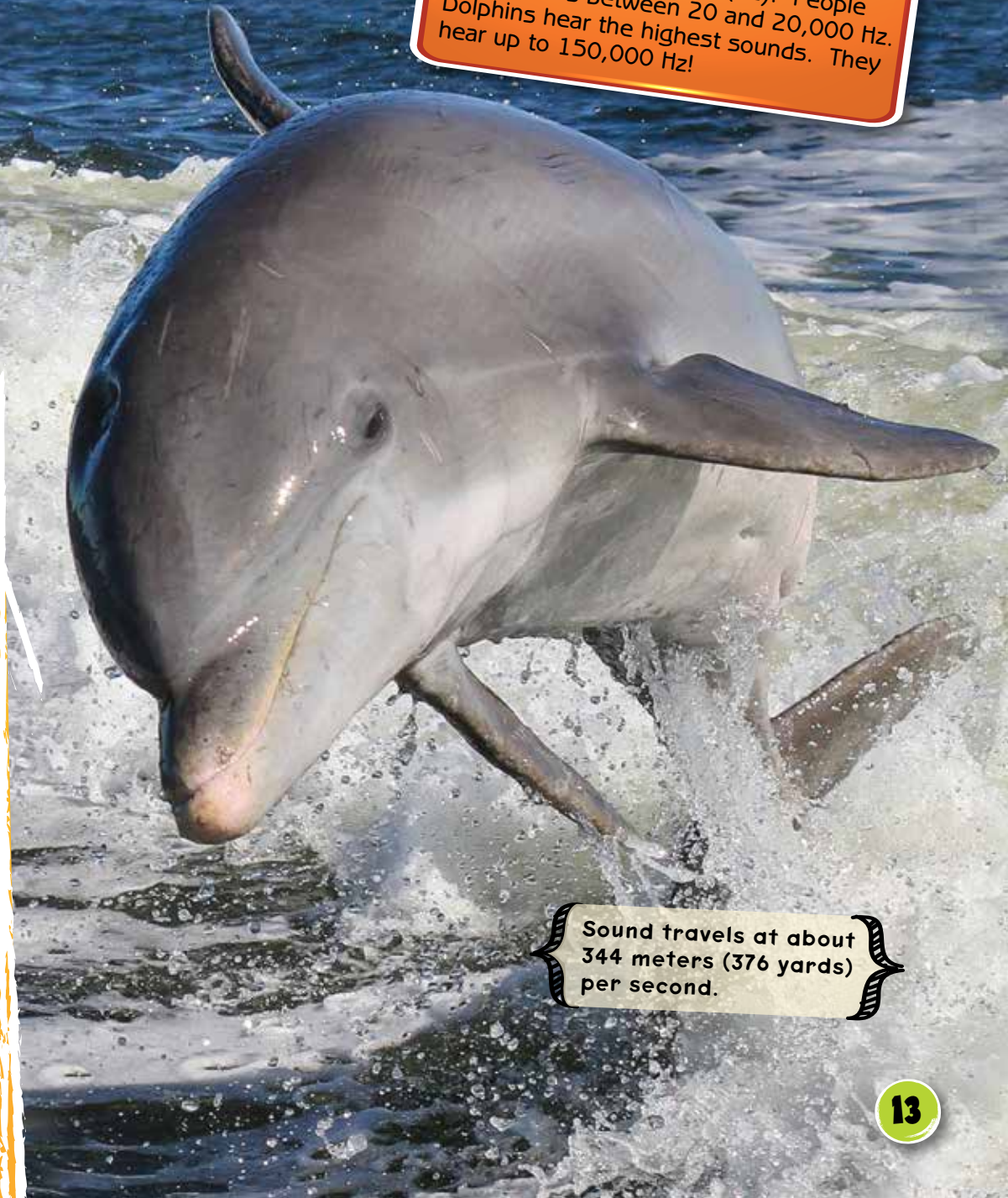


Playing Catch

Bats have ears shaped like funnels to help them catch the sound produced when they echolocate. They also have a flap in their ear to direct the sound. It's like a baseball glove for sound!

A High-Pitched Hello

Sound is measured in waves per second. One unit is called a hertz (Hz). People hear sounds between 20 and 20,000 Hz. Dolphins hear the highest sounds. They hear up to 150,000 Hz!



Sound travels at about 344 meters (376 yards) per second.

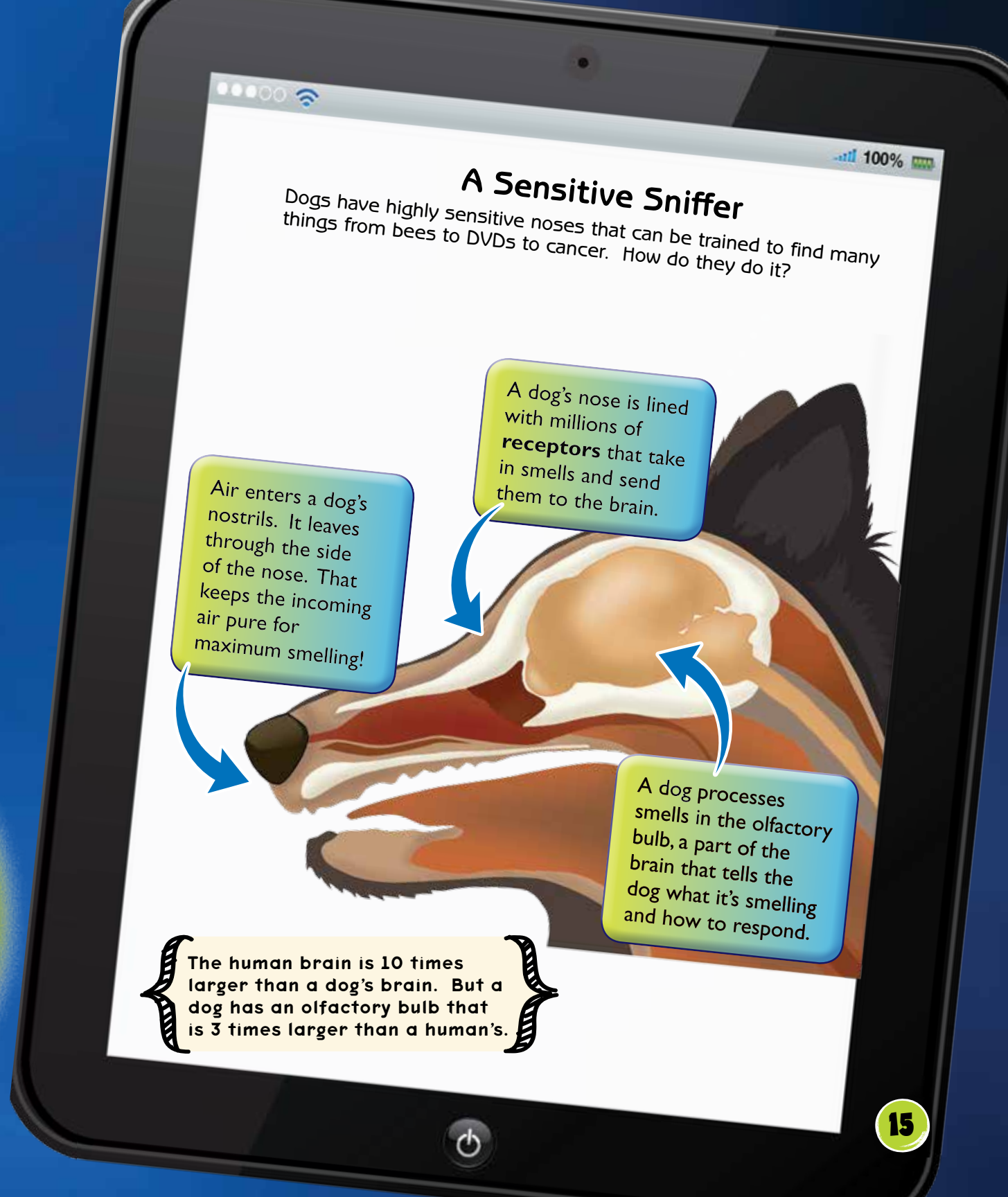
Whose Nose Knows?

For many animals, a keen sense of smell is a matter of life or death. A scent in the air or water carries a lot of information. Even in very small amounts, chemicals that make up an odor can be helpful. Animals use their sniffers to locate food or prey. They also use their noses to avoid predators. The right scent can even help animals find a mate.

There are some amazing noses in the animal kingdom. Consider an elephant's nose. It averages 2 meters (6.5 feet) in length! This terrific trunk is a super-sniffer. It also doubles as a useful tool. It can hold gallons of water and pick up heavy tree limbs.

Male moths boast one of the greatest senses of smell. They use their **antennae** to notice female moths up to six miles away. An octopus uses its tentacles to smell. A catfish uses its whiskers to “sniff” around. A snake uses its tongue to grab scent particles right out of the air!

male moth



You probably talk to or e-mail your friends to see how they're doing. You might ask them questions, listen, and look at them. But do you ever sniff your friends to catch up? This is one way animals talk to one another. They send and receive information through smell. Think of a skunk. When you or other animals catch a whiff, the skunk's message comes through loud and clear: stay away! A skunk's scent serves as a powerful form of communication and protection.

A lot of other animals use their scent like a "Keep Out" sign, as well. Gorillas, foxes, and wild cats are just a few that do this. They urinate on trees or rocks to mark their territory. This lets other animals know that the land is already occupied. Visitors are NOT welcome!



Tell Me Everything
Animals use smell to communicate, not only with one another but also with you, too! When you're upset or scared, your pet can smell it. Your pets can know what mood you're in without you having to say a word.

Other animals use scents like a party invitation. When one ant finds food, the whole gang is invited! Ants pass scent messages to one another with their antennae. They also leave a trail of scent on the ground. This way, other ants can easily find the feast.



green ants

When a bee stings an animal or a person, it releases chemicals that other bees can smell. This lets them know there is danger in the area.



Bunting
When cats rub their heads against something, it's called *bunting*. This lets them mark their personal scent on family members, close friends, and treasured items. It's a kitty compliment!

Tongues for Tasting

What are your favorite foods? Why is it that you enjoy some foods more than others? It might be because of the texture of the food or the color. But you probably like it mostly because of the way it tastes. Many animals are sensitive to taste, too. Some have favorite foods. Many have foods they won't touch. Some are so particular they'll eat only one kind of food.

Different species have different taste buds in order to better detect the food they need to eat. Some use their taste buds to help them know what to avoid. Bitterness can be a sign that a type of food is poisonous. Sweetness can be a sign that a food will give animals a quick jolt of energy.

Taste buds are sensory **organs**. These are the receptors that tell the brain whether a food is salty, sour, sweet, or bitter. Scientists think most animals experience tastes the same way people do. But it's difficult to know!



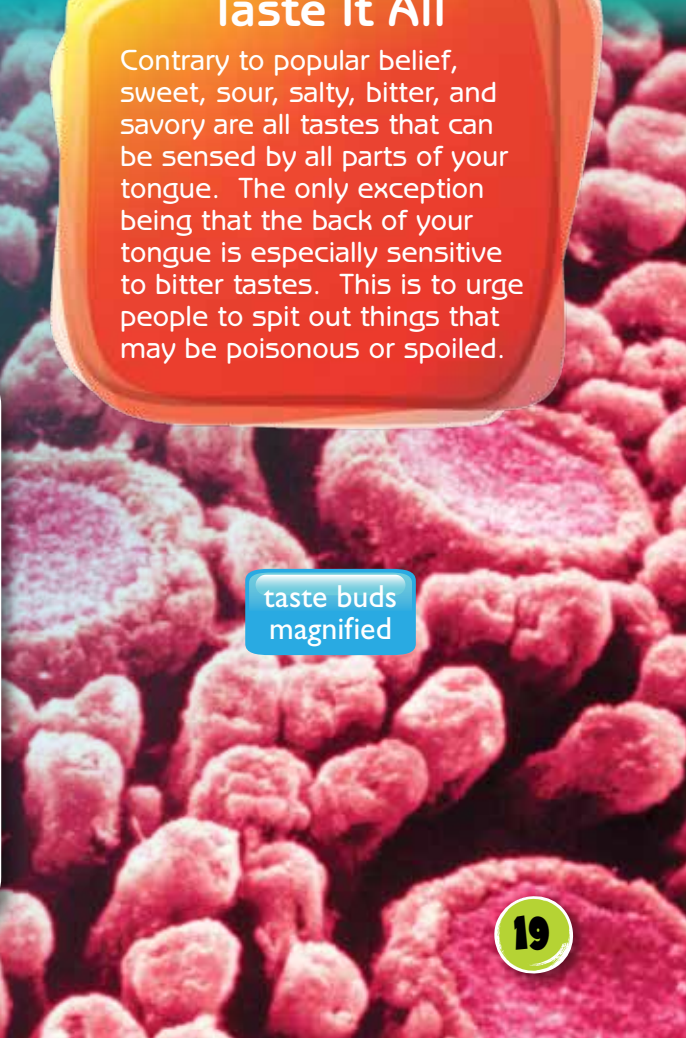
Taste It All
Contrary to popular belief, sweet, sour, salty, bitter, and savory are all tastes that can be sensed by all parts of your tongue. The only exception being that the back of your tongue is especially sensitive to bitter tastes. This is to urge people to spit out things that may be poisonous or spoiled.



Meow!
Cats can't taste sweetness at all. They lost this ability long ago. While your kitten may lap up the water you dish out, don't give your cat any ice cream. This favorite treat of humans would be wasted on cats!

Test your Taste Buds
People can have anywhere from 2,000 to 8,000 taste buds. Find out if you have a lot or a little with a simple at home experiment.

1. Put two drops of blue food coloring on your tongue and swallow a few times.
2. Check your tongue to see how blue it is. If it's really blue, you have fewer taste buds. A pink tongue means you have a lot!



In humans, taste buds are found on the tongue. But insects like butterflies use their feet to taste things! They walk on flowers to decide if they want the nectar. Their tongues remain neatly rolled up under their heads and then spring out to suck up nectar. These creatures taste sweetness 200 times more strongly than we do!

A snake tastes things by grabbing scent particles out of the air with its tongue. It presses these particles into a space on the roof of its mouth. This nook, called *Jacobson's organ*, sends a message to its brain with the scent information.

Humans have 2 to 8 thousand taste buds on their tongues. A **carnivore** has fewer. For instance, a lion has about 470. It eats a simple diet of meat and more meat. It doesn't need to have a wide range of tastes. And the few foods this animal does eat tend to be pretty safe. An **omnivore** has more taste buds. A pig clocks in at 15,000. It needs to find a wider variety of food. An **herbivore** has the most taste buds. A cow has 25,000! It needs to locate a lot of different flavors to meet its dietary needs. An herbivore also tends to have more taste buds so it can detect dangerous chemicals in plants.



For the Win!

Catfish take the cake for the largest number of taste buds. They have about 175,000! They are located in the catfish's mouth and on its skin and whiskers. With so many taste buds, the catfish can find food in dark water.



butterfly eye

butterfly tongue rolled up

Touch & Feel

You use your sense of touch to make your bed, eat a snack, write a note, and cuddle an animal. You might also use this sense to avoid danger, such as a hot stove. Most animals have developed a sense of touch for the same reasons. Their sense of touch allows them to build a home, find food, communicate, and stay safe. Animals have developed a variety of touch organs to help them survive.

Walrus hunt for food by rubbing their heads in the mud. They use the whiskers around their mouths to feel for food. They can easily detect something, such as a crab or a clam, that has the right shape and texture for eating. Then, they dig in for lunch!

A giant anteater can barely see. But it does have a super-nose for finding insects. When its extra-long tongue goes to work, it can extend deep inside an ant nest. The sticky saliva acts like glue. The giant anteater's tongue can slurp up 25,000 insects a day!



giant anteater



Hot Lips

Snakes have gaps around their lips that allow them to feel nearby heat. These gaps are called *heat pits*. They alert the snake to warm-blooded prey ready for the taking. Can you say "dinnertime"?

Humans aren't the only animals that use touch to say hello. Apes and monkeys hug and sometimes kiss when they meet one another.

An animal's sense of touch can keep it safe and sound. Many kinds of fish swim in groups for safety. They move together like dancers. To do this, they use their lateral line system. A fish has one lateral line on each side of its body. It includes receptors that sense pressure. When a neighbor fish moves, the others can sense it in a split second. They move with it. Moving together, the fish find safety in numbers.

Star-nosed moles are nearly blind. So, they have evolved an incredible sense of touch. These moles have 22 soft tentacles surrounding their noses. These tentacles carry 25,000 touch **sensors**. The sensors are more sensitive than human fingers! Moles use these sensors to find their way through the dark. They hunt for food this way, too. They also use this super-sense to avoid going out into the open where they might be attacked by predators.

Other animals rely on being untouchable. Porcupines sport prickly spines to keep enemies away. Bees and wasps use their sharp stingers to ward off enemies.

A Tricky Touch

When you touch something, electrical signals are sent to your brain. Scientists monitored monkeys' brains and watched where signals were sent when the monkeys were touched. Then, they sent an electrical signal to that part of the brain but didn't touch the monkeys! The monkeys reacted as if they were touched.



star-nosed mole

Hunting by Touch

Like the star-nosed mole, the water shrew relies entirely on touch to hunt. It doesn't use smell, sight, or hearing to guide it. Instead, its whiskers help it locate food underwater.



water shrew



Power of Information

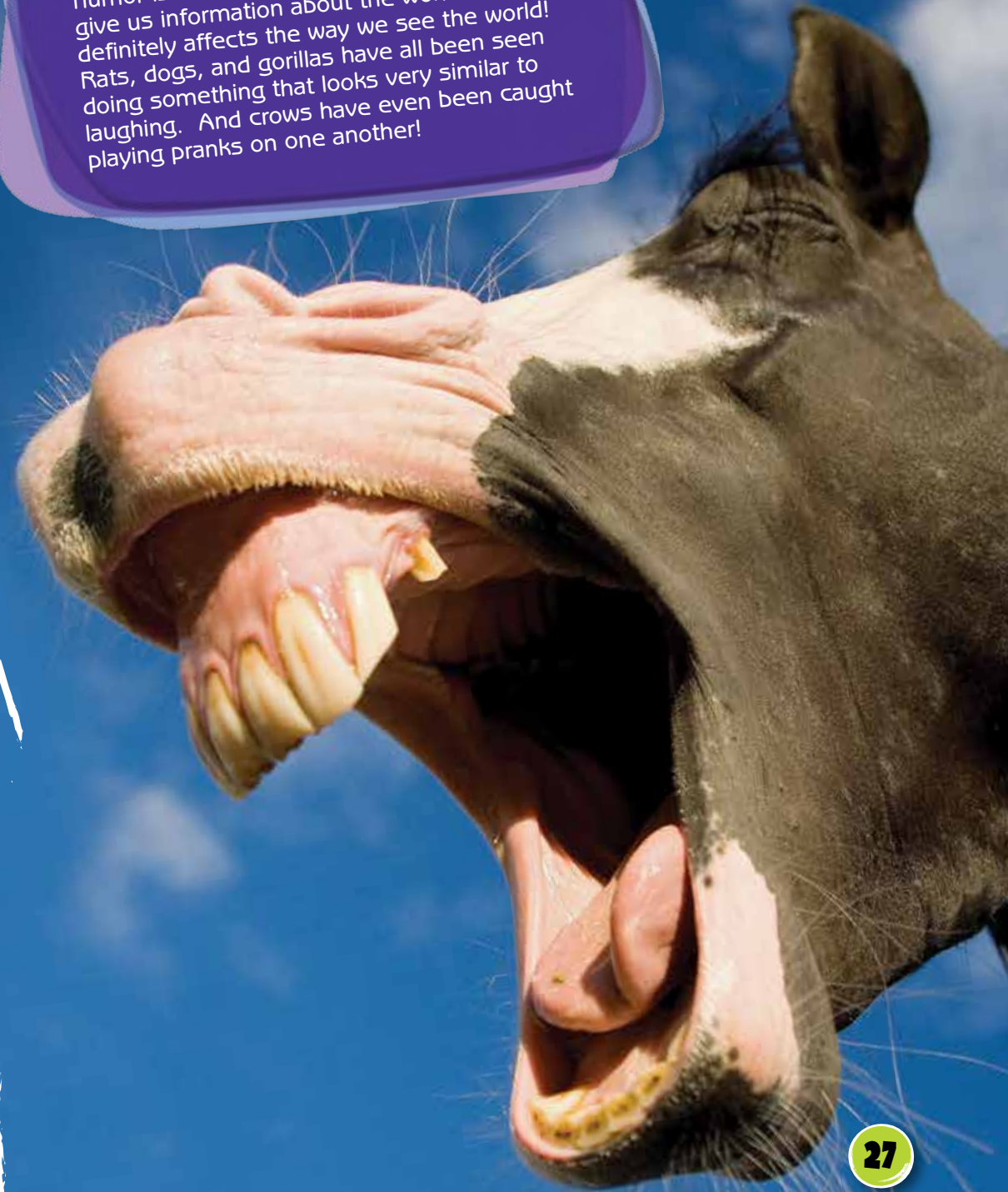
Every animal, from a tiny ant to a gigantic whale, needs to receive and process information about the world. While many animals have the same five senses as people, some have developed additional senses that are hard for us to imagine. Sights, sounds, smells, tastes, electrical pulses, and more all provide animals with information. And the brain lies at the center of it all, taking in sensory details and telling the body how to respond. The way each animal receives information and uses it may differ. That's because the world looks, sounds, tastes, and feels different to every living thing. But every creature uses its senses to make sense of the world!



common squirrel monkey

A Sense of Humor

Humor isn't like the other senses. It doesn't give us information about the world. But it definitely affects the way we see the world! Rats, dogs, and gorillas have all been seen doing something that looks very similar to laughing. And crows have even been caught playing pranks on one another!



Think Like a Scientist

How does the shape of an animal's body parts relate to its abilities? Experiment and find out!

What to Get

- 4 sheets of paper
- music
- scissors
- tape



What to Do

- 1 Roll the paper into a cone shape. Make the smaller end fit snugly around your ear. Tape the paper together.
- 2 Hold the smaller end of the cone to your ear. Plug the other ear with a finger. Listen to music.
- 3 Now switch the direction of the cone. Listen again. What do you notice? Experiment with different ear shapes.
- 4 Next, hold two sheets of paper on either side of your face. Try to look around without moving your head. What type of animal may have vision similar to this?
- 5 Take two sheets of paper and cut long slits so you can barely see through them. Hold them up to your eyes and look around. How well can you see?
- 6 Cut the slits wider so you can see a bit more. How does your vision change? Experiment with different eye shapes. What animals have these eyes?



Glossary

adapted—changed so that it is easier to live in a particular place

antennae—thin, sensitive organs on the head of an insect, crab, etc., which are used mainly to feel and touch things

carnivore—a living thing that only eats meat

cells—basic units of life

field of vision—the area that you can see without moving your eyes

herbivore—a living thing that only eats plants

omnivore—a living thing that eats both plants and animals

organs—parts of the body that have particular functions

pupil—the small, black, round area at the center of the eye

receptors—nerve endings that sense changes in light, temperature, pressure, etc., and cause the body to react in a particular way

sensors—devices that detect or sense heat, light, sound, motion, etc., and then react to it in a particular way

vibrations—rapid motions of particles back and forth

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Your Turn!



Night Lights

Next time you're out at night, take time to listen to all the sounds around you. Smell the air. Use your hands to feel around you. Now, imagine being a nocturnal animal. Think about how you could use your senses to find food and stay safe.