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Integrated Science

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GRADE 7 • VOLUME 2

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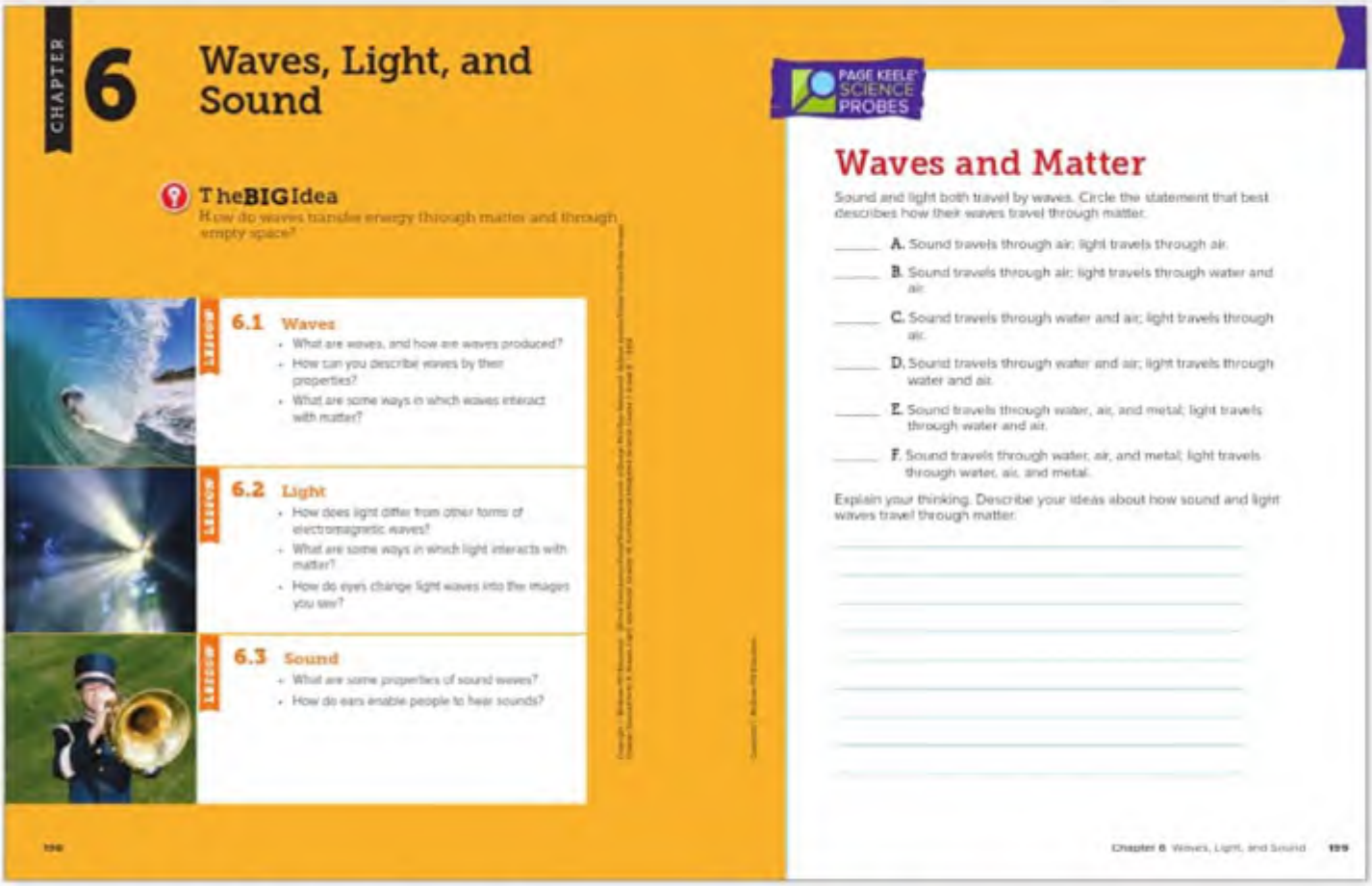
CHAPTER 6

Waves, Light, and Sound

The BIG Idea

How do waves transfer energy through matter and through empty space?

6.1 Waves
- What are waves, and how are waves produced?
- How can you describe waves by their properties?
- What are some ways in which waves interact with matter?

6.2 Light
- How does light differ from other forms of electromagnetic waves?
- What are some ways in which light interacts with matter?
- How do eyes change light waves into the images you see?

6.3 Sound
- What are some properties of sound waves?
- How do ears enable people to hear sounds?

PAGE KEELEY SCIENCE PROBES

Waves and Matter

Sound and light both travel by waves. Circle the statement that best describes how their waves travel through matter.

A. Sound travels through air; light travels through air.

B. Sound travels through air; light travels through water and air.

C. Sound travels through water and air; light travels through air.

D. Sound travels through water and air; light travels through water and air.

E. Sound travels through water, air, and metal; light travels through water and air.

F. Sound travels through water, air, and metal; light travels through water, air, and metal.

Explain your thinking. Describe your ideas about how sound and light waves travel through matter.

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Waves, Light, and Sound

The BIG Idea

There are no right or wrong answers to these questions. Write studentgenerated questions produced during the discussion on chart paper and return to them throughout the chapter.

Guiding Questions

AL Describe a water wave you have seen.	*Students may describe a large wave rolling across an ocean or a lake, smaller waves in a pond or swimming pool, ripples in a pool of rainwater, a bathtub, or sink.*
OL Describe one property of a wave.	*Students may describe the size, speed, or height of a wave, or the amount of energy it carries.*
BL Think about water waves of varying sizes on a lake or in a swimming pool. Describe one way in which waves of varying sizes are the same and one way in which they're different.	*Students may describe how larger waves affect boats and other objects in the water as compared to smaller waves, which often have little effect. No matter the size, all water waves transfer energy as they move across the surface of the water.*

PAGE KEELEY SCIENCE PROBES

Waves and Matter

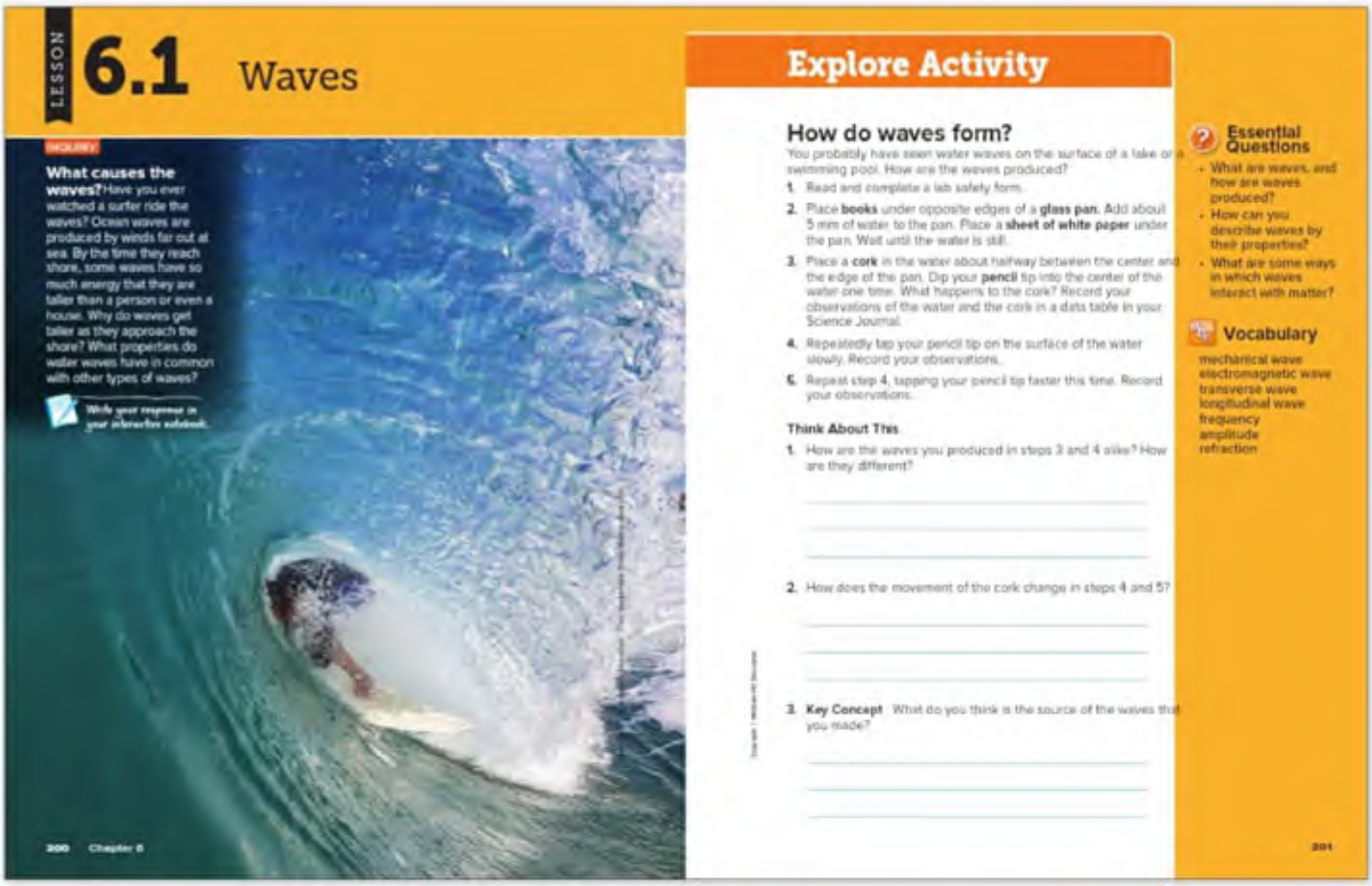
Answers to the Page Keeley Science Probe can be found in the Teacher's Edition of the *Activity Lab Workbook*.

Use the photo to start a discussion that connects students to The Big Idea. To focus the discussion, ask the class the questions below.

TIP List Related Terms Ask students to brainstorm a list of terms they already know that relate to waves, light, and sound. For example, students might list words such as *brightness* or *energy*. Write the list on chart paper or on the board. As the class reads the chapter, add new terms based on what they learn .

Guiding Questions

AL What do the different colors on the map mean?	*Varying colors are used on maps to show differing degrees of precipitation.*
OL How do meteorologists get the information they display on a weather map?	*Weather satellites capture images that meteorologists rely on to predict weather patterns and climate.*
BL How do waves transfer energy through matter and through empty space?	*Energy creates disturbances that transfer the energy in waves through matter and space.*


LESSON 6.1 Waves

INQUIRY

What causes the waves? Have you ever watched a surfer ride the waves? Ocean waves are produced by winds far out at sea. By the time they reach shore, some waves have so much energy that they are taller than a person or even a house. Why do waves get taller as they approach the shore? What properties do water waves have in common with other types of waves?

Write your response in your interactive notebook.

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Explore Activity

How do waves form?

You probably have seen water waves on the surface of a lake or a swimming pool. How are the waves produced?

1. Read and complete a lab safety form.
2. Place **books** under opposite edges of a **glass pan**. Add about 5 mm of water to the pan. Place a **sheet of white paper** under the pan. Wait until the water is still.
3. Place a **cork** in the water about halfway between the center and the edge of the pan. Dip your **pencil** tip into the center of the water one time. What happens to the cork? Record your observations of the water and the cork in a data table in your Science Journal.
4. Repeatedly tap your pencil tip on the surface of the water slowly. Record your observations.
5. Repeat step 4, tapping your pencil tip faster this time. Record your observations.

Think About This

1. How are the waves you produced in steps 3 and 4 alike? How are they different?

2. How does the movement of the cork change in steps 4 and 5?

3. **Key Concept** What do you think is the source of the waves that you made?

Essential Questions

- What are waves, and how are waves produced?
- How can you describe waves by their properties?
- What are some ways in which waves interact with matter?

Vocabulary

mechanical wave
electromagnetic wave
transverse wave
longitudinal wave
frequency
amplitude
refraction

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INQUIRY

About the Photo **What causes the waves?** Ask students to describe the waves in this photo. Discuss how the waves travel across the surface of the water.

Guiding Questions

AL	How does it feel when a wave flows past you?	*Waves push against you and make you bounce up and down in the water.*
OL	Waves make objects rise and fall in the water. Why do you think that happens?	*Waves have a lot of energy and can make things move.*
BL	How do you think the waves affect people and objects in the water?	*As the waves pass, they affect the motion of the people and objects in the water.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Create Wave Trading Cards

1. Give one index card to each student. Assign each student a number from 1 to 4. Then tell students to draw a picture of a different kind of wave according to the assigned number:
   1. Graw a picture of what happens to pond water when a pebble is tossed into it.
   2. Draw a picture of a rainbow created by a prism.
   3. Draw a picture of wind pushing a sailboat.
   4. Draw a picture of ocean waves reaching a rocky shore.
2. Have students look at the four vocabulary terms that end with *wave*. **Ask: Which term best describes your illustration? Explain.** *Students should write their answers on the backs of their cards.*
3. Instruct students to refer to their index cards as they read this lesson, and to raise their hands when they read the section that explains the type of wave they illustrated.

ExploreActivity

How do waves form?

Purpose
The students will understand that energy causes waves. Changing the energy transferred to a medium changes the properties of the wave.

Materials
two textbooks, glass pan, sheet of white paper, cork, pencil
Alternative materials: cork sliced into a disc about 1 cm thick, fishing bobber, or plastic bottle top

Before You Begin
Have students brainstorm different waves they have seen (such as waves on a flag, ocean waves, or waves at a stadium) and then think about what causes these waves.

Guide the Investigation

- A drop of liquid dish soap or food coloring in the water decreases surface tension and makes the waves easier to see.
- The cork might move to the edge of the pan. Have students think about how energy is transferred to the cork and what that might do to the cork's motion.

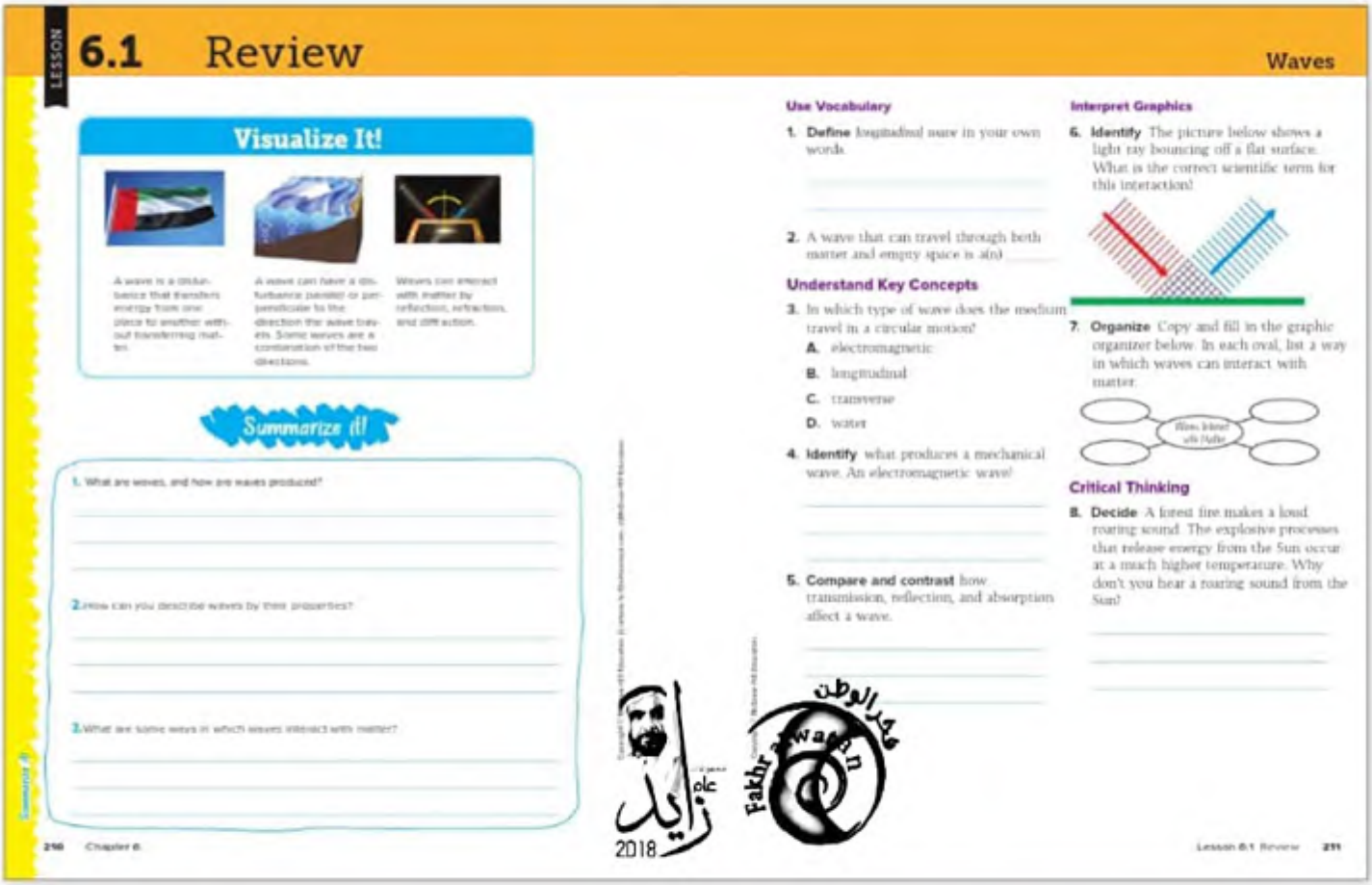
Sample Data Table

Procedure	Behavior of water	Behavior of cork
Tap one time	Concentric circles moved to edge, bounced off, and stopped.	Bobbed, then stopped moving
Slowly tap	Continuous concentric circles	Bobbed back and forth each time a wave went under it
Quickly tap	Continuous concentric circles close together	Bobbed back and forth each time a wave went under it

Think About This

1. The waves were circular and spread out from the pencil tip in all directions with equal speed. Step 3 produced a wave that traveled to the edges and bounced off the sides of the pan, but the water became still very quickly. Step 4 produced repeated circular waves throughout the pan.
2. In step 4 the cork wobbled a couple of times, then stopped moving. In step 5, the cork wobbled back and forth repeatedly.
3. **Key Concept** The energy from the pencil tip caused all the waves.

Teacher Notes



LESSON 6.1 Review — Waves

Visualize It!

A wave is a disturbance that transfers energy from one place to another without transferring matter.

A wave can have a disturbance parallel or perpendicular to the direction the wave travels. Some waves are a combination of the two directions.

Waves can interact with matter by reflection, refraction, and diffraction.

Summarize it!

1. What are waves, and how are waves produced?

2. How can you describe waves by their properties?

3. What are some ways in which waves interact with matter?

Use Vocabulary

1. **Define** longitudinal wave in your own words.

2. A wave that can travel through both matter and empty space is a(n) _____.

Understand Key Concepts

3. In which type of wave does the medium travel in a circular motion?
   A. electromagnetic
   B. longitudinal
   C. transverse
   D. water

4. **Identify** what produces a mechanical wave. An electromagnetic wave?

5. **Compare and contrast** how transmission, reflection, and absorption affect a wave.

Interpret Graphics

6. **Identify** The picture below shows a light ray bouncing off a flat surface. What is the correct scientific term for this interaction?

7. **Organize** Copy and fill in the graphic organizer below. In each oval, list a way in which waves can interact with matter.

Critical Thinking

8. **Decide** A forest fire makes a loud roaring sound. The explosive processes that release energy from the Sun occur at a much higher temperature. Why don't you hear a roaring sound from the Sun?

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Visual Summary

Concepts and terms are easier to remember when they are associated with an image. **Ask: Which Key Concept does each image relate to?**

Use Vocabulary

1. Sample answer: In a longitudinal wave, each particle in the medium vibrates back and forth, parallel to the direction in which the wave travels.
2. electromagnetic wave

Understand Key Concepts

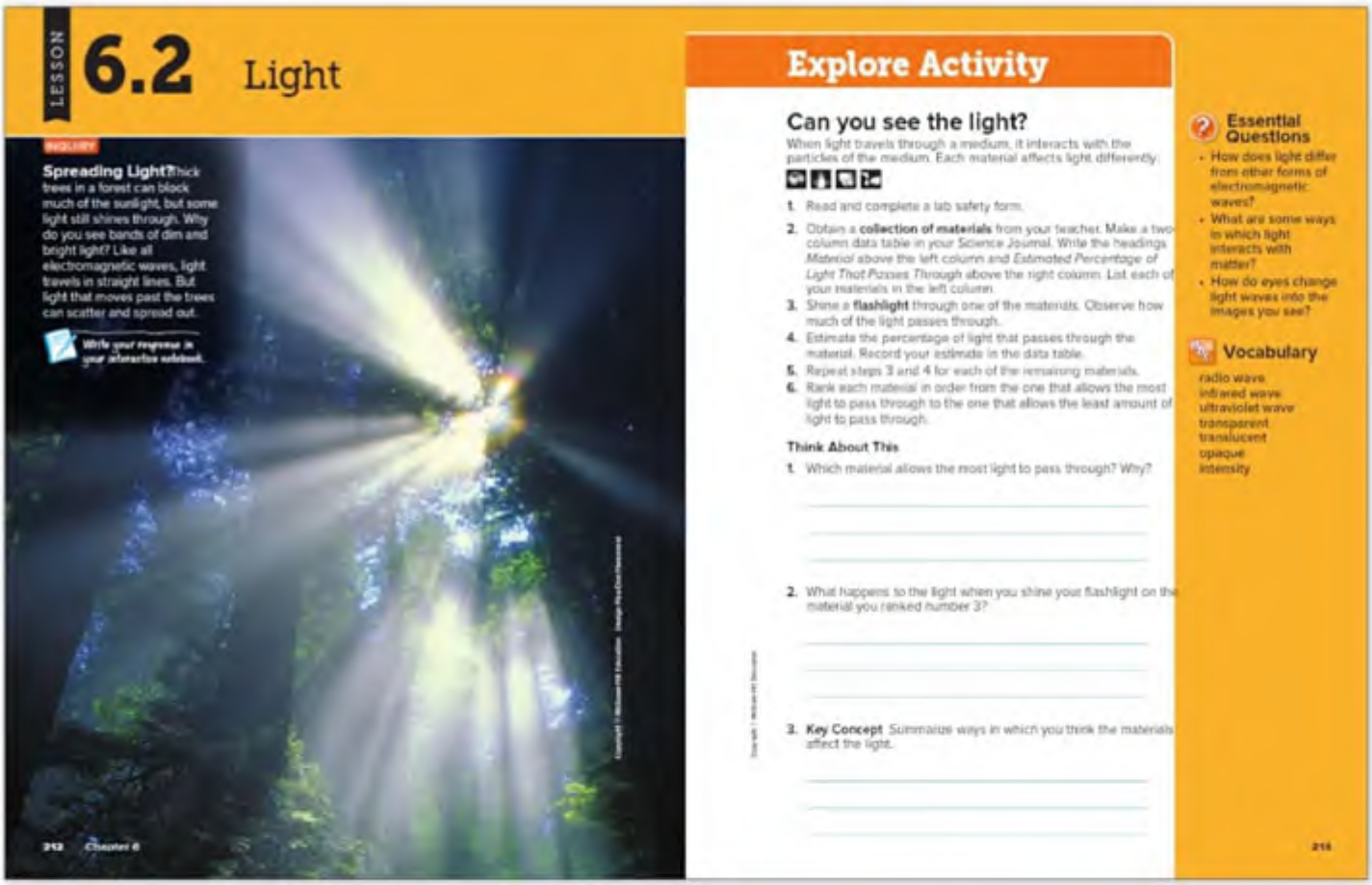
3. D. water
4. A mechanical wave is produced when a source of energy causes particles of matter to vibrate. An electromagnetic wave is produced when a source of energy causes charged particles to vibrate.
5. Transmission transfers wave energy through a material. Absorption transfers wave energy to the medium through which the wave travels. Reflection is the bouncing of a wave off a surface.

Interpret Graphics

6. reflection
7. List any four of these five answers: absorption, reflection, refraction, diffraction, transmission.

Critical Thinking

8. We cannot hear the explosions on the Sun because sound is a mechanical wave and cannot travel through space.



INQUIRY

About the Photo **Spreading Light?** Instruct students to look at the photograph of light shining through the forest. Have them consider what they know about how waves travel and the energy they transmit in order to make predictions about light waves.

Guiding Questions

AL	Where does the light appear to be the brightest?	*Near the top of the picture, behind the trees, where you see what might be the Sun.*
OL	Where does the light appear the dimmest?	*Near the bottom of the picture and to the left and right, which are farthest from the beam of light.*
BL	Why do you think certain areas of the forest are illuminated by the light waves better than other areas?	*The forest is brightest where there are fewer objects blocking the light and where you can see its source. The forest is darkest where the trees are thickest and in those areas farthest from the light beam.*

Essential Questions

After this lesson, students should understand the Key Concepts and be able to answer these questions. Have students write each question in their Science Journals. Revisit each question as you cover its relevant content.

Vocabulary

Develop Prior Knowledge

1. Write this lesson's vocabulary terms on the board.
2. Ask students to read them and think about which terms they have heard before. Students are likely to be familiar with the words *transparent* and *intensity*, among others.
3. Working together as a class, have student create definitions for any terms they already know. Write their definitions on chart paper or the board.
4. After completing the lesson, return to the definitions and revise them as needed or include additional information that students have learned.

ExploreActivity

Can you see the light?

Purpose
To observe how light interacts with different materials.

Materials
a collection of five materials that can cover the end of a flashlight such as white paper, gauze, plastic wrap, a textbook, or paper towel

Before You Begin
Discuss percentage and estimation. Tell the students that their estimations can be whole numbers.

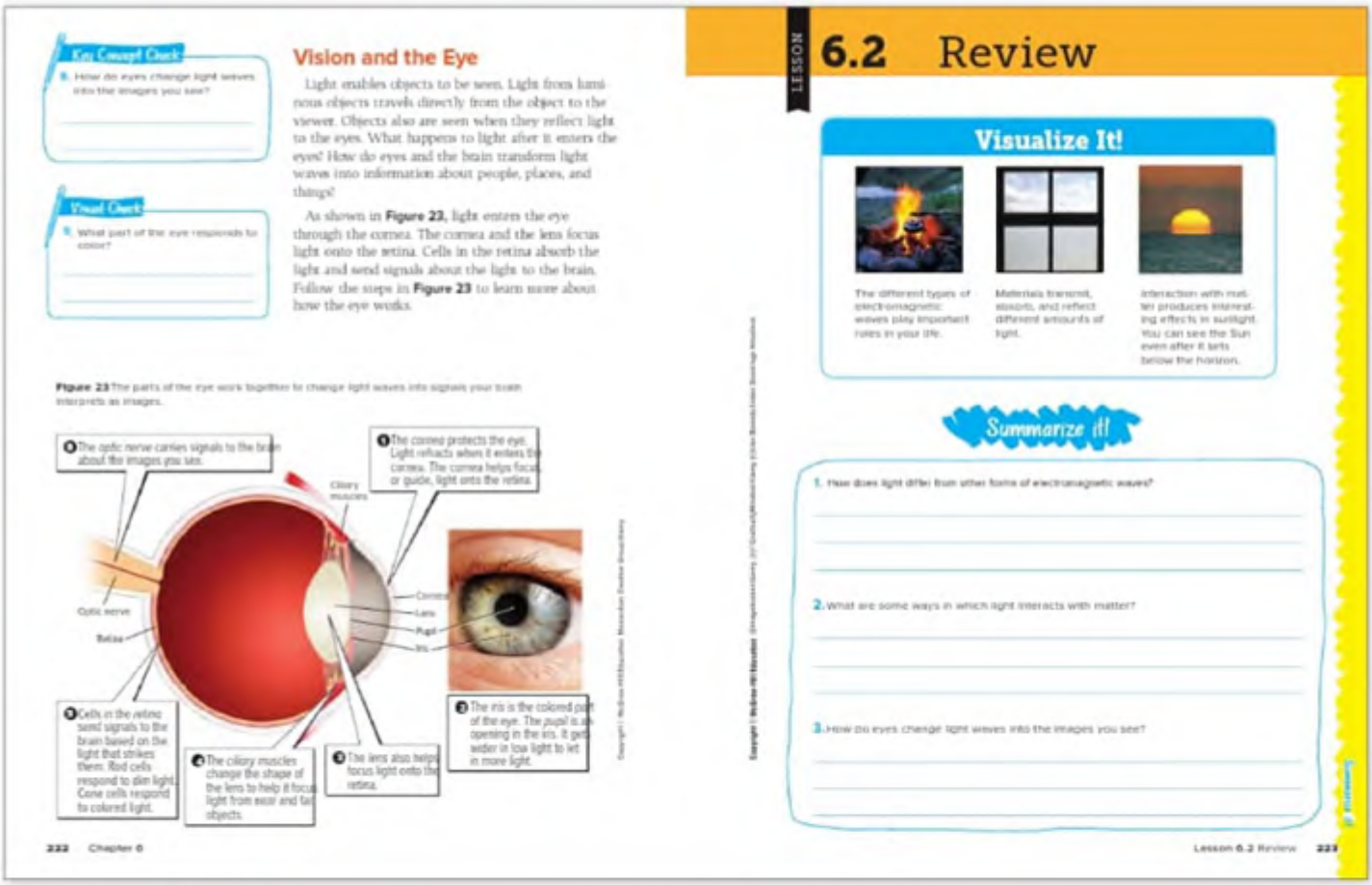
Guide the Investigation
Make the classroom as dark as possible for best results with this lab. Students should shine the flashlight 15 cm to 20 cm from the same white surface or white piece of paper for each trial.

Material	Estimated amount of light (%)	Rank
White paper	20%	4
Gauze	80%	2
Textbook	0%	5
Plastic	100%	1
Paper towel	40%	3

Think About This

1. Answers will vary. The plastic wrap allowed the most light to pass through because it was clear.
2. Some of the light was blocked, but some of the light passed through.
3. **Key Concept** Answers will vary. The light waves are blocked by particles that make up each material.

Teacher Notes



Key Concept Check

8. How do eyes change light waves into the images you see?

Visual Check

9. What part of the eye responds to color?

Vision and the Eye

Light enables objects to be seen. Light from luminous objects travels directly from the object to the viewer. Objects also are seen when they reflect light to the eyes. What happens to light after it enters the eyes? How do eyes and the brain transform light waves into information about people, places, and things?

As shown in **Figure 23**, light enters the eye through the cornea. The cornea and the lens focus light onto the retina. Cells in the retina absorb the light and send signals about the light to the brain. Follow the steps in **Figure 23** to learn more about how the eye works.

Figure 23 The parts of the eye work together to change light waves into signals your brain interprets as images.

LESSON 6.2 Review

Visualize It!

The different types of electromagnetic waves play important roles in your life.

Materials transmit, absorb, and reflect different amounts of light.

Interaction with matter produces interesting effects in sunlight. You can see the Sun even after it sets below the horizon.

Summarize it!

1. How does light differ from other forms of electromagnetic waves?

2. What are some ways in which light interacts with matter?

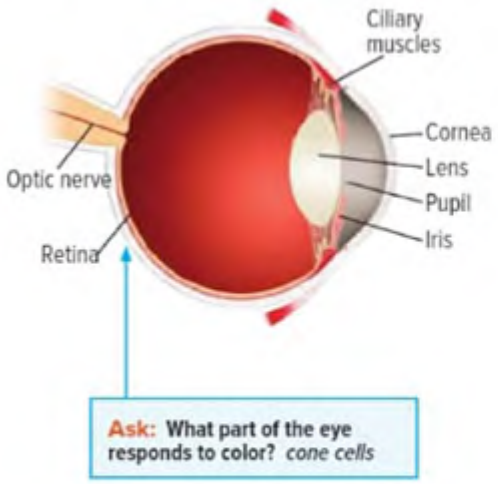
3. How do eyes change light waves into the images you see?

Visual Literacy: The Eye

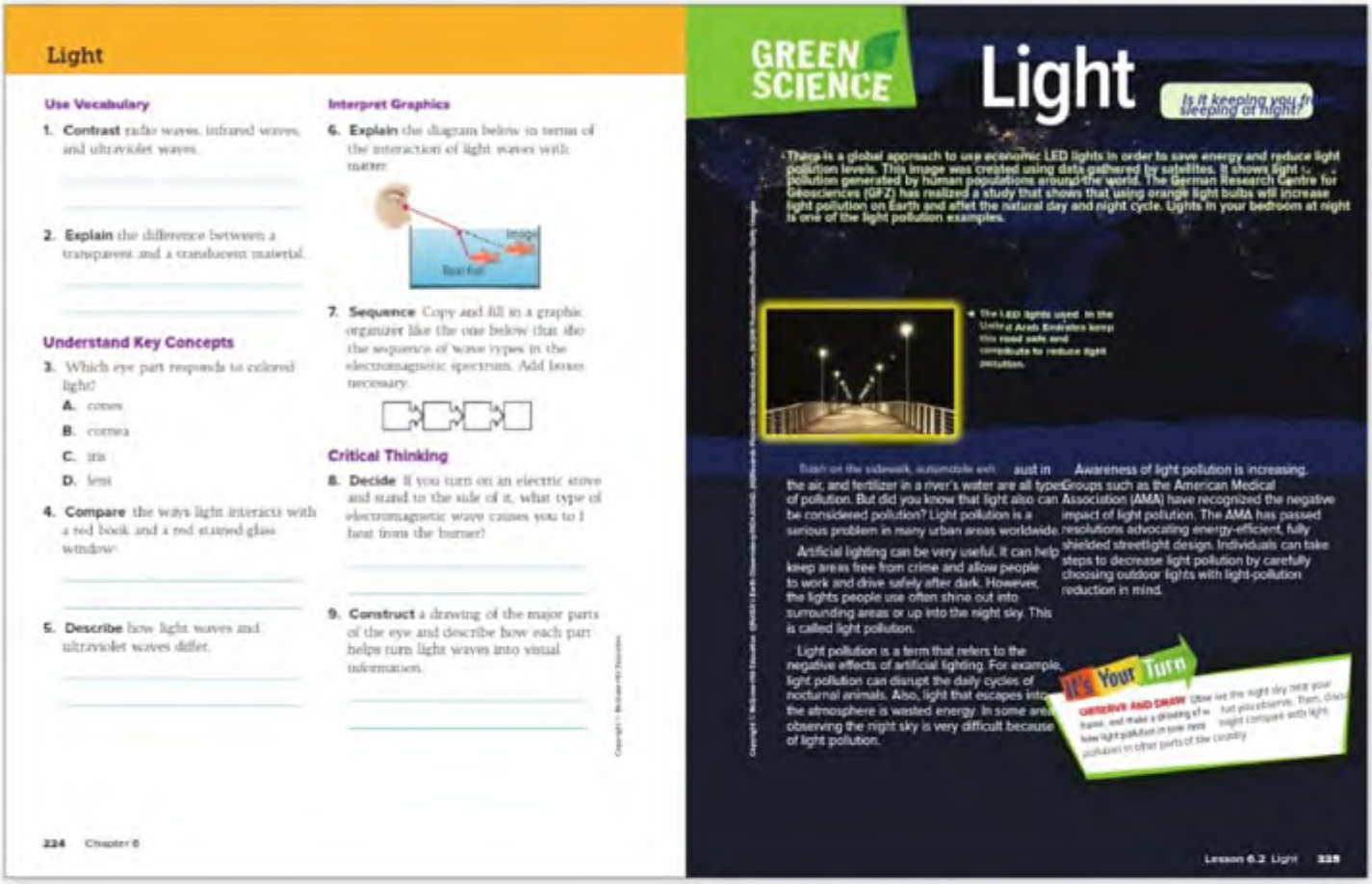
Discuss the parts of the eye in **Figure 23.** Note that light enters through the pupil. When the eyelid covers the pupil, no light enters. Ask these questions and discuss the structures of the eye. **Ask: Why isn't the cornea or lens visible in the photograph of the eye?** *The cornea is clear and thus invisible. The lens is behind the pupil on the inside of the eye.*

Visual Summary

Concepts and terms are easier to remember when they are associated with an image. **Ask: Which Key Concept does each image relate to?**



Ask: What part of the eye responds to color? *cone cells*



Light

Use Vocabulary

1. **Contrast** radio waves, infrared waves, and ultraviolet waves.

2. **Explain** the difference between a transparent and a translucent material.

Understand Key Concepts

3. Which eye part responds to colored light?
   A. cones
   B. cornea
   C. iris
   D. lens

4. **Compare** the ways light interacts with a red book and a red stained glass window.

5. **Describe** how light waves and ultraviolet waves differ.

Interpret Graphics

6. **Explain** the diagram below in terms of the interaction of light waves with matter.

7. **Sequence** Copy and fill in a graphic organizer like the one below that ilbo the sequence of wave types in the electromagnetic spectrum. Add boxes necessary.

Critical Thinking

8. **Decide** If you turn on an electric stove and stand to the side of it, what type of electromagnetic wave causes you to f heat from the burner?

9. **Construct** a drawing of the major parts of the eye and describe how each part helps turn light waves into visual information.

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GREEN SCIENCE

Light

Is it keeping you fr sleeping at night?

There is a global approach to use economic LED lights in order to save energy and reduce light pollution levels. This image was created using data gathered by satellites. It shows light p pollution generated by human populations around the world. The German Research Centre for Geosciences (GFZ) has realized a study that shows that using orange light bulbs will increase light pollution on Earth and affet the natural day and night cycle. Lights in your bedroom at night is one of the light pollution examples.

The LED lights used in the United Arab Emirates keep this road safe and contribute to reduce light pollution.

Trash on the sidewalk, automobile exh dust in the air, and fertilizer in a river's water are all types of pollution. But did you know that light also can be considered pollution? Light pollution is a serious problem in many urban areas worldwide.

Artificial lighting can be very useful. It can help keep areas free from crime and allow people to work and drive safely after dark. However, the lights people use often shine out into surrounding areas or up into the night sky. This is called light pollution.

Light pollution is a term that refers to the negative effects of artificial lighting. For example, light pollution can disrupt the daily cycles of nocturnal animals. Also, light that escapes into the atmosphere is wasted energy. In some are observing the night sky is very difficult because of light pollution.

Awareness of light pollution is increasing. Groups such as the American Medical Association (AMA) have recognized the negative impact of light pollution. The AMA has passed resolutions advocating energy-efficient, fully shielded streetlight design. Individuals can take steps to decrease light pollution by carefully choosing outdoor lights with light-pollution reduction in mind.

It's Your Turn

OBSERVE AND DRAW Observe the night sky near your home, and make a drawing of w but you observe. Then, discu how light pollution in took nere night compare with light pollution in other parts of the country.

Lesson 6.2 Light 225

Use Vocabulary

1. Radio waves have the longest wavelengths, lowest frequencies, and lowest energy of all electromagnetic waves. Infrared waves have wavelengths just longer than light and can be sensed as thermal energy. Ultraviolet waves have shorter wavelengths, higher frequencies, and more energy than light, and they can pass through and damage skin.

2. You can see images clearly through a transparent substance, but images look blurry through a translucent substance.

Understand Key Concepts

3. A. cones

4. With the red book, all wavelengths of light are absorbed except red, which reflects off it. A red stained glass window absorbs almost all wavelengths of light except red. The red wavelengths are both transmitted and reflected, so the window looks red from both sides.

5. Light waves have a longer wavelength, lower frequency, and less energy than ultraviolet waves.

Interpret Graphics

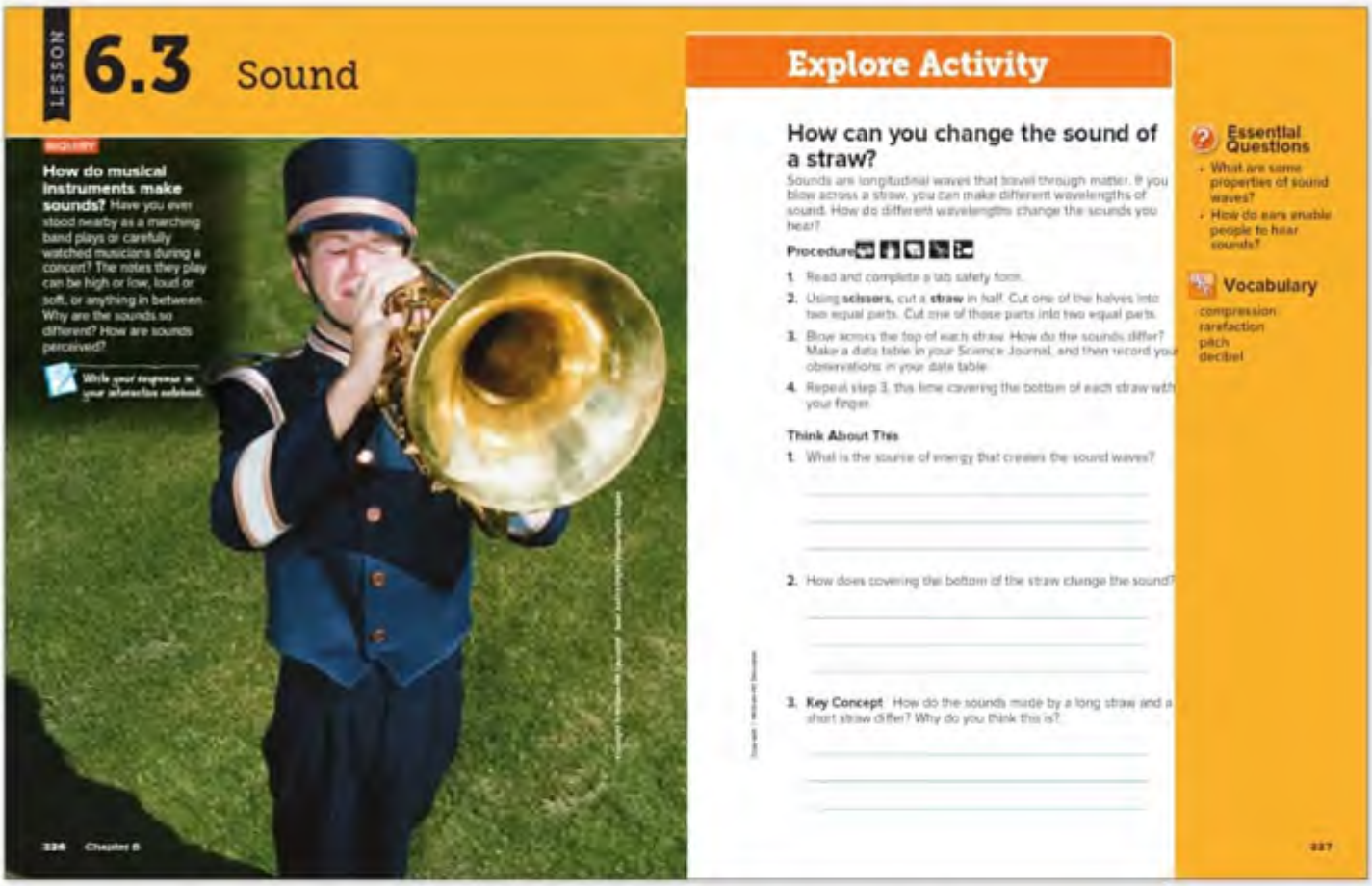
6. Light rays from the fish refract away from the normal as they move from the water into the air. The person perceives the rays as having come along a straight line, from the place where the image appears.

7. radio waves, microwaves, infrared waves, light, ultraviolet, X-rays, gamma rays

Critical Thinking

8. infrared waves.

9. Diagrams should be similar to **Figure 23** and contain the same information.



INQUIRY

About the Photo **How does it make sound?** Have students brainstorm a list of musical instruments, such as a piano, guitar, drums, saxophone, and so on. Remind them that vibrations produce waves, including sound waves. Then ask students to predict how each type of instrument they name vibrates to make music. For example, when you hit a drum, the skin vibrates and produces sound. To play a guitar or a piano, you pluck or strike the instrument's strings, which vibrate. When you play a woodwind instrument, such as a saxophone, the reed in the mouthpiece vibrates as you blow across it.

Guiding Questions

AL	How do instruments make sounds?	*Instruments create vibrations in different ways to create sound waves.*
OL	Why do you think different instruments produce different sounds?	*Different instruments vibrate in different ways and produce different sounds as a result.*
BL	Why do you think certain instruments such as strings, percussion, or woodwinds, are grouped together in orchestras?	*Instruments are grouped together because they vibrate in the same way and produce similar sounds as a result.*

Essential Questions

After this lesson, students should understand the Key Concepts and be able to answer these questions. Have students write each question in their Science Journals. Revisit each question as you cover its relevant content.

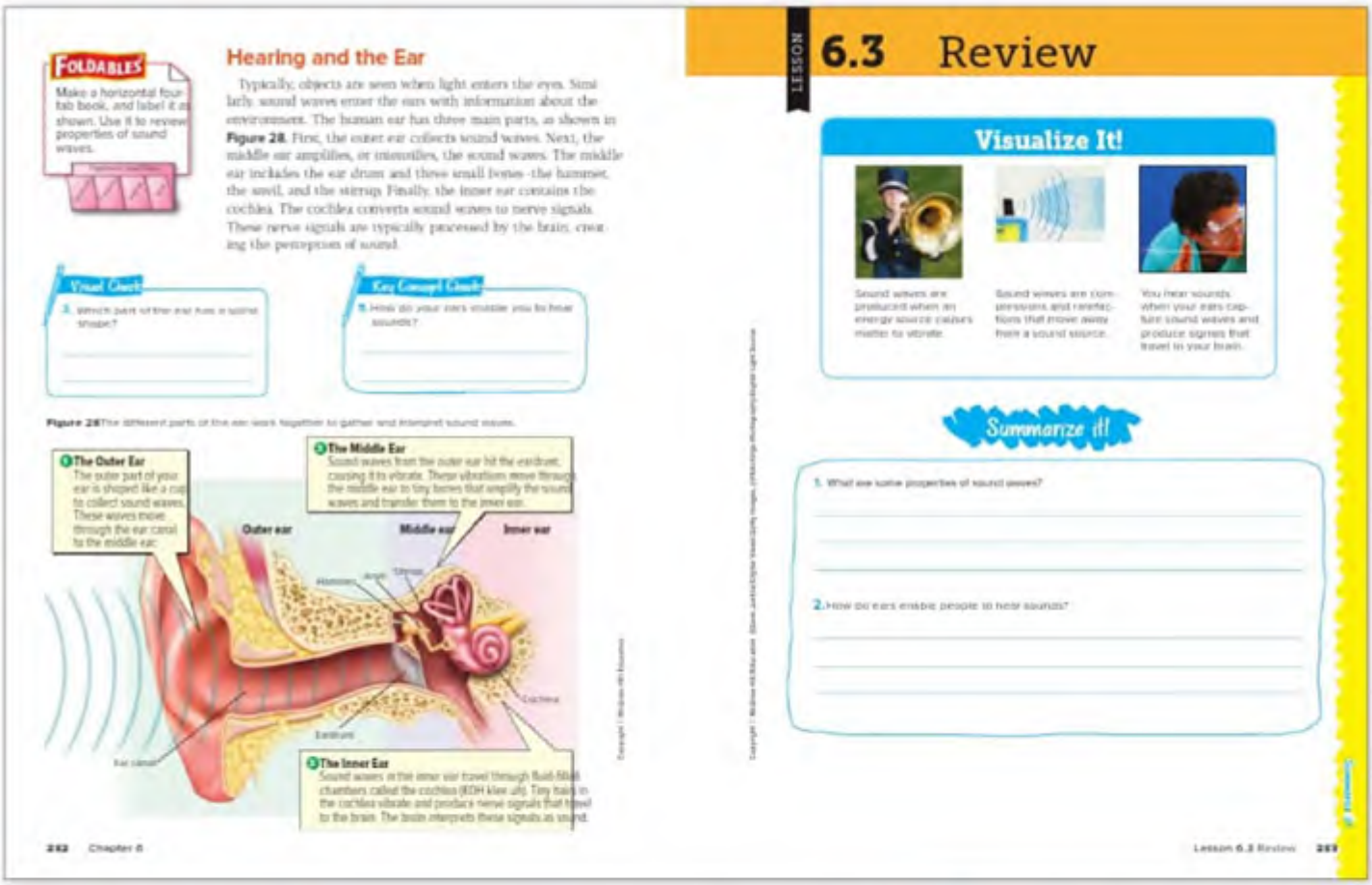
Vocabulary

Compound Words

Predict How Terms Relate to the Photo

1. Write the four vocabulary words on the board.
2. Have students describe what is happening in the photo and ask them to read the caption.
3. Ask them to make predictions that explain how the four vocabulary words might relate to the image of the trumpet player.
4. To help with the predictions, guide students to connect the explanation from the caption to the sounds produced by the trumpet player. Ask: **Which words from the caption might be linked to vocabulary words?** Students might mention high and low sounds, and loud or soft sounds. Ask: **How might a sound that is high differ from a sound that is low?** Ask: **How might a sound that is loud compare to a sound that is soft?**

Encourage students to answers these questions by making low soft sounds, then high loud sounds.



Hearing and the Ear

Explain that we hear because of the way our ears detect audible vibrations and our brains interpret the sound waves. Have students read the paragraphs on this page and answer these questions.

Guiding Questions

AL How does the cochlea help you hear? *The special cells in the cochlea convert sound waves into nerve signals that are interpreted by the brain.*

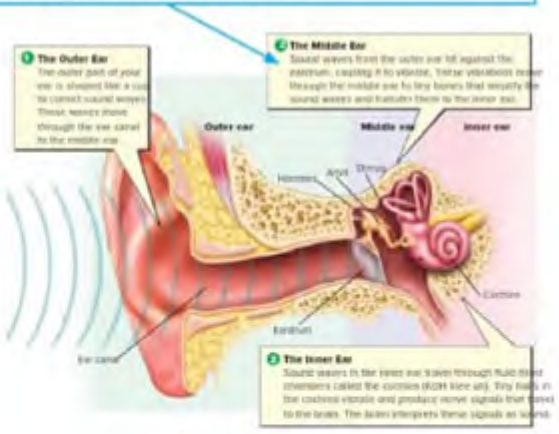
OL How do your ears enable you to hear sounds? *Your outer ear collects sound waves and transfers the vibrations to the eardrum. As the vibrations move through the ear, the ear amplifies the sound and then converts it into nerve signals, which the brain can interpret.*

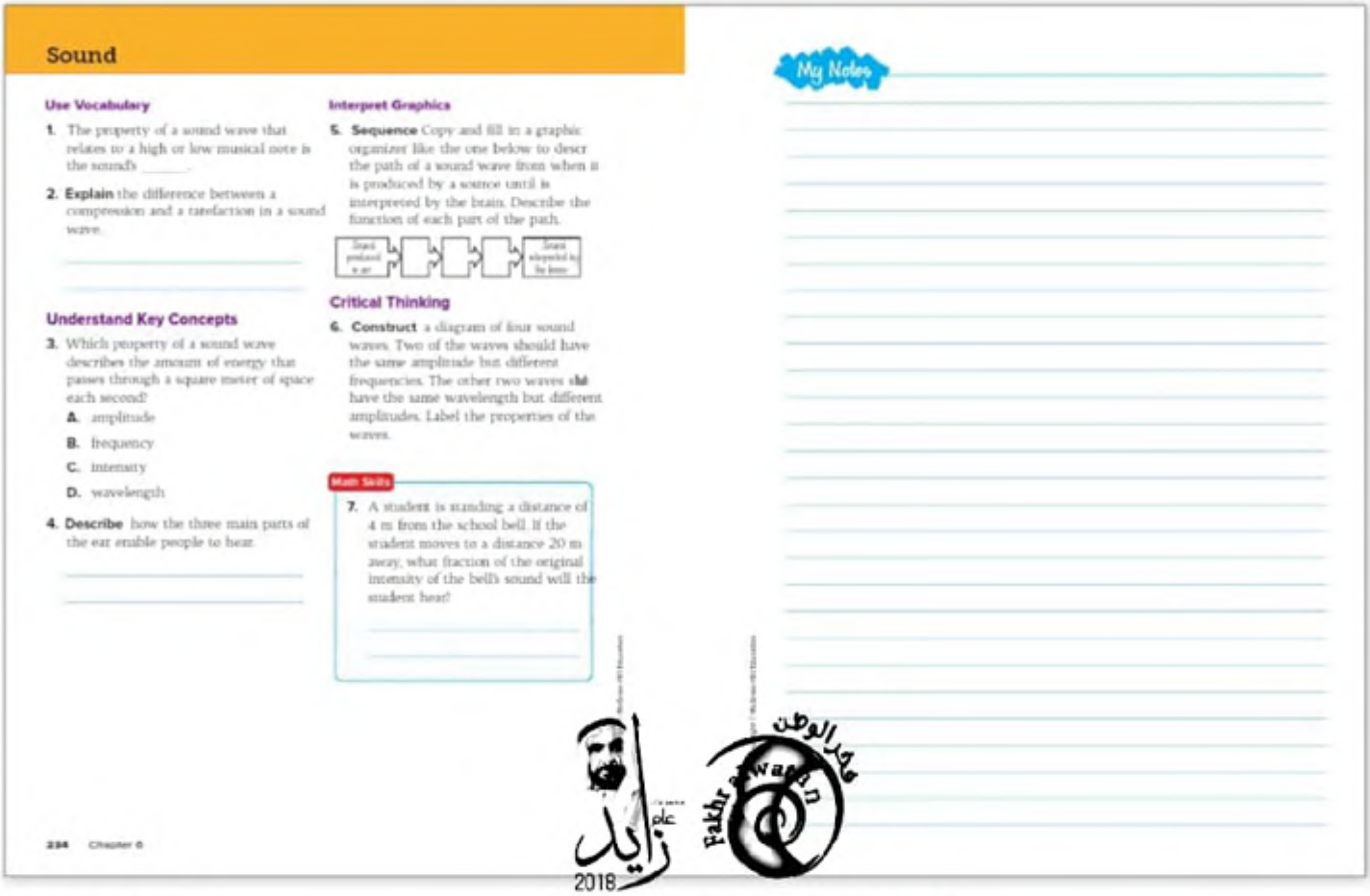
BL People who need hearing aids sometimes wear them to correct problems with their cochlea. How do you think problems with the cochlea can impact a person's hearing? *The special cells in the cochlea send signals to the brain. If the cochlea were to have difficulty changing sound waves or sending these signals, it would be harder for the brain to interpret sounds; as a result, it would be harder to hear.*

Visual Literacy: Parts of the Human Ear

Have students study the diagram in **Figure 28** and identify the different parts of the ear.

Ask: **What happens to the sound waves in the middle ear and inner ear?** *Sound waves make the eardrum vibrate, which amplifies the sound and sends it to the cochlea in the inner ear. In the cochlea, sound waves are converted to nerve signals and sent to the brain.*





Sound

Use Vocabulary

1. The property of a sound wave that relates to a high or low musical note is the sound's _____.

2. **Explain** the difference between a compression and a rarefaction in a sound wave.

Understand Key Concepts

3. Which property of a sound wave describes the amount of energy that passes through a square meter of space each second?
   A. amplitude
   B. frequency
   C. intensity
   D. wavelength

4. **Describe** how the three main parts of the ear enable people to hear.

Interpret Graphics

5. **Sequence** Copy and fill in a graphic organizer like the one below to descr the path of a sound wave from when it is produced by a source until is interpreted by the brain. Describe the function of each part of the path.

Critical Thinking

6. **Construct** a diagram of four sound waves. Two of the waves should have the same amplitude but different frequencies. The other two waves sh have the same wavelength but different amplitudes. Label the properties of the waves.

Math Skills

7. A student is standing a distance of 4 m from the school bell. If the student moves to a distance 20 m away, what fraction of the original intensity of the bell's sound will the student hear?

My Notes

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Use Vocabulary

1. pitch

2. A compression is an area of higher pressure, where the particles are closer together. A rarefaction is an area of lower pressure, where the particles are farther apart.

Understand Key Concepts

3. **C.** Intensity

4. The outer ear collects sound waves. The middle ear transfers and amplifies the sound waves. The inner ear changes the vibrations to nerve signals, which the brain can interpret.

Interpret Graphics

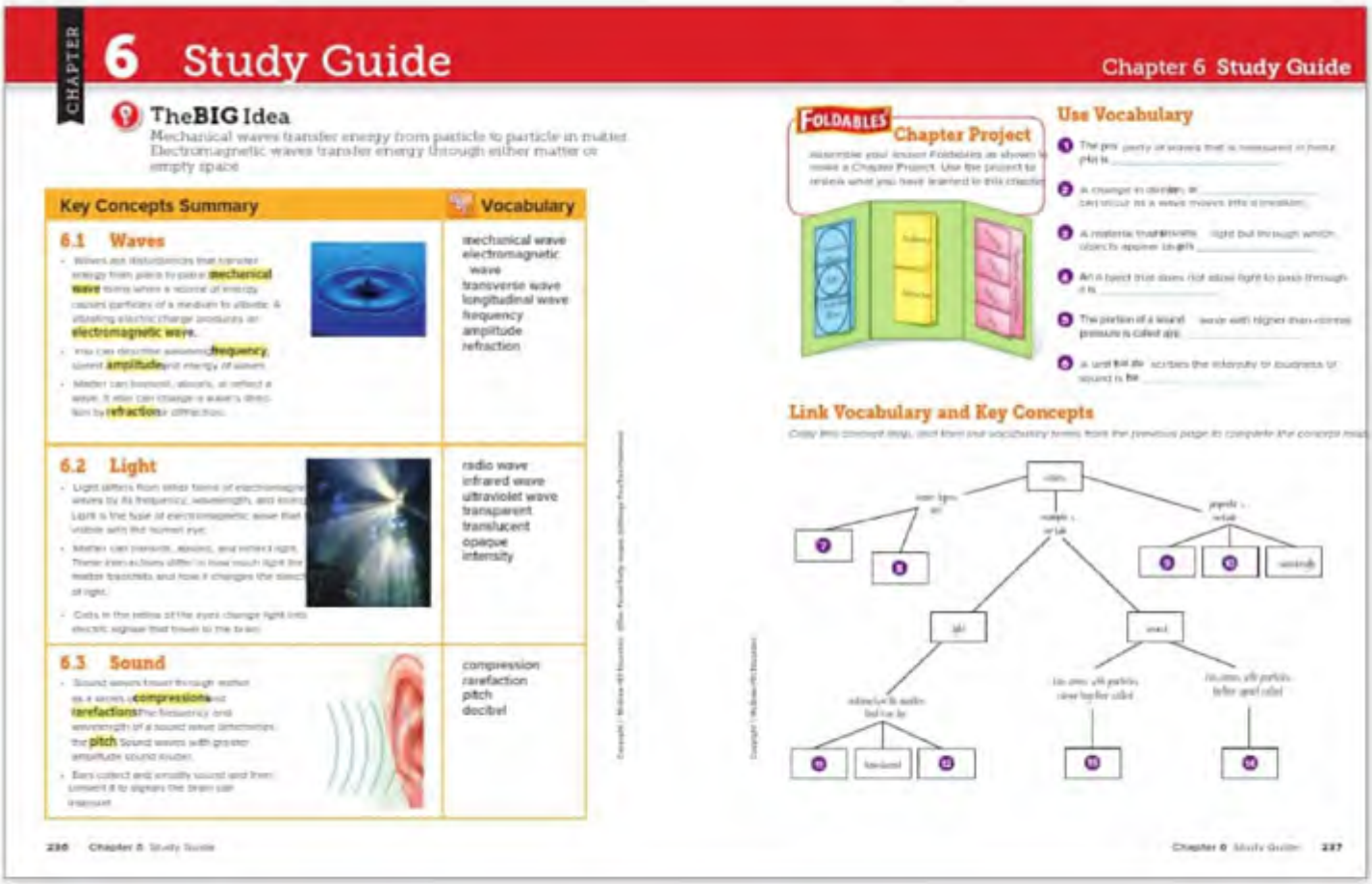
5. Sound produced in air→Outer ear collects sound waves→Middle ear amplifies the sound waves→Inner ear changes the vibrations to nerve signals→Sound interpreted by the brain.

Critical Thinking

6. Check student diagrams to be sure that they have illustrated the correct wave properties. Students should label amplitude, frequency, and wavelength.

Math Skills

7. 1/2


CHAPTER 6 Study Guide

Chapter 6 Study Guide

The BIG Idea

Mechanical waves transfer energy from particle to particle in matter. Electromagnetic waves transfer energy through either matter or empty space.

Key Concepts Summary

6.1 Waves

- Waves are disturbances that transfer energy from place to place. A mechanical wave forms when a source of energy causes particles of a medium to vibrate. A vibrating electric charge produces an electromagnetic wave.
- You can describe waves by frequency, current amplitude, and energy of waves.
- Matter can transmit, absorb, or reflect a wave. It also can change a wave's direction by refraction or diffraction.

6.2 Light

- Light differs from other forms of electromagnetic waves by its frequency, wavelength, and energy. Light is the type of electromagnetic wave that is visible with the human eye.
- Matter can transmit, absorb, and reflect light. These interactions differ in how much light the matter transmits and how it changes the direction of light.
- Cells in the retina of the eyes change light into electric signals that travel to the brain.

6.3 Sound

- Sound waves travel through matter as a series of compressions and rarefactions. The frequency and wavelength of a sound wave determine the pitch. Sound waves with greater amplitude sound louder.
- Ears collect and amplify sound and then convert it to signals the brain can interpret.

Vocabulary

mechanical wave
electromagnetic wave
transverse wave
longitudinal wave
frequency
amplitude
refraction
radio wave
infrared wave
ultraviolet wave
transparent
translucent
opaque
intensity
compression
rarefaction
pitch
decibel

FOLDABLES Chapter Project

Use Vocabulary

Link Vocabulary and Key Concepts

236 Chapter 6 Study Guide

Chapter 6 Study Guide 237

Key Concepts Summary

Study Strategy: Check Answers to Key Concept Questions

Teach students to focus on the areas that they do not understand and to spend less time on concepts they have mastered.

1. Write the Key Concept questions from the start of each lesson on chart paper or the board.
2. Ask students to answer each question in their Science Journals.
3. Instruct students to note the questions they had a difficult time answering. Then have them compare their answers to the Key Concepts Summary in the Chapter Study Guide. Tell them to write a check beside any answers that were correct and to circle any answers that were inaccurate or incomplete.
4. Have students look through the chapter to find any information relevant to the answers they circled. Have them use this information to rewrite their answers.

Example:

A wave is a disturbance that transfers energy. ✓

It is caused by vibrations.

Amplitude is one property of waves.

Vocabulary

Study Strategy: Create Wave Concept Maps

Ask students to create a concept map for the different kinds of waves described in the chapter. This graphic organizer enables students to understand more about each word than just its definition.

1. Have students draw concept maps, similar to the one below, for each kind of wave. The type of wave should be in the center of the map.
2. Have students write the following questions in the surrounding bubbles on the concept map: What is it? How is it produced? What is one property of this kind of wave? What is one way this wave interacts with matter?
3. Then students should answer these questions and fill in the answers in the appropriate bubbles on the map.
4. After students complete the maps, ask them to write a comprehensive definition of each kind of wave.

Example:

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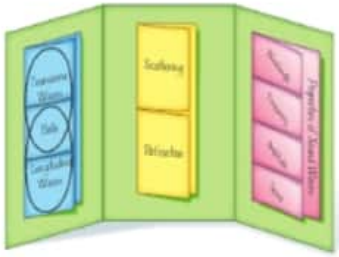


Use the Foldables® Chapter Project as a way to connect Key Concepts.

1. Ask students to organize their Foldables® in a way that reflects how the concepts in each Foldable relate to each other.
2. Use glue or staples to hold the sheets together as needed.
3. When complete, ask students to place their Foldables® Chapter Project at the front of the room. Have the class critique and discuss the way in which students have organized their Foldables®.

Use Vocabulary

1. frequency
2. refraction
3. translucent
4. opaque
5. compression
6. decibel

Link Vocabulary and Key Concepts

7–8. mechanical wave, electromagnetic wave (in any order)

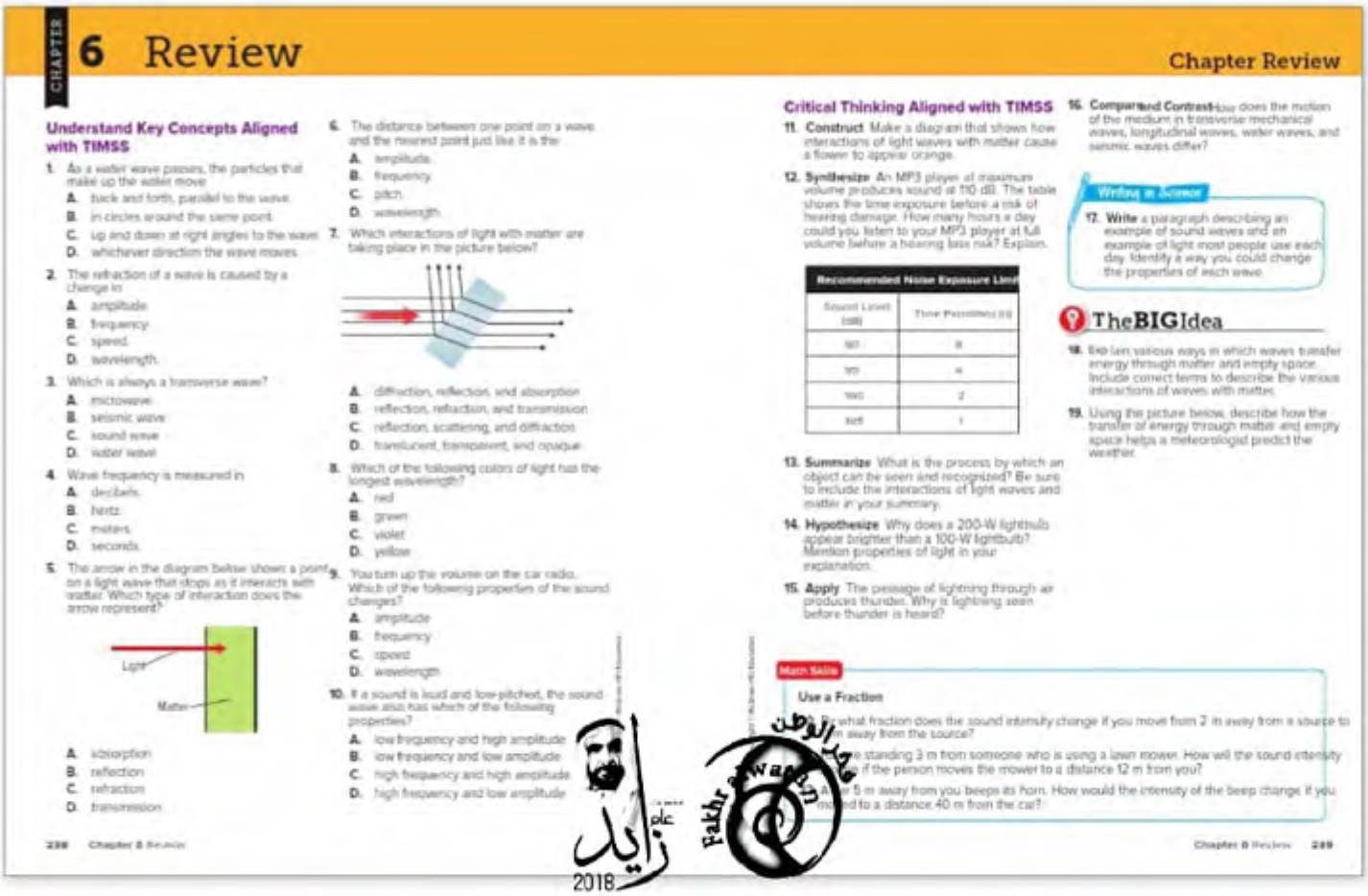
9–10. frequency, amplitude (in any order)

11–12. transparent, opaque (in any order)

13. compressions

14. rarefactions

Teacher Notes



CHAPTER 6 Review

Chapter Review

Understand Key Concepts Aligned with TIMSS

1. As a water wave passes, the particles that make up the water move
   A. back and forth, parallel to the wave.
   B. in circles around the same point.
   C. up and down at right angles to the wave.
   D. whichever direction the wave moves.
2. The refraction of a wave is caused by a change in
   A. amplitude.
   B. frequency.
   C. speed.
   D. wavelength.
3. Which is always a transverse wave?
   A. microwave
   B. seismic wave
   C. sound wave
   D. water wave
4. Wave frequency is measured in
   A. decibels.
   B. hertz.
   C. meters.
   D. seconds.
5. The arrow in the diagram below shows a point on a light wave that stops as it interacts with matter. Which type of interaction does the arrow represent?

   A. absorption
   B. reflection
   C. refraction
   D. transmission
6. The distance between one point on a wave and the nearest point just like it is the
   A. amplitude.
   B. frequency.
   C. pitch.
   D. wavelength.
7. Which interactions of light with matter are taking place in the picture below?

   A. diffraction, reflection, and absorption
   B. reflection, refraction, and transmission
   C. reflection, scattering, and diffraction
   D. translucent, transparent, and opaque
8. Which of the following colors of light has the longest wavelength?
   A. red
   B. green
   C. violet
   D. yellow
9. You turn up the volume on the car radio. Which of the following properties of the sound changes?
   A. amplitude
   B. frequency
   C. speed
   D. wavelength
10. If a sound is loud and low-pitched, the sound wave also has which of the following properties?
   A. low frequency and high amplitude
   B. low frequency and low amplitude
   C. high frequency and high amplitude
   D. high frequency and low amplitude

Critical Thinking Aligned with TIMSS

11. **Construct** Make a diagram that shows how interactions of light waves with matter cause a flower to appear orange.
12. **Synthesize** An MP3 player at maximum volume produces sound at 110 dB. The table shows the time exposure before a risk of hearing damage. How many hours a day could you listen to your MP3 player at full volume before a hearing loss risk? Explain.

Recommended Noise Exposure Limit	
Sound Level (dB)	Time Permitted (h)
90	8
95	4
100	2
105	1

13. **Summarize** What is the process by which an object can be seen and recognized? Be sure to include the interactions of light waves and matter in your summary.
14. **Hypothesize** Why does a 200-W lightbulb appear brighter than a 100-W lightbulb? Mention properties of light in your explanation.
15. **Apply** The passage of lightning through air produces thunder. Why is lightning seen before thunder is heard?
16. **Compare and Contrast** How does the motion of the medium in transverse mechanical waves, longitudinal waves, water waves, and seismic waves differ?

Writing in Science

17. **Write** a paragraph describing an example of sound waves and an example of light most people use each day. Identify a way you could change the properties of each wave.

The BIG Idea

18. Explain various ways in which waves transfer energy through matter and empty space. Include correct terms to describe the various interactions of waves with matter.
19. Using the picture below, describe how the transfer of energy through matter and empty space helps a meteorologist predict the weather.

Math Skills

Use a Fraction

[illegible] what fraction does the sound intensity change if you move from 2 m away from a source to [illegible] m away from the source?

[illegible] are standing 3 m from someone who is using a lawn mower. How will the sound intensity [illegible] if the person moves the mower to a distance 12 m from you?

[illegible] are 5 m away from you beeps its horn. How would the intensity of the beep change if you [illegible] moved to a distance 40 m from the car?

238 Chapter 6 Review

Chapter 6 Review 239

Understand Key Concepts

1 **B.** in circles around the same point.
2 **C.** speed.
3 **A.** microwave
4 **B.** hertz.
5 **A.** absorption
6 **D.** wavelength.
7 **B.** reflection, refraction, and transmission
8 **A.** red
9 **A.** amplitude
10 **A.** low frequency and high amplitude

Critical Thinking

11 Diagrams should indicate white light approaching the flower. All colors but orange enter the flower and are absorbed. Orange light is reflected from the flower.

12 You could listen to the player a maximum amount of 30 minutes. Each 5 dB of sound cuts the safe listening time in half. Because 110 dB is 5 dB higher than 105 dB, an hour time limit would be cut to 30 minutes.

13 When light strikes an object, some of the light reflects back to your eyes. When the light waves enter your eyes, they are focused by the cornea and the lens onto the retina. Cells on the retina absorb the light and produce a signal the brain can interpret.

14 Assuming the colors of the two bulbs are the same, the wavelengths and frequencies of the light from the two bulbs will be equal. However, the 200 watt bulb produces light waves with approximately two times the amplitude of the 100 watt bulb.

15 Light travels much faster than sound waves.

16 In a transverse mechanical wave, the medium's movement is perpendicular to the wave's direction. In a longitudinal wave, the medium's movement is parallel to the wave's direction. In a water wave, the medium moves in small circles. In a seismic wave, the medium's movement can be parallel to the wave, perpendicular to the wave, or a combination of parallel and perpendicular.

Writing in Science

17 Students' paragraphs will vary but should contain accurate information about how to change the properties of light and sound waves.

The BIG Idea

18 Mechanical and electromagnetic waves can both transfer energy through matter but only electromagnetic waves can transfer energy through empty space. Matter can transmit, absorb, refract, reflect or diffract energy.

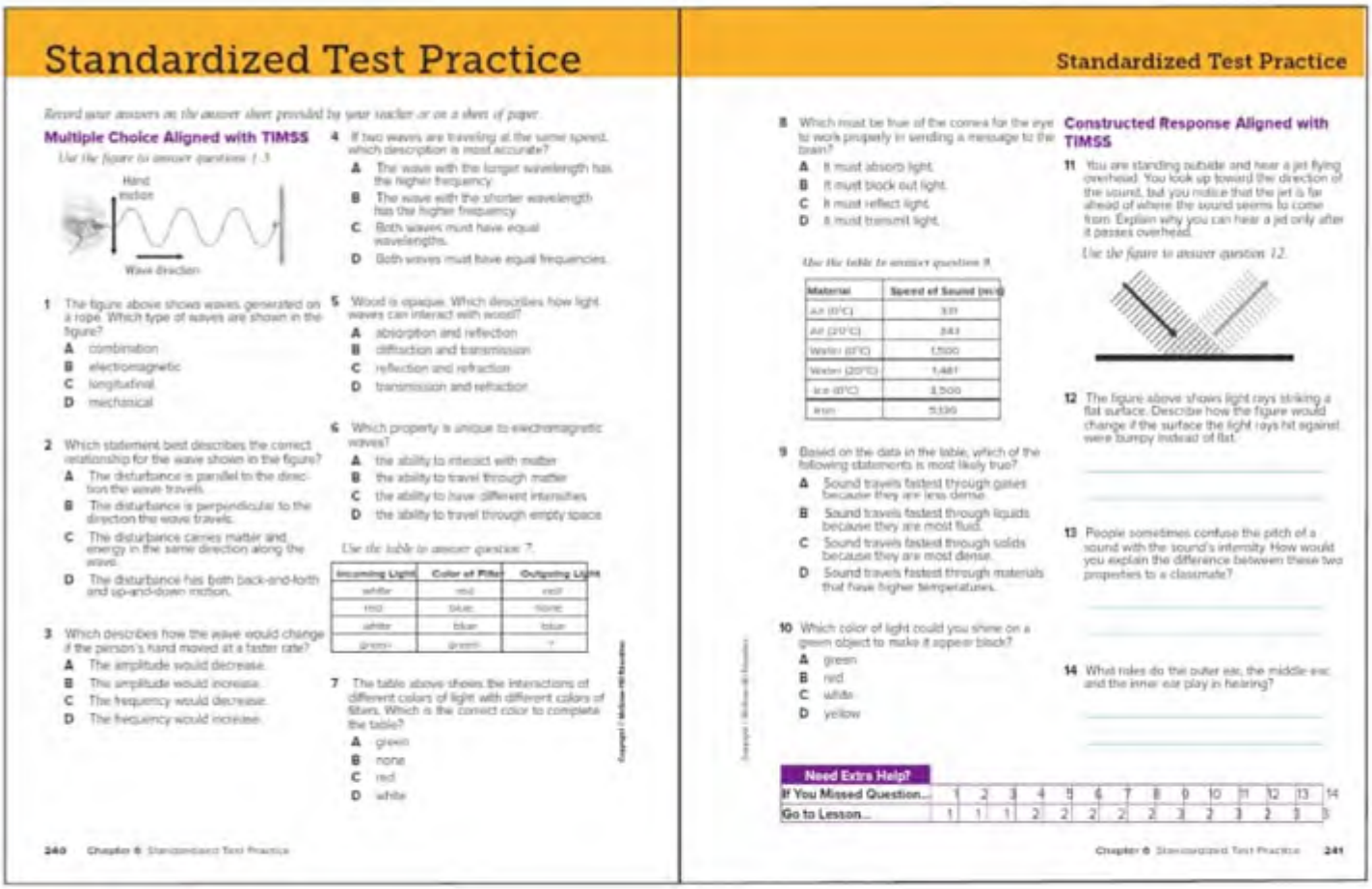
19 Weather satellites that orbit above Earth use microwaves that transfer information through space to weather stations. There, computers transform the information transmitted by the microwaves to visible light that is transmitted through air to the meteorologist's eyes.

Math Skill

Calculate Work

20. $\frac{1}{25}$
21. $\frac{1}{16}$
22. $\frac{1}{64}$

Teacher Notes



Standardized Test Practice

Record your answers on the answer sheet provided by your teacher or on a sheet of paper.

Multiple Choice Aligned with TIMSS

Use the figure to answer questions 1–3.

Hand motion

Wave direction

1 The figure above shows waves generated on a rope. Which type of waves are shown in the figure?
- A combination
- B electromagnetic
- C longitudinal
- D mechanical

2 Which statement best describes the correct relationship for the wave shown in the figure?
- A The disturbance is parallel to the direction the wave travels.
- B The disturbance is perpendicular to the direction the wave travels.
- C The disturbance carries matter and energy in the same direction along the wave.
- D The disturbance has both back-and-forth and up-and-down motion.

3 Which describes how the wave would change if the person's hand moved at a faster rate?
- A The amplitude would decrease.
- B The amplitude would increase.
- C The frequency would decrease.
- D The frequency would increase.

4 If two waves are traveling at the same speed, which description is most accurate?
- A The wave with the longer wavelength has the higher frequency.
- B The wave with the shorter wavelength has the higher frequency.
- C Both waves must have equal wavelengths.
- D Both waves must have equal frequencies.

5 Wood is opaque. Which describes how light waves can interact with wood?
- A absorption and reflection
- B diffraction and transmission
- C reflection and refraction
- D transmission and refraction

6 Which property is unique to electromagnetic waves?
- A the ability to interact with matter
- B the ability to travel through matter
- C the ability to have different intensities
- D the ability to travel through empty space

Use the table to answer question 7.

Incoming Light	Color of Filter	Outgoing Light
white	red	red
red	blue	none
white	blue	blue
green	green	?

7 The table above shows the interactions of different colors of light with different colors of filters. Which is the correct color to complete the table?
- A green
- B none
- C red
- D white

8 Which must be true of the cornea for the eye to work properly in sending a message to the brain?
- A It must absorb light.
- B It must block out light.
- C It must reflect light.
- D It must transmit light.

Use the table to answer question 9.

Material	Speed of Sound (m/s)
Air (0°C)	331
Air (20°C)	343
Water (0°C)	1,500
Water (20°C)	1,481
Ice (0°C)	3,500
Iron	5,130

9 Based on the data in the table, which of the following statements is most likely true?
- A Sound travels fastest through gases because they are less dense.
- B Sound travels fastest through liquids because they are most fluid.
- C Sound travels fastest through solids because they are most dense.
- D Sound travels fastest through materials that have higher temperatures.

10 Which color of light could you shine on a green object to make it appear black?
- A green
- B red
- C white
- D yellow

Constructed Response Aligned with TIMSS

11 You are standing outside and hear a jet flying overhead. You look up toward the direction of the sound, but you notice that the jet is far ahead of where the sound seems to come from. Explain why you can hear a jet only after it passes overhead.

Use the figure to answer question 12.

12 The figure above shows light rays striking a flat surface. Describe how the figure would change if the surface the light rays hit against were bumpy instead of flat.

13 People sometimes confuse the pitch of a sound with the sound's intensity. How would you explain the difference between these two properties to a classmate?

14 What roles do the outer ear, the middle ear, and the inner ear play in hearing?

Need Extra Help?

If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Go to Lesson...	1	1	1	2	2	2	2	2	3	2	3	2	3	3

Multiple Choice

1 D—Correct. Combination describes water waves and some types of seismic waves. Electromagnetic describes light and other waves that travel through matter and empty space. Longitudinal describes sound waves and some types of seismic waves.

2 B—Correct. A: Incorrect. This statement describes transverse waves. C: Incorrect. This statement is not accurate for any kind of wave. D: Incorrect. This statement describes combination waves (surface waves).

3 D—Correct. A, B: Incorrect. The amplitude of the wave does not change with a change in speed. C: Incorrect. When wave speed increases, the number of wavelengths that pass a point each second increases.

4 B—Correct. A: Incorrect. When speed is equal, the wave with the longer wavelength must have a lower frequency. C, D: Incorrect. Waves traveling at the same speed do not need to have equal wavelengths and frequencies.

5 A—Correct. B, C, D—Refraction and transmission occur only with transparent and translucent materials.

6 D—Correct. A, B, C—All describe properties common to both electromagnetic waves and mechanical waves.

7 A—Correct. B, C, D—The color of a transparent or translucent object is the color of light that it transmits.

8 D—Correct. A, C: Incorrect. Light that is reflected or absorbed would not enter the eye. B: Incorrect. If blocked, light could not reach the retina.

9 C—Correct. A: Incorrect. The table shows the slowest speeds for air. B: Incorrect. For the materials shown, the speeds for sound through the liquids are slower than the speeds of sound through the solids. D: Incorrect. The speed of sound is faster in cold materials.

10 B—Correct. A, C, D—Green, white, and yellow light all contain green light that would reflect off the object, making it appear green.

Constructed Response

11 Sound travels more slowly than light. Your eyes detect the jet image at its true location, but the sound takes more time reach your ears.

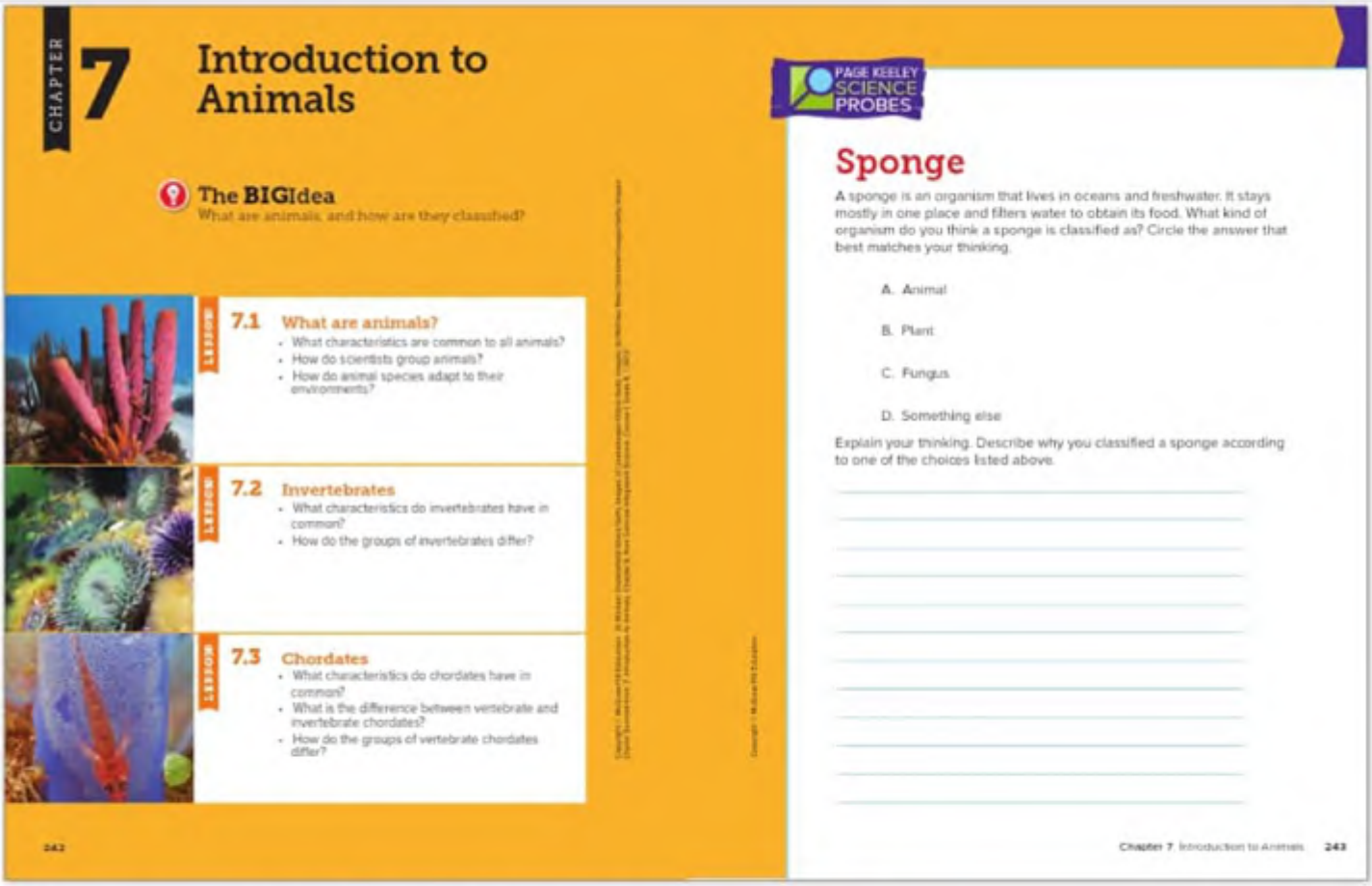
12 The incoming light for the diagram would stay the same. The reflected light lines would be shown at a variety of angles because the reflecting surface is rough. Each ray, however, would obey the law of reflection, with the angle the outgoing ray makes with the normal equal to the angle the incoming ray makes with the normal.

13 Pitch is determined by the frequency of the wave. A high-frequency sound wave is heard as a sound with a high pitch. Sound intensity is the amount of energy that passes through a square meter of space each second. You perceive a high intensity as a louder sound.

14 The outer ear collects sound waves. The middle ear amplifies the intensity of sound waves. The inner ear changes the sound waves to nerve signals.

Answer Key

Question	Answer
1	D
2	B
3	D
4	B
5	A
6	D
7	A
8	D
9	C
10	B
11	See extended answer.
12	See extended answer.
13	See extended answer.
14	See extended answer.



CHAPTER 7

Introduction to Animals

The BIGIdea

What are animals, and how are they classified?

LESSON 7.1 What are animals?

- What characteristics are common to all animals?
- How do scientists group animals?
- How do animal species adapt to their environments?

LESSON 7.2 Invertebrates

- What characteristics do invertebrates have in common?
- How do the groups of invertebrates differ?

LESSON 7.3 Chordates

- What characteristics do chordates have in common?
- What is the difference between vertebrate and invertebrate chordates?
- How do the groups of vertebrate chordates differ?

PAGE KEELEY SCIENCE PROBES

Sponge

A sponge is an organism that lives in oceans and freshwater. It stays mostly in one place and filters water to obtain its food. What kind of organism do you think a sponge is classified as? Circle the answer that best matches your thinking.

A. Animal

B. Plant

C. Fungus

D. Something else

Explain your thinking. Describe why you classified a sponge according to one of the choices listed above.

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What are animals, and how are they classified?

The BIG Idea

There are no right or wrong answers to these questions. Write studentgenerated questions produced during the discussion on chart paper and return to them throughout the chapter.

Guiding Questions

AL What are animals?

Start a discussion to find out how students define the term animal. Animals are organisms composed of many nucleated cells which are held together by a protein called collagen. Animals have muscle cells and nerve cells, and they get the energy they need from the food they eat. All animals begin their lives as fertilized cells called zygotes, which develop into embryos.

OL What are some different kinds of animals?

Students will probably name specific mammals, birds, reptiles, amphibians, and fish. Make sure they are aware that insects, spiders, sponges, and worms are also animals.

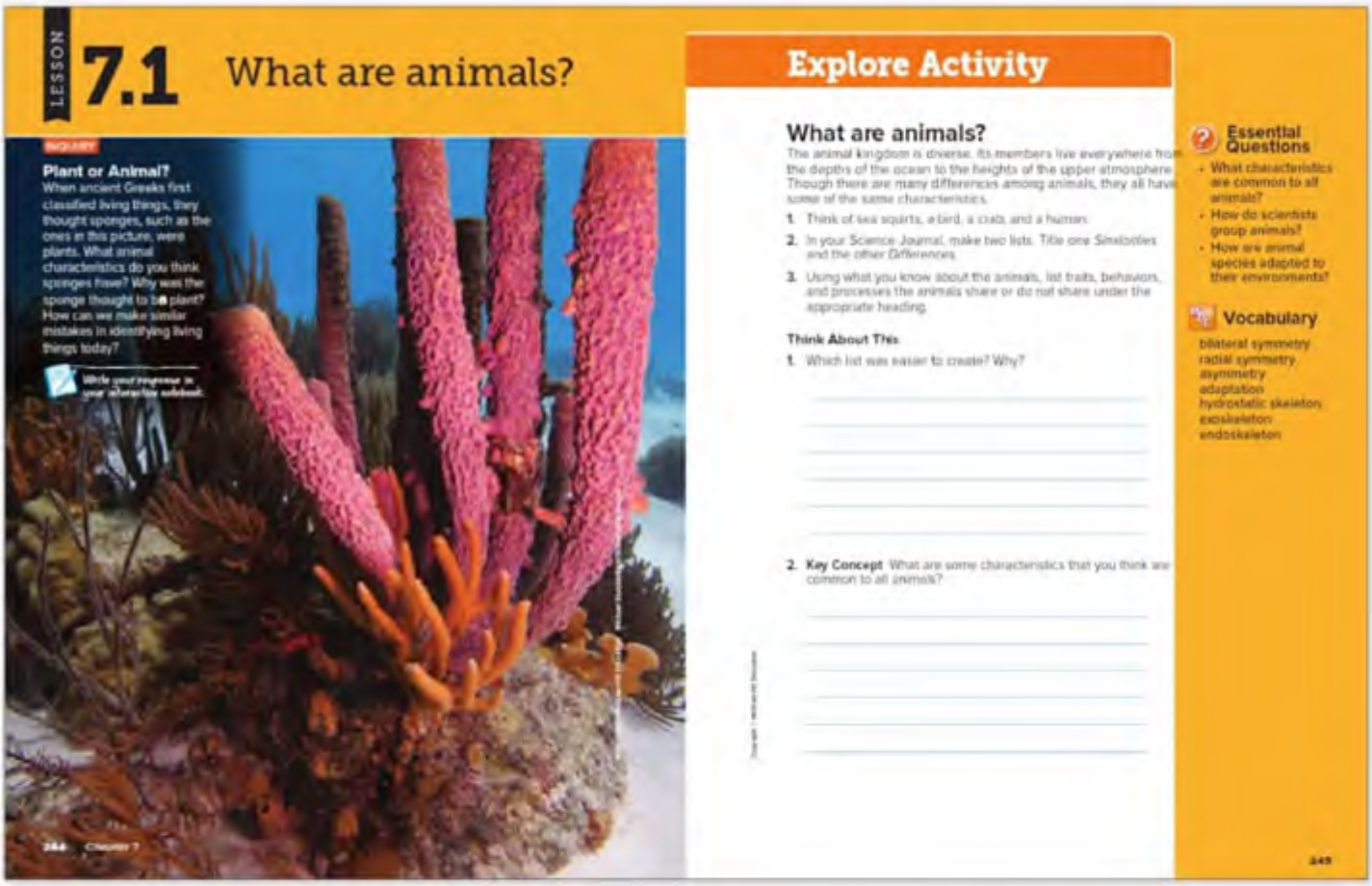
BL How are animals classified?

Students might propose that scientists look for ways that animals are similar and different, and group animals with similar characteristics together. Lead students to discuss body structures, internal structures, and how animals develop.

PAGE KEELEY SCIENCE PROBES

Sponge

Answers to the Page Keeley Science Probe can be found in the Teacher's Edition of the *Activity Lab Workbook*.


LESSON 7.1 What are animals?

INQUIRY

Plant or Animal?

When ancient Greeks first classified living things, they thought sponges, such as the ones in this picture, were plants. What animal characteristics do you think sponges have? Why was the sponge thought to be a plant? How can we make similar mistakes in identifying living things today?

Write your response in your interactive notebook.

Explore Activity

What are animals?

The animal kingdom is diverse. Its members live everywhere from the depths of the ocean to the heights of the upper atmosphere. Though there are many differences among animals, they all have some of the same characteristics.

1. Think of sea squirts, a bird, a crab, and a human.
2. In your Science Journal, make two lists. Title one *Similarities* and the other *Differences*.
3. Using what you know about the animals, list traits, behaviors, and processes the animals share or do not share under the appropriate heading.

Think About This

1. Which list was easier to create? Why?

2. **Key Concept** What are some characteristics that you think are common to all animals?

Essential Questions

- What characteristics are common to all animals?
- How do scientists group animals?
- How are animal species adapted to their environments?

Vocabulary

bilateral symmetry
radial symmetry
asymmetry
adaptation
hydrostatic skeleton
exoskeleton
endoskeleton

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INQUIRY

About the Photo **Plant or Animal?** It wasn't just the Greeks who thought sponges were plants. Until the 1700s, when naturalists determined that sponges are animals, most people assumed these organisms were plants.

Start the lesson with questions about the characteristics of animals.

Guiding Questions

OL What animal characteristics do you think sponges have?	*Use this question to begin a discussion comparing and contrasting the characteristics of plants and animals. Possible answer: Sponges get energy from food they take in rather than changing light energy into food energy as plants do.*
OL Why was the sponge thought to be a plant?	*Possible answer: Because a sponge seems to be "rooted" in one place like a plant. Also, a sponge doesn't have eyes, ears, a nose, and a mouth like many animals do.*

Essential Questions

After this lesson, students should understand the Key Concepts and be able to answer these questions. Have students write each question in their Science Journals. Revisit each question as you cover its relevant content.

Vocabulary

Exploring a Term

1. Write the term *bilateral symmetry* on chart paper or the board.
2. Explain that if something has bilateral symmetry it can be divided into two halves that are mirror images of each other. The human body is one example of bilateral symmetry.
3. Discuss bilateral symmetry in human society. Explain that people throughout history have loved symmetry. Greek temples, for example, had nearly perfect bilateral symmetry, and many modern buildings are also bilaterally symmetrical.
4. Explain that bilateral symmetry can also make good sense from a functional standpoint. Most chairs, for example, have bilateral symmetry when viewed from the front or back. This type of design for a chair is aesthetically pleasing, but it's also very practical. An asymmetrical chair is likely to be uncomfortable or even unstable.

ExploreActivity

What are animals?

Prep: *5 min* **Class:** *10 min*

Purpose
To recognize commonalities among a diverse grouping of animals.

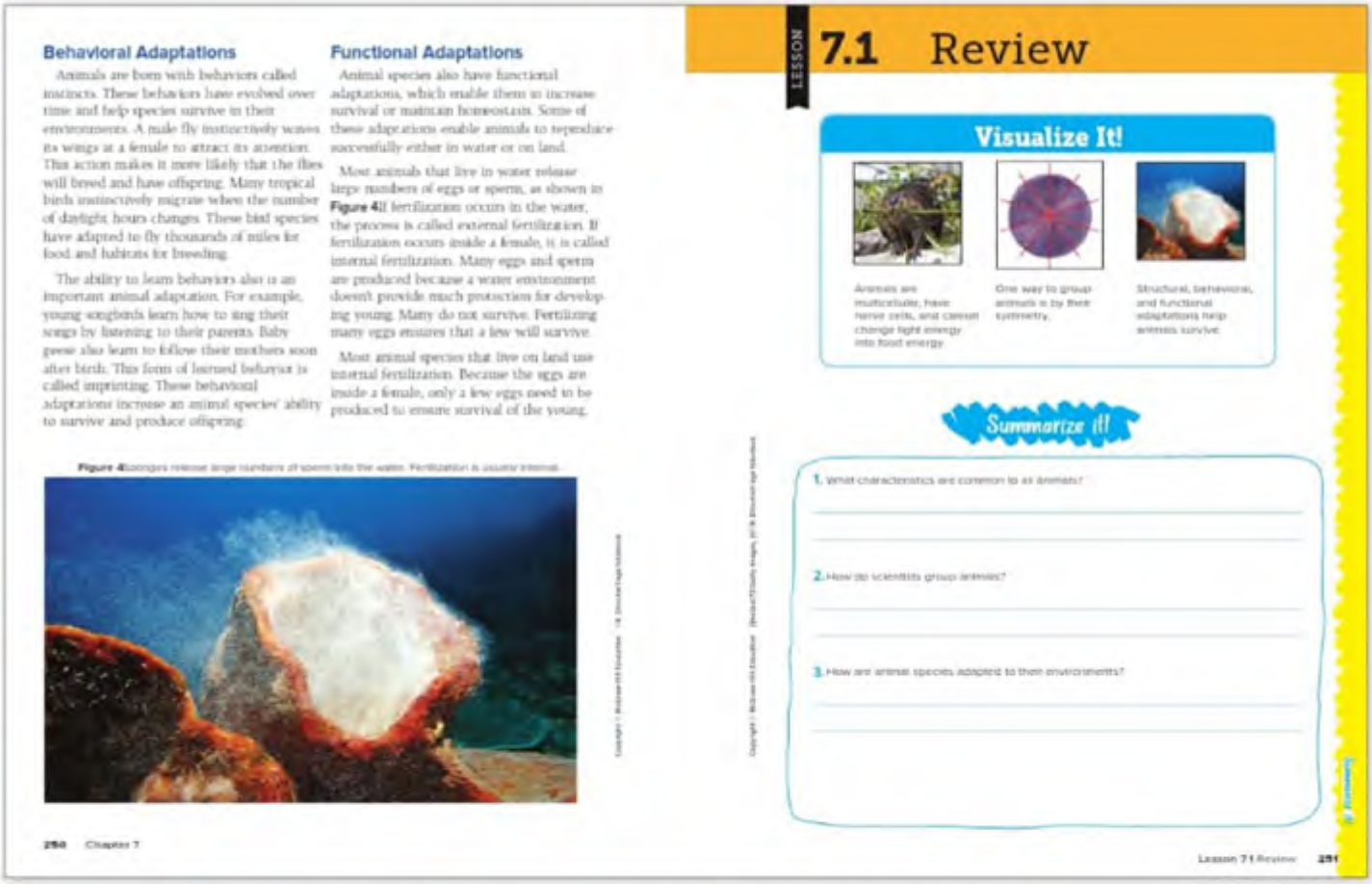
Before You Begin
Review the kingdoms of life. If time is available, a class brainstorming session of what makes animals different from some of the other kingdoms may be helpful to jump start student thinking for the activity.

Guide the Investigation

- Remind students to avoid generating lists based on the specific specimens in the pictures. The bird, for example, is meant to represent all birds, not just the individual pictured in the photograph.
- If students struggle with the lists, encourage them to be more general. If necessary, ask them a question such as, "Do they all eat?"
- Students may have limited knowledge of the sea squirt. Its larval form swims before it settles and attaches to the ocean floor.

Think About This

1. Students will likely say that the list of differences was easier to create because the differences tend to be physical characteristics that are easy to see. The similarities tend to be characteristics not evident in the photographs.
2. Answers will vary but should include some of the following: all animals are multicellular, respond to their environment, are consumers, reproduce, show independent movement, grow, and change.



Behavioral Adaptations

Animals are born with behaviors called instincts. These behaviors have evolved over time and help species survive in their environments. A male fly instinctively waves its wings at a female to attract its attention. This action makes it more likely that the flies will breed and have offspring. Many tropical birds instinctively migrate when the number of daylight hours changes. These bird species have adapted to fly thousands of miles for food and habitats for breeding.

The ability to learn behaviors also is an important animal adaptation. For example, young songbirds learn how to sing their songs by listening to their parents. Baby geese also learn to follow their mothers soon after birth. This form of learned behavior is called imprinting. These behavioral adaptations increase an animal species' ability to survive and produce offspring.

Functional Adaptations

Animal species also have functional adaptations, which enable them to increase survival or maintain homeostasis. Some of these adaptations enable animals to reproduce successfully either in water or on land.

Most animals that live in water release large numbers of eggs or sperm, as shown in **Figure 4**. If fertilization occurs in the water, the process is called external fertilization. If fertilization occurs inside a female, it is called internal fertilization. Many eggs and sperm are produced because a water environment doesn't provide much protection for developing young. Many do not survive. Fertilizing many eggs ensures that a few will survive.

Most animal species that live on land use internal fertilization. Because the eggs are inside a female, only a few eggs need to be produced to ensure survival of the young.

Figure 4 Salmon release large numbers of sperm into the water. Fertilization is usually external.

LESSON 7.1 Review

Visualize It!

Animals are multicellular, have nerve cells, and cannot change light energy into food energy.

One way to group animals is by their symmetry.

Structural, behavioral, and functional adaptations help animals survive.

Summarize it!

1. What characteristics are common to all animals?

2. How do scientists group animals?

3. How are animal species adapted to their environments?

Behavioral Adaptations

Help students understand that some animal behaviors are inherited and others are learned.

Guiding Questions

AL	What is the name for an inherited animal behavior, such as migration?	*instinct*
AL	How do songbirds learn how to sing?	*They learn it by listening to their parents.*
OL	What is the term for the kind of behavior by which baby geese learn to follow their mothers?	*imprinting*
BL	How do you think migrating thousands of miles to warmer climates helps geese survive and produce offspring?	*Students may surmise that geese will have more available food in the warmer climate. Also, it might be easier for offspring to develop and survive in the warmer climate.*

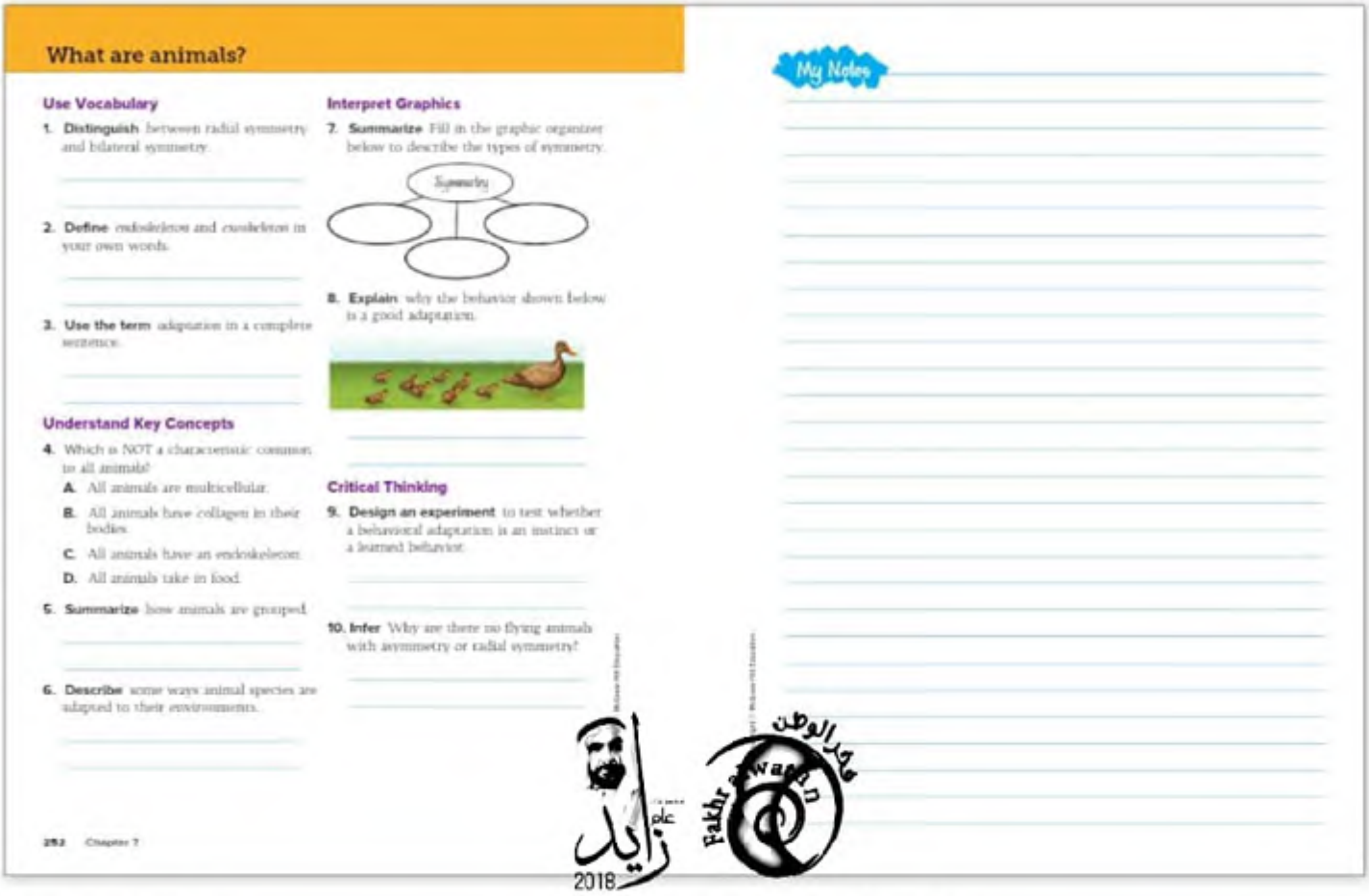
Functional Adaptations

Changes in the way an animal's body functions are called functional adaptations. Discuss functional adaptations relating to reproduction and then review adaptations in general.

Guiding Questions

AL	What are the two kinds of fertilization?	*external fertilization and internal fertilization*
AL	Which type of fertilization is used by most land animals?	*Most land animals use internal fertilization.*
OL	How are species adapted to their environments?	*Species have adapted to their environments by evolving useful body structures, special behaviors, and new ways of functioning.*
BL	When fertilization occurs internally, only a few eggs must be produced in order to reproduce successfully. Why do you think this is true?	*Students may surmise that the female's body protects the eggs from the environment and provides nourishment.*

Summarize it!



What are animals?

Use Vocabulary

1. **Distinguish** between radial symmetry and bilateral symmetry.

2. **Define** endoskeleton and exoskeleton in your own words.

3. **Use the term** adaptation in a complete sentence.

Understand Key Concepts

4. Which is NOT a characteristic common to all animals?
   A. All animals are multicellular.
   B. All animals have collagen in their bodies.
   C. All animals have an endoskeleton.
   D. All animals take in food.

5. **Summarize** how animals are grouped.

6. **Describe** some ways animal species are adapted to their environments.

Interpret Graphics

7. **Summarize** Fill in the graphic organizer below to describe the types of symmetry.

8. **Explain** why the behavior shown below is a good adaptation.

Critical Thinking

9. **Design an experiment** to test whether a behavioral adaptation is an instinct or a learned behavior.

10. **Infer** Why are there no flying animals with asymmetry or radial symmetry?

My Notes

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Use Vocabulary

1. Bilateral symmetry is a structural arrangement in which an imaginary line down the center of the animal divides it into two mirror-image halves. Radial symmetry applies to any animal that can be divided anywhere through its central axis to make two mirror-image halves. **DOK 1**

2. Possible answers include: An exoskeleton is a thick, hard outer covering or shell that protects the soft insides of an animal. An endoskeleton is an inner framework of supports found in many animals. **DOK 2**

3. Possible answers include: The complex "camera eye" of some animals is an adaptation that allows the animals to form accurate images of their worlds. **DOK 2**

Understand Key Concepts

4. c. All animals have an endoskeleton. **DOK 1**

5. Animals are grouped in a number of ways, including by the type of body symmetry they display, what their physical traits are, and from what ancestors they evolved. **DOK 1**

6. Animals are adapted with special senses like infrared sight, with different kinds of skeletons to support their bodies, and with different ways to circulate their blood through their bodies. **DOK 1**

Interpret Graphics

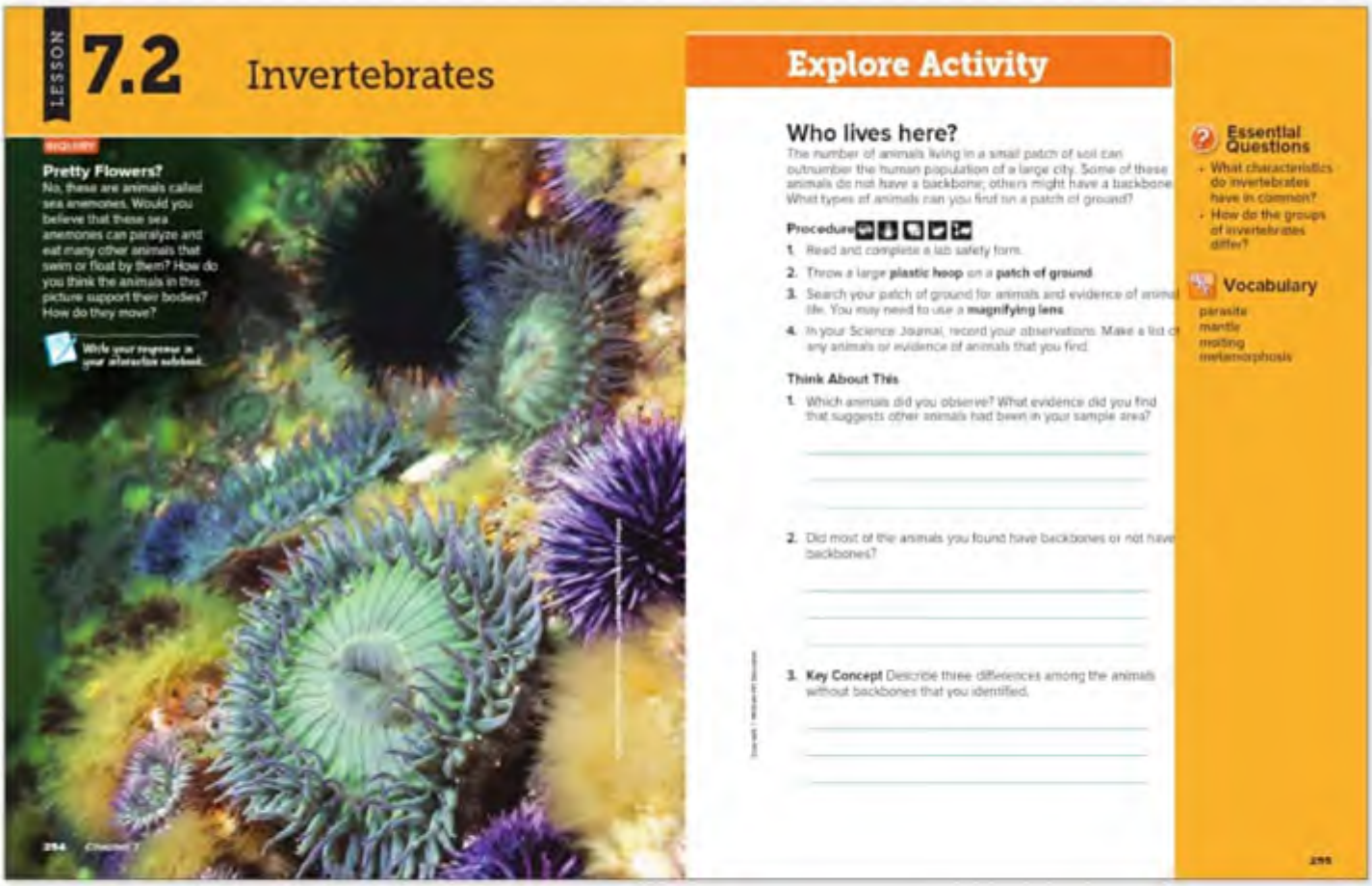
7. The lower ovals should contain the terms radial *symmetry*, *bilateral symmetry*, and *asymmetry*. **DOK 1**

8. Baby geese that follow and learn from their mother are more likely to survive and produce offspring of their own. **DOK 2**

Critical Thinking

9. Correct student responses will discuss showing evidence that a trait was present at birth or showed up later after the individual had a chance to observe the behavior in one or both of its parents. **DOK 4**

10. Wings are paired appendages and animals must have bilateral symmetry to have paired appendages. **DOK 3**



INQUIRY

About the Photo **Pretty Flowers?** Some sea anemones live for up to 50 years, and spend their lives attached to rocks along the bottom of the sea or on coral reefs. Anemones sting passing fish with tentacles that are filled with venom. Each paralyzed fish is moved into the mouth of the anemone. There are about 1,000 different types of colorful sea anemones. Sea anemones can be as small as a centimeter or as large as 1.8 meters in diameter.

Guiding Questions

OL	How do you think sea anemones support their bodies?	*Use this question to discuss the fact that these animals are soft—they have no backbones or hard outer coverings. Students might infer that the anemones' bodies are supported by fluid inside, filling them out like balloons.*
BL	How do you think sea anemones move?	*Students may infer that the anemones use their tentacles to push themselves through the water.*

Essential Questions

After this lesson, students should understand the Key Concepts and be able to answer these questions. Have students write each question in their Science Journals. Revisit each question as you cover its relevant content.

Vocabulary

Using Word Origins

1. Write *metamorphosis* on the board or chart paper. Circle *meta, morph,* and *sis*. Write *change* above *meta*. Write *shape* above *morph*. Write *action or process* above *sis*. Explain that you have written the meaning of each word part above the part. Remind students that words are made up of different parts, and that knowing the meanings of word parts helps in learning new words.
2. **Ask: What do you think is the meaning of *metamorphosis*?** *the action or process of changing shape or form* **Ask: *How did you determine the meaning of metamorphosis?*** *used the meanings of the different word parts*

3. Explain that in this chapter students will learn about some organisms that change shapes as they develop from egg to adulthood. As an example, remind students that butterflies spend part of their lives as caterpillars.

ExploreActivity

Who lives here?

Purpose
To classify animals as either vertebrates or invertebrates.

Materials
plastic hoop, patch of ground, magnifying lens

Before You Begin

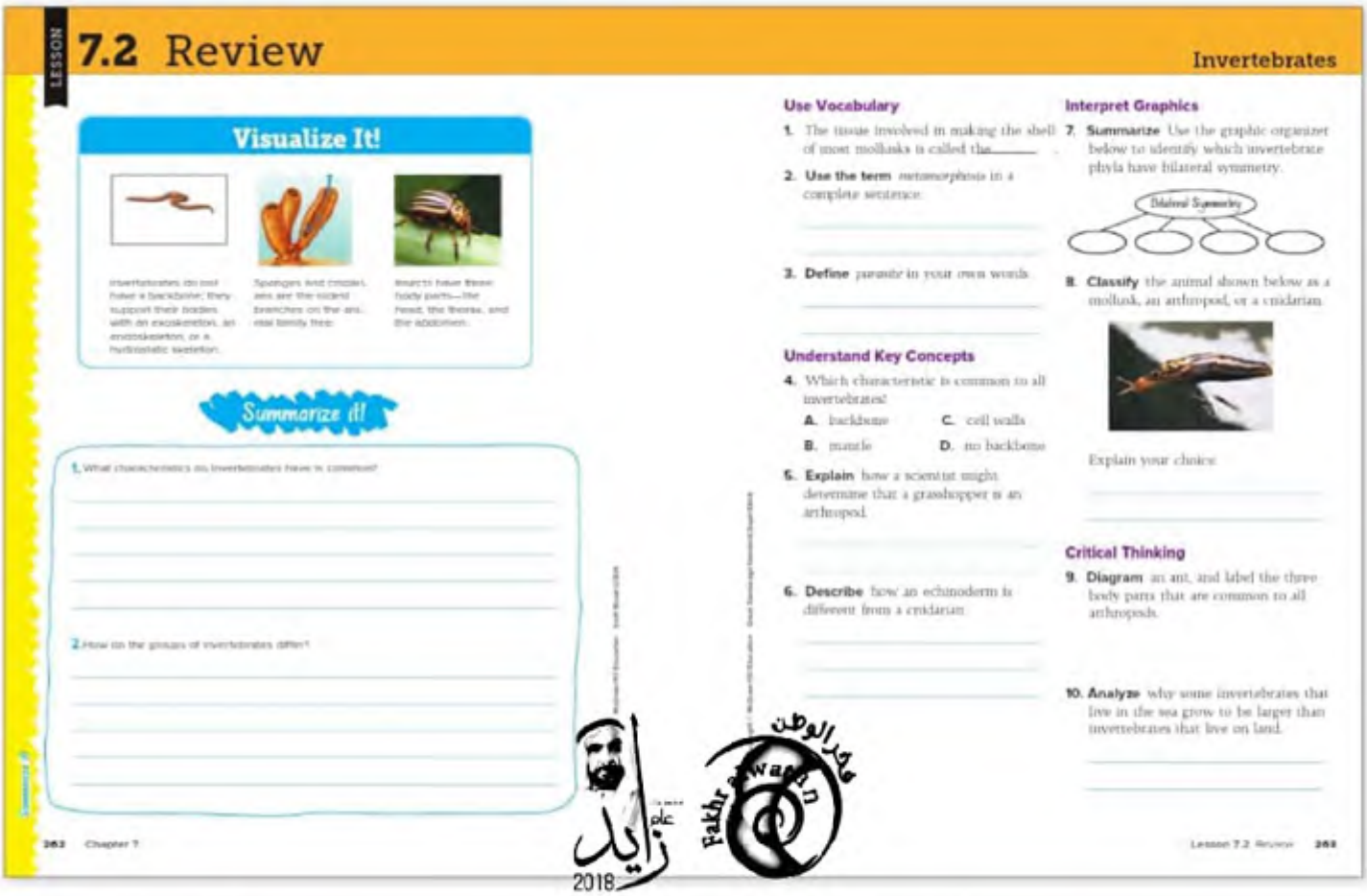
- Assign students to groups of four.
- Determine the location where students will be observing. Parks and farm fields, for example, yield a good deal of evidence.
- Have students brainstorm possible "evidence" of animals to look for ("shells" [exoskeletons], burrowed holes in the ground, holes left in plant material from feeding insects, etc.).

Guide the Investigation

- Read and check students' lab safety forms.
- Discuss with students how to systematically search their sp[illegible]
- Encourage students to search for all evidence of animals, [illegible] to ask questions when they are uncertain about what they ha[illegible] found.
- ⚠ Emphasize that students should not handle or disturb any animals they find.

Think About This

1. Students will likely find ants, beetles, spiders, and possibly pill bugs. Evidence of animals they might find include insect parts, animal holes, worm casings, partially eaten plants, ant mounds, and spider webs.
2. Most of the animals on the list are invertebrates and have no backbone.
3. Answers will vary but will likely include references to body parts such as legs, antennae, wings, pincers, skin (worms), etc.



LESSON 7.2 Review

Invertebrates

Visualize It!

Summarize it!

1. What characteristics do invertebrates have in common?

2. How do the groups of invertebrates differ?

Use Vocabulary

1. The tissue involved in making the shell of most mollusks is called the _____.
2. **Use the term** *metamorphosis* in a complete sentence.
3. **Define** *parasite* in your own words.

Understand Key Concepts

4. Which characteristic is common to all invertebrates?
   A. backbone C. cell walls
   B. mantle D. no backbone
5. **Explain** how a scientist might determine that a grasshopper is an arthropod.
6. **Describe** how an echinoderm is different from a cnidarian.

Interpret Graphics

7. **Summarize** Use the graphic organizer below to identify which invertebrate phyla have bilateral symmetry.

8. **Classify** the animal shown below as a mollusk, an arthropod, or a cnidarian.

Explain your choice.

Critical Thinking

9. **Diagram** an ant, and label the three body parts that are common to all arthropods.
10. **Analyze** why some invertebrates that live in the sea grow to be larger than invertebrates that live on land.

Visual Summary

Concepts and terms are easier to remember when they are associated with an image. **Ask: Which Key Concept does each image relate to?**

Summarize it!

Use Vocabulary

1. mantle. **DOK 1**
2. Possible answers include: A caterpillar goes through the process of metamorphosis when it changes into a moth or butterfly. **DOK 2**
3. Possible answers include: A parasite is an animal that survives by living inside another animal. **DOK 2**

Understand Key Concepts

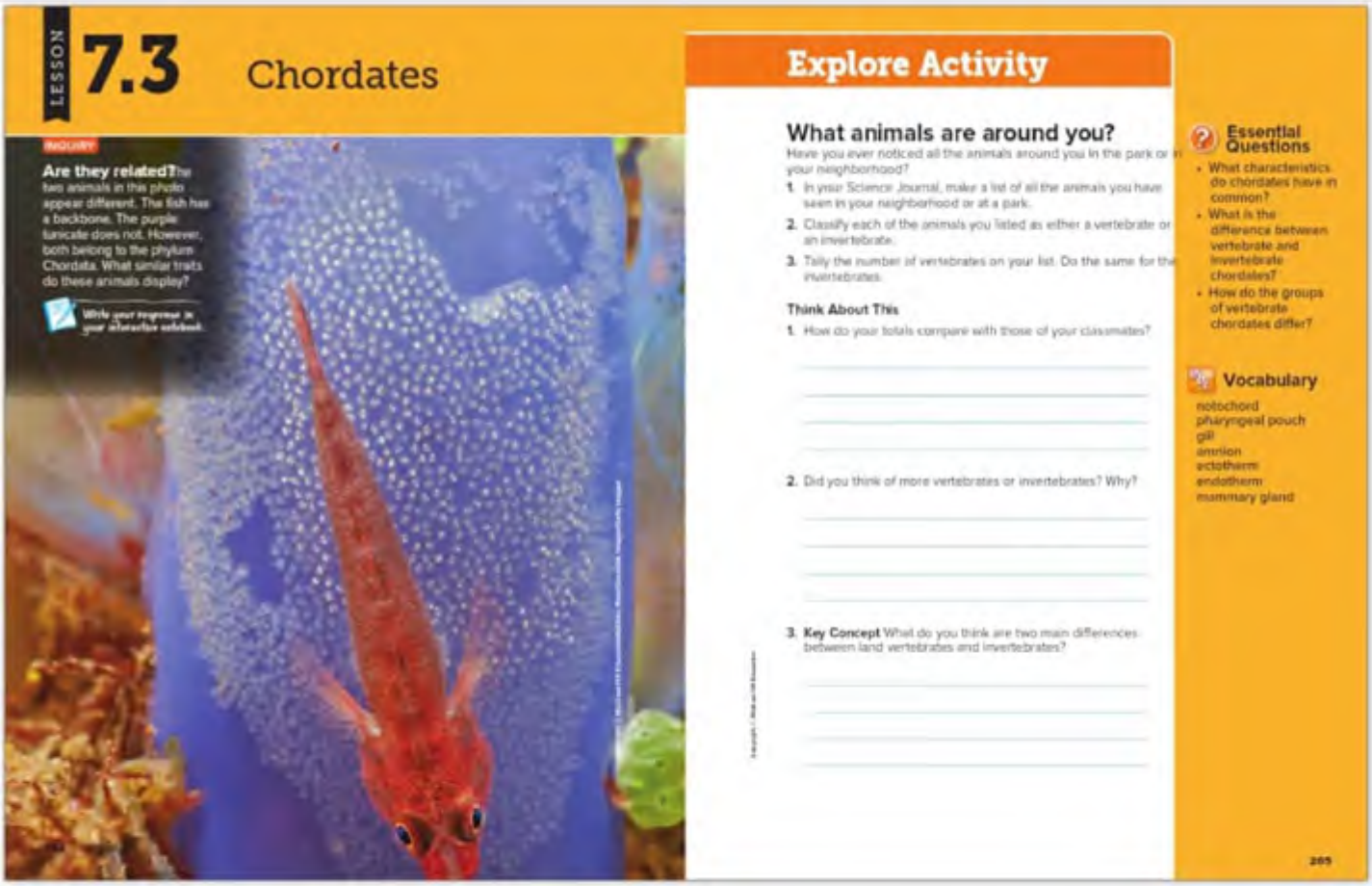
4. D. no backbone **DOK 1**
5. A scientist can identify that the grasshopper has no backbone and also has many jointed appendages, which are all characteristics of arthropods. **DOK 2**
6. An echinoderm has a hard endoskeleton just under its thin outer skin, but a cnidarian has a hydrostatic skeleton and has special cells that inject poison into its prey. **DOK 2**

Interpret Graphics

7. segmented worm, roundworm, mollusk, arthropod, and flatworm (in any order) **DOK 1**
8. It is a mollusk. It does not have jointed appendages or radial symmetry **DOK 2**

Critical Thinking

9. Accept any answer that includes all 3 parts of the arthropod (head, thorax, abdomen) **DOK 4**
10. Invertebrates that live in the sea are supported by the buoyancy of the water while invertebrates that live on land only have their skeletons to support them. **DOK 3**


LESSON 7.3 Chordates

INQUIRY

Are they related? The two animals in this photo appear different. The fish has a backbone. The purple tunicate does not. However, both belong to the phylum Chordata. What similar traits do these animals display?

Write your response in your interactive notebook.

Explore Activity

What animals are around you?

Have you ever noticed all the animals around you in the park or in your neighborhood?

1. In your Science Journal, make a list of all the animals you have seen in your neighborhood or at a park.
2. Classify each of the animals you listed as either a vertebrate or an invertebrate.
3. Tally the number of vertebrates on your list. Do the same for the invertebrates.

Think About This

1. How do your totals compare with those of your classmates?

2. Did you think of more vertebrates or invertebrates? Why?

3. **Key Concept** What do you think are two main differences between land vertebrates and invertebrates?

Essential Questions

- What characteristics do chordates have in common?
- What is the difference between vertebrate and invertebrate chordates?
- How do the groups of vertebrate chordates differ?

Vocabulary

notochord
pharyngeal pouch
gill
amnion
ectotherm
endotherm
mammary gland

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INQUIRY

About the Photo **Are they related?** Students will probably be unfamiliar with tunicates, a type of underwater saclike filter feeders also known as "sea squirts." Both the fish and the tunicate belong to the phylum Chordata. Tell students they will learn more about these organisms as they discuss the lesson.

Guiding Questions

AL	What similar traits do these animals display?	*Students will likely answer "none." Point out that the two animals do share some traits that aren't obvious.*
OL	What does the fish have that the tunicate does not?	*backbone*
BL	What might be the advantages of having a backbone?	*Backbones give organisms support and flexibility. Some students might know that backbones protect part of the nervous system. Use this question to launch a discussion of the different needs and functions of organisms.*

Essential Questions

After this lesson, students should understand the Key Concepts and be able to answer these questions. Have students write each question in their Science Journals. Revisit each question as you cover its relevant content.

Vocabulary

Use Word Roots and Suffixes to Understand Word Meaning

1. Write *ectotherm* on the board.
2. Circle *ecto*, and explain that this word root means *"outside."*
3. Underline the suffix *therm*, and explain that this suffix means *"heat."*
4. **Ask: What does *ectotherm* mean?** *heat from outside*
5. Help students recognize that an ectotherm is an animal that heats its body using heat in its environment.
6. Repeat with *endotherm*: *endo* meaning *"inside,"* *endotherm* meaning "heat from inside," and *endotherm* meaning "animal that generates body heat from the inside."
7. Tell students they will learn more about ectotherms and endotherms in the lesson.

ExploreActivity

What animals are around you?

Purpose
To observe and classify some vertebrates and invertebrates.

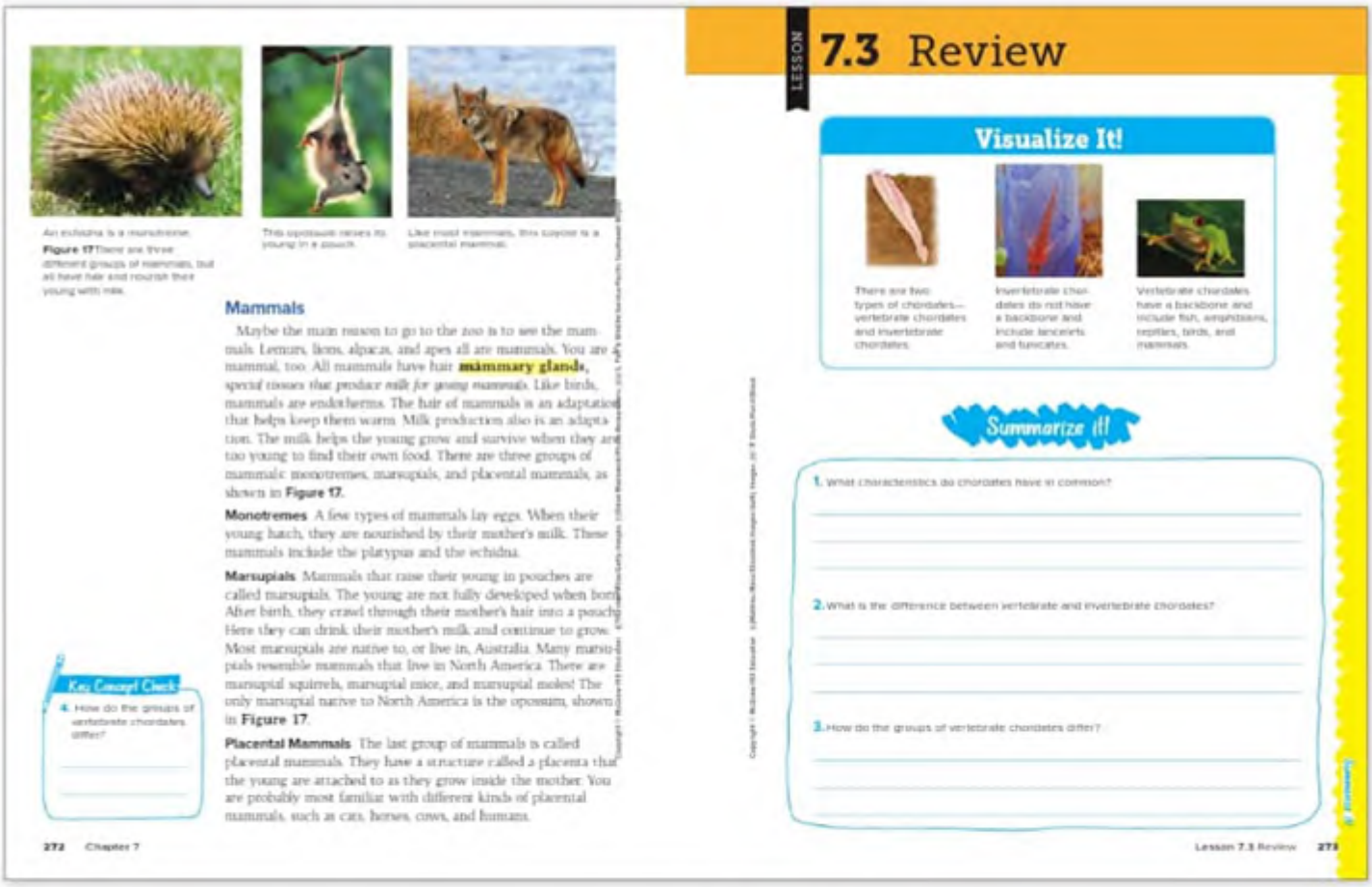
Before You Begin
Remind students of the meanings of *vertebrate* and *invertebrate*.

Guide the Investigation

- As students recall their time in the park or neighborhood, tell them to think about animals in the air and on the ground.
- Encourage students to be specific. For example, instead of writing just the word *bird*, they can write the names of different types birds they have seen such as *robin, blue jay,* and *hawk*.

Analyze and Conclude

1. Answers will vary.
2. Answers will vary, but most students will probably have a longer list of vertebrates. The vertebrates tend to be more noticeable and memorable because of their size.
3. Terrestrial (or land) vertebrates grow larger than terrestrial invertebrates. Vertebrates have different body coverings than invertebrates.



An echidna is a monotreme.

Figure 17 There are three different groups of mammals, but all have hair and nourish their young with milk.

This opossum raises its young in a pouch.

Like most mammals, this coyote is a placental mammal.

Mammals

Maybe the main reason to go to the zoo is to see the mammals. Lemurs, lions, alpacas, and apes all are mammals. You are a mammal, too. All mammals have hair **mammary glands**, special tissues that produce milk for young mammals. Like birds, mammals are endotherms. The hair of mammals is an adaptation that helps keep them warm. Milk production also is an adaptation. The milk helps the young grow and survive when they are too young to find their own food. There are three groups of mammals: monotremes, marsupials, and placental mammals, as shown in **Figure 17**.

Monotremes A few types of mammals lay eggs. When their young hatch, they are nourished by their mother's milk. These mammals include the platypus and the echidna.

Marsupials Mammals that raise their young in pouches are called marsupials. The young are not fully developed when born. After birth, they crawl through their mother's hair into a pouch. Here they can drink their mother's milk and continue to grow. Most marsupials are native to, or live in, Australia. Many marsupials resemble mammals that live in North America. There are marsupial squirrels, marsupial mice, and marsupial moles! The only marsupial native to North America is the opossum, shown in **Figure 17**.

Placental Mammals The last group of mammals is called placental mammals. They have a structure called a placenta that the young are attached to as they grow inside the mother. You are probably most familiar with different kinds of placental mammals, such as cats, horses, cows, and humans.

Key Concept Check

4. How do the groups of vertebrate chordates differ?

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LESSON 7.3 Review

Visualize It!

There are two types of chordates—vertebrate chordates and invertebrate chordates.

Invertebrate chordates do not have a backbone and include lancelets and tunicates.

Vertebrate chordates have a backbone and include fish, amphibians, reptiles, birds, and mammals.

Summarize it!

1. What characteristics do chordates have in common?

2. What is the difference between vertebrate and invertebrate chordates?

3. How do the groups of vertebrate chordates differ?

Lesson 7.3 Review 273

Mammals

Students can recall that they have discussed four types of vertebrate chordates—the fishes, amphibians, reptiles, and birds. Tell students they will now discuss another type of vertebrate chordate—mammals. Use the scaffolded questions and Visual Literacy feature to guide their understanding.

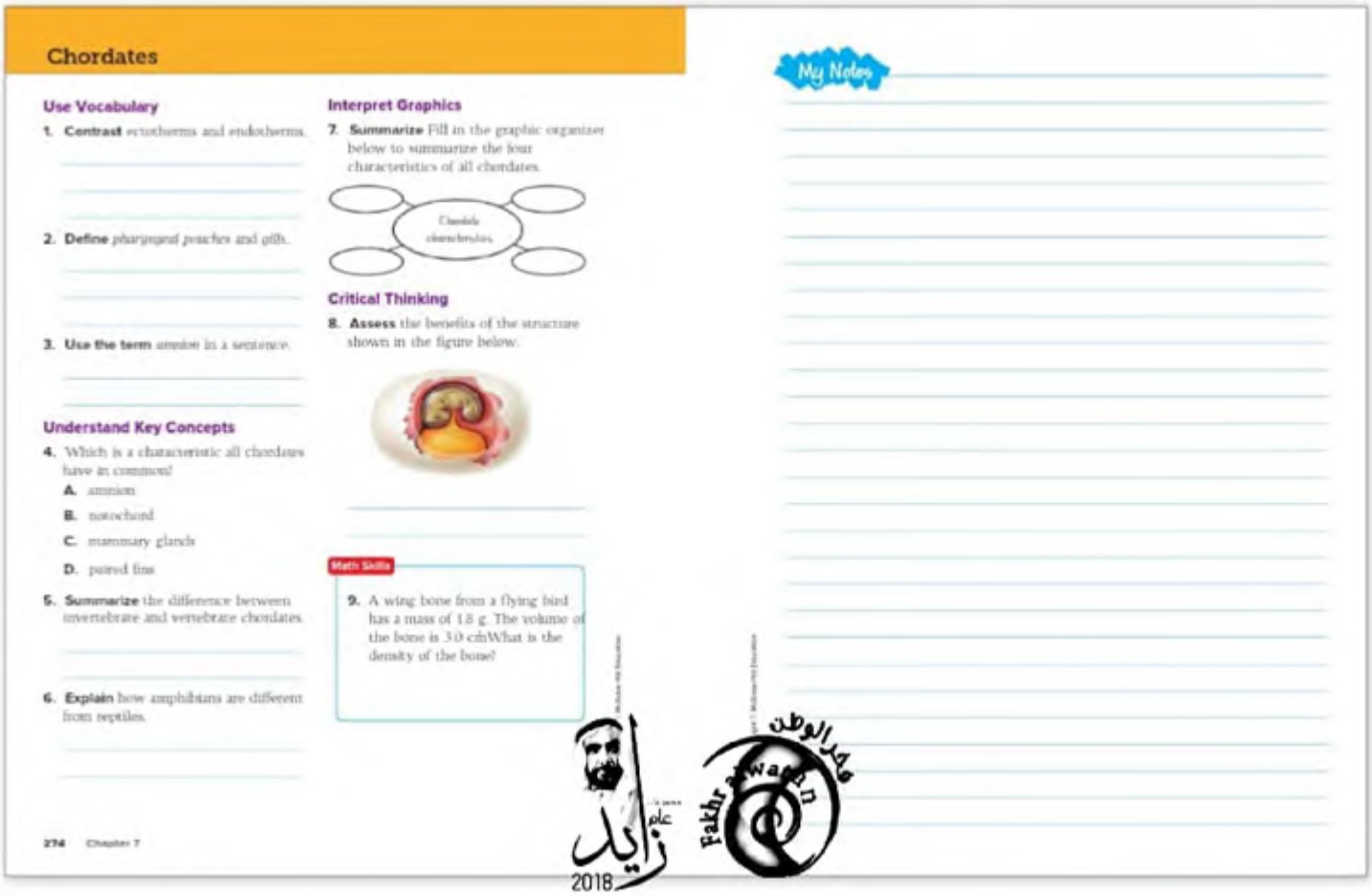
Guiding Questions

AL	What are mammary glands?	*special tissues that produce milk for young mammals*
OL	How do the groups of vertebrate chordates differ?	*Groups of vertebrate chordates differ in several major ways. A few are: Fish—fully aquatic with fins and gills; Amphibians—four limbs but aquatic fertilization; Reptiles—ectotherm and scaly skin, but amniotic egg; Birds— feathers, endotherm, and amniotic egg; Mammals—endotherm, amniotic egg, and hair and milk production.*

Visual Summary

Concepts and terms are easier to remember when they are associated with an image. **Ask: Which Key Concept does each image relate to?**

Summarize it!



Chordates

Use Vocabulary

1. **Contrast** ectotherms and endotherms.

2. **Define** *pharyngeal pouches* and *gills*.

3. **Use the term** amnion in a sentence.

Understand Key Concepts

4. Which is a characteristic all chordates have in common?
   A. amnion
   B. notochord
   C. mammary glands
   D. paired fins

5. **Summarize** the difference between invertebrate and vertebrate chordates.

6. **Explain** how amphibians are different from reptiles.

Interpret Graphics

7. **Summarize** Fill in the graphic organizer below to summarize the four characteristics of all chordates.

Critical Thinking

8. **Assess** the benefits of the structure shown in the figure below.

Math Skills

9. A wing bone from a flying bird has a mass of 1.8 g. The volume of the bone is 3.0 cmWhat is the density of the bone?

My Notes

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Use Vocabulary

1. Possible answers: Ectotherms are animals that heat their bodies using the heat in their environments, while endotherms are animals that generate their own body heat. **DOK 1**
2. Possible answers: Pharyngeal pouches are grooves along the side of a developing chordate that, in fish, provide support for the gills, which are organs that exchange carbon dioxide for oxygen in the water. **DOK 1**
3. Answers will vary. Possible response: Development of the young of reptiles, birds, and mammals takes place in a protective fluid-filled sac called the amnion. **DOK 2**

Understand Key Concepts

4. **B.** notochord **DOK 1**
5. Invertebrate chordates, like vertebrate chordates, have all four chordate characteristics (notochord, nerve cord, pharyngeal pouches, and tail), but they never develop backbones like the vertebrate chordates. **DOK 2**
6. Amphibians are tetrapods with smooth skin, and they lay and fertilize their eggs in water. Reptiles are tetrapods with scaly skin—and most reptiles lay amniotic eggs on land. **DOK 2**

Interpret Graphics

7. Center oval: Chordate characteristics; Four smaller ovals: *notochord, tail, nerve cord, pharyngeal pouches* **DOK 1**

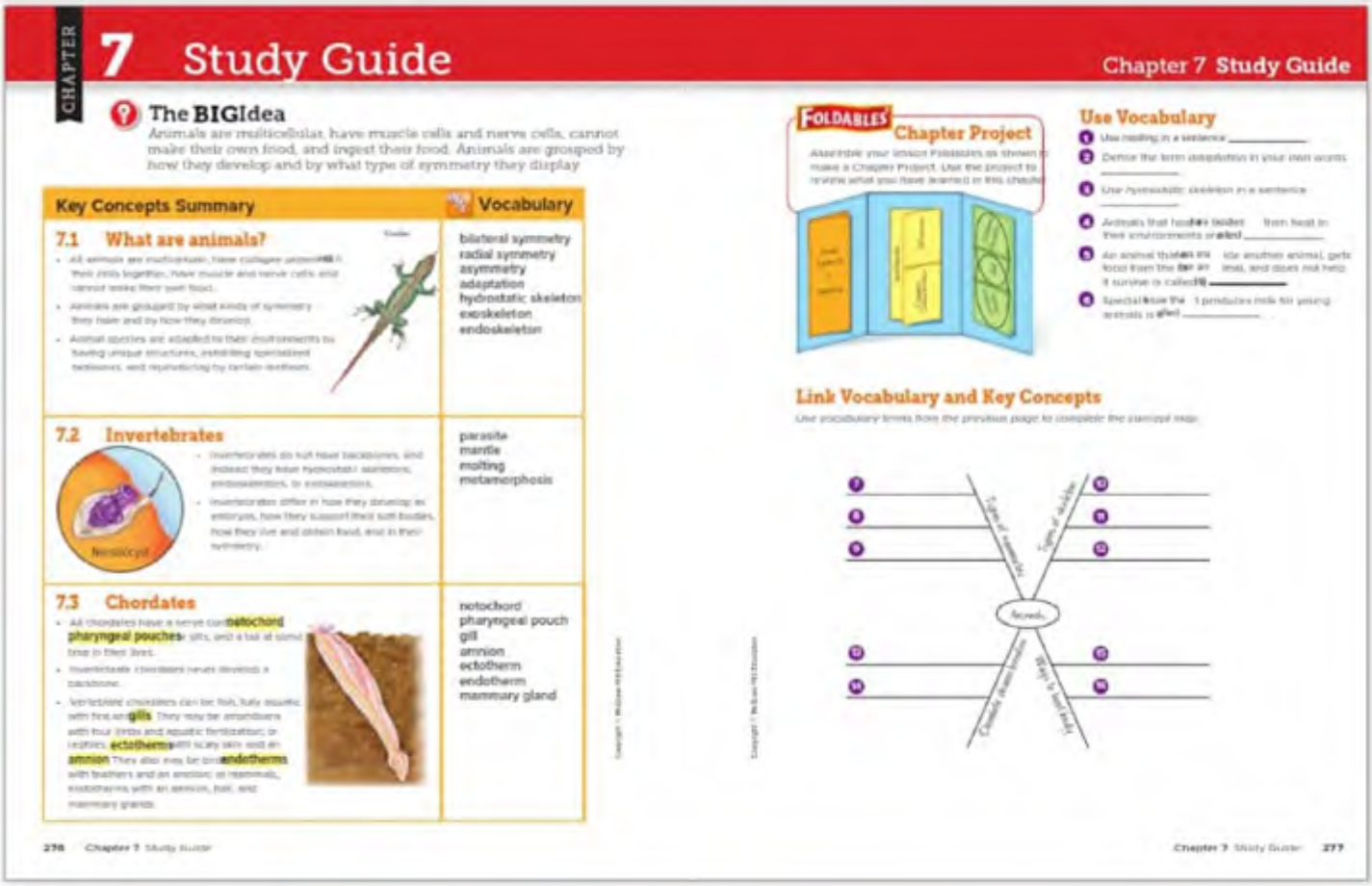
Critical Thinking

8. The amniotic egg enabled reptile, bird, and mammal young to develop without depending on water. **DOK 3**

Math Skills

9. density $= \frac{1.8\ g}{3.0\ cm3}$

   density $= \frac{.6\ g}{cm^3}$ **DOK 3**


CHAPTER 7 Study Guide

Chapter 7 Study Guide

The BIGIdea

Animals are multicellular, have muscle cells and nerve cells, cannot make their own food, and ingest their food. Animals are grouped by how they develop and by what type of symmetry they display

Key Concepts Summary

Vocabulary

7.1 What are animals?

bilateral symmetry
radial symmetry
asymmetry
adaptation
hydrostatic skeleton
exoskeleton
endoskeleton

7.2 Invertebrates

parasite
mantle
molting
metamorphosis

7.3 Chordates

notochord
pharyngeal pouch
gill
amnion
ectotherm
endotherm
mammary gland

FOLDABLES Chapter Project

Use Vocabulary

Link Vocabulary and Key Concepts

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Chapter 7 Study Guide 277

Key Concepts Summary

Study Strategy: Questions and Answers

Students often complete a reading without realizing they failed to understand it. Self-assessment helps students practice metacognition, increasing their awareness of their understanding.

1. Ask students to create a chart similar to the one below in their Science Journals.
2. Instruct students to use the information in each Key Concept Summary statement and the lessons to write one or more questions in the first column of their charts.
3. Have students write answers to each of their questions in the second column of their charts. Prompt them to use complete sentences.
4. Instruct pairs of students to take turns asking and answering each other's questions and assessing their own understanding.

Example:

	Question	Answer
Lesson 1	What holds animal cells together?	Collagen protein holds animal cells together.

Vocabulary

Study Strategy: In Your Own Words

Ask students to work in pairs to write vocabulary definitions in their own words. Connecting vocabulary words to students' own language promotes understanding more effectively than memorizing.

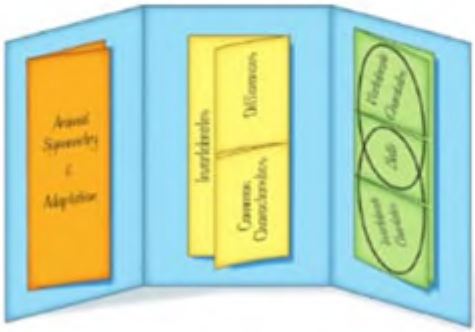
1. Have students create a two-column table like the one below in their Science Journals.
2. Have them write the vocabulary words in the Study Guide in the left column.
3. Ask students to review the definition of each word in the chapter.
4. Ask students to use their own words to write a definition for each vocabulary word, including any notes that will help them remember its meaning.

Example:

Vocabulary word	My Definition and Notes
bilateral symmetry	Bilateral symmetry is a body plan in which an animal can be divided into two identical halves. Humans have bilateral symmetry. It is one of three types of symmetry in animals.

FOLDABLES®

Chapter Project



Use the Foldables® Chapter Project as a way to connect Key Concepts.

1. Ask students to organize their Foldables® in a way that reflects how the concepts in each Foldable relate to each other.
2. Use glue or staples to hold the sheets together as needed.
3. When complete, ask students to place their Foldables® Chapter Project at the front of the room. Have the class critique and discuss the way in which students have organized their Foldables®.

Use Vocabulary

1. Answers will vary. Sample answer: The roundworm was shedding its exoskeleton during the process of molting.
2. Answers will vary. Sample answer: An adaptation is a trait that an animal is born with and that will help it survive and reproduce.
3. Answers will vary. Sample answer: A hydrostatic skeleton is a cavity filled with liquid and surrounded by muscle.
4. ectotherms
5. parasite
6. mammary glands

Link Vocabulary and Key Concepts

7 8 9

bilateral symmetry/radial symmetry/asymmetry

10 11 12

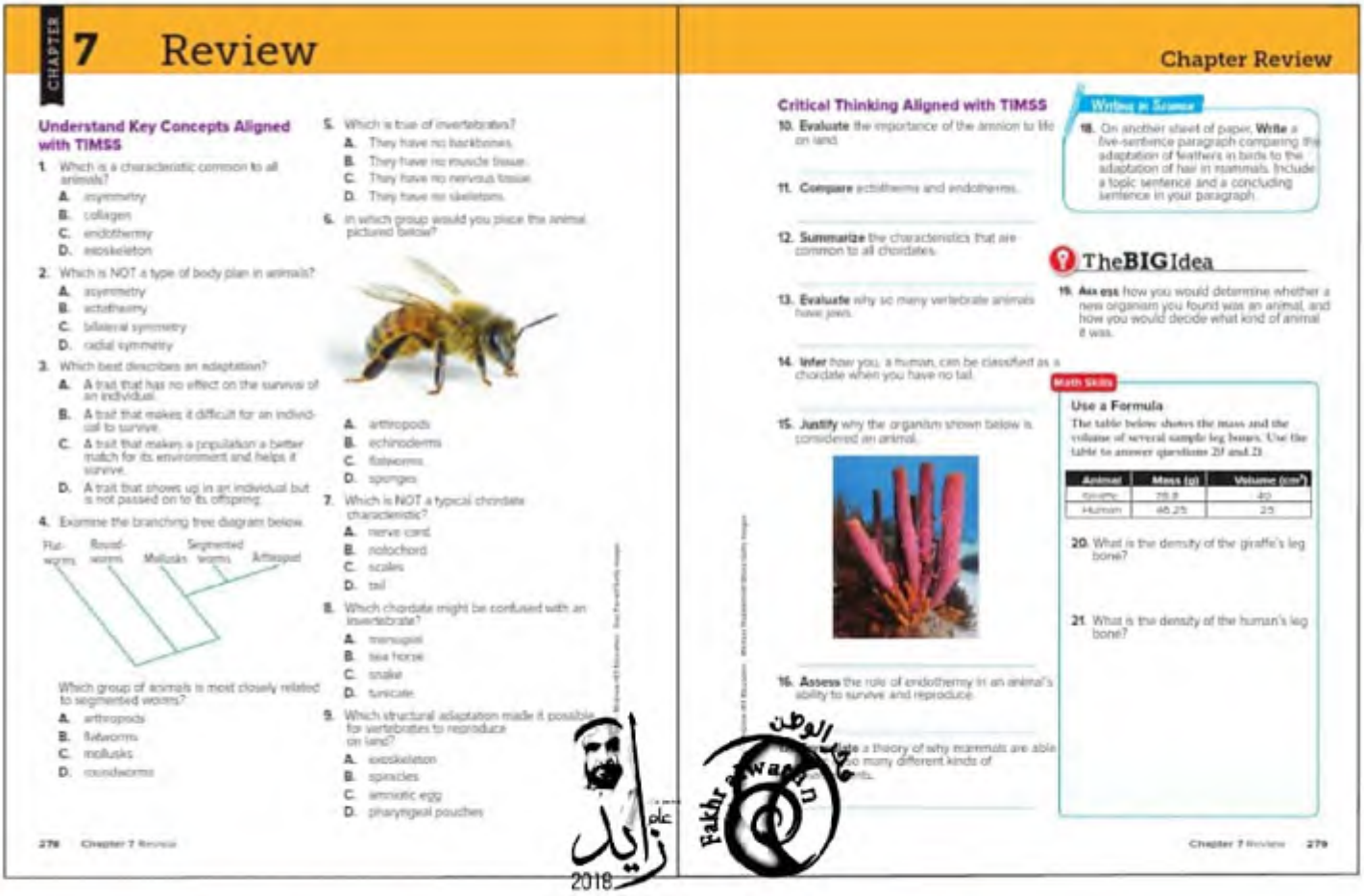
hydrostatic skeleton/ exoskeleton/ endoskeleton

13 14

notochord/pharyngeal pouch

15 16

ectotherm/endotherm



CHAPTER 7 Review

Understand Key Concepts Aligned with TIMSS

1. Which is a characteristic common to all animals?
   A. asymmetry
   B. collagen
   C. endothermy
   D. exoskeleton
2. Which is NOT a type of body plan in animals?
   A. asymmetry
   B. ectothermy
   C. bilateral symmetry
   D. radial symmetry
3. Which best describes an adaptation?
   A. A trait that has no effect on the survival of an individual.
   B. A trait that makes it difficult for an individual to survive.
   C. A trait that makes a population a better match for its environment and helps it survive.
   D. A trait that shows up in an individual but is not passed on to its offspring.
4. Examine the branching tree diagram below.

Which group of animals is most closely related to segmented worms?
   A. arthropods
   B. flatworms
   C. mollusks
   D. roundworms
5. Which is true of invertebrates?
   A. They have no backbones.
   B. They have no muscle tissue.
   C. They have no nervous tissue.
   D. They have no skeletons.
6. In which group would you place the animal pictured below?

   A. arthropods
   B. echinoderms
   C. flatworms
   D. sponges
7. Which is NOT a typical chordate characteristic?
   A. nerve cord
   B. notochord
   C. scales
   D. tail
8. Which chordate might be confused with an invertebrate?
   A. hemichordate
   B. sea horse
   C. snake
   D. tunicate
9. Which structural adaptation made it possible for vertebrates to reproduce on land?
   A. exoskeleton
   B. spiracles
   C. amniotic egg
   D. pharyngeal pouches

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Chapter Review

Critical Thinking Aligned with TIMSS

10. **Evaluate** the importance of the amnion to life on land.
11. **Compare** ectotherms and endotherms.
12. **Summarize** the characteristics that are common to all chordates.
13. **Evaluate** why so many vertebrate animals have jaws.
14. **Infer** how you, a human, can be classified as a chordate when you have no tail.
15. **Justify** why the organism shown below is considered an animal.

16. **Assess** the role of endothermy in an animal's ability to survive and reproduce.
17. **Create** a theory of why mammals are able to live in so many different kinds of environments.

Writing in Science

18. On another sheet of paper, **Write** a five-sentence paragraph comparing the adaptation of feathers in birds to the adaptation of hair in mammals. Include a topic sentence and a concluding sentence in your paragraph.

The BIG Idea

19. **Assess** how you would determine whether a new organism you found was an animal, and how you would decide what kind of animal it was.

Math Skills

Use a Formula

The table below shows the mass and the volume of several sample leg bones. Use the table to answer questions 20 and 21.

Animal	Mass (g)	Volume (cm³)
Giraffe	78.8	40
Human	46.25	25

20. What is the density of the giraffe's leg bone?
21. What is the density of the human's leg bone?

Chapter 7 Review 279

Understand Key Concepts

1 B. collagen
2 B. ectothermy
3 C. A trait that makes a population a better match for its environment and helps it survive.
4 C. mollusks
5 A. They have no backbones.
6 A. arthropods
7 C. scales
8 D. tunicate
9 C. amniotic egg

Critical Thinking

10 Reptiles, birds, and mammals all develop as embryos in a protective membrane called an amnion. The development of the amnion was important to life on land because it allowed terrestrial animals to reproduce without depending on water.

11 Ectotherms, like reptiles, are animals that heat their bodies using the heat in their environments. Basking can help an ectotherm to have a warm body, which helps it move faster and more easily catch prey. Ectotherms can move to cool, dark places to conserve energy when food is scarce. Endotherms, like birds and mammals, generate their body heat from the inside. Endotherms are able to live in cold habitats, but keeping their body temperatures high requires a lot of energy from food. Endotherms shiver their muscles when they get cold which helps produce more body heat.

12 All chordates have a dorsal hollow nerve cord, a notochord, pharyngeal pouches or slits, and a post-anal tail.

13 Jaws help vertebrate animals catch and consume prey more efficiently.

14. When humans are developing as embryos, they have a tail. The tail stops growing during development while the rest of the embryo continues to grow. What's left of the tail is the tailbone (coccy x).

15 A sponge is an animal because it is multicellular, has collagen, and does not make its own food.

16 Endothermy is an adaptation in birds and mammals where they produce their own body heat. Endothermy leads to an increased ability to be active and survive and reproduce in habitats where temperatures can get cold.

17 Mammals can live in many different kinds of environments because they are endotherms and do not rely on outside conditions to maintain their body temperature. Many mammals also have the adaptation of hair, which helps keep them warm.

Writing in Science

18 Answers should include an understanding of the similarities and differences between feathers and hair.

The BIG Idea

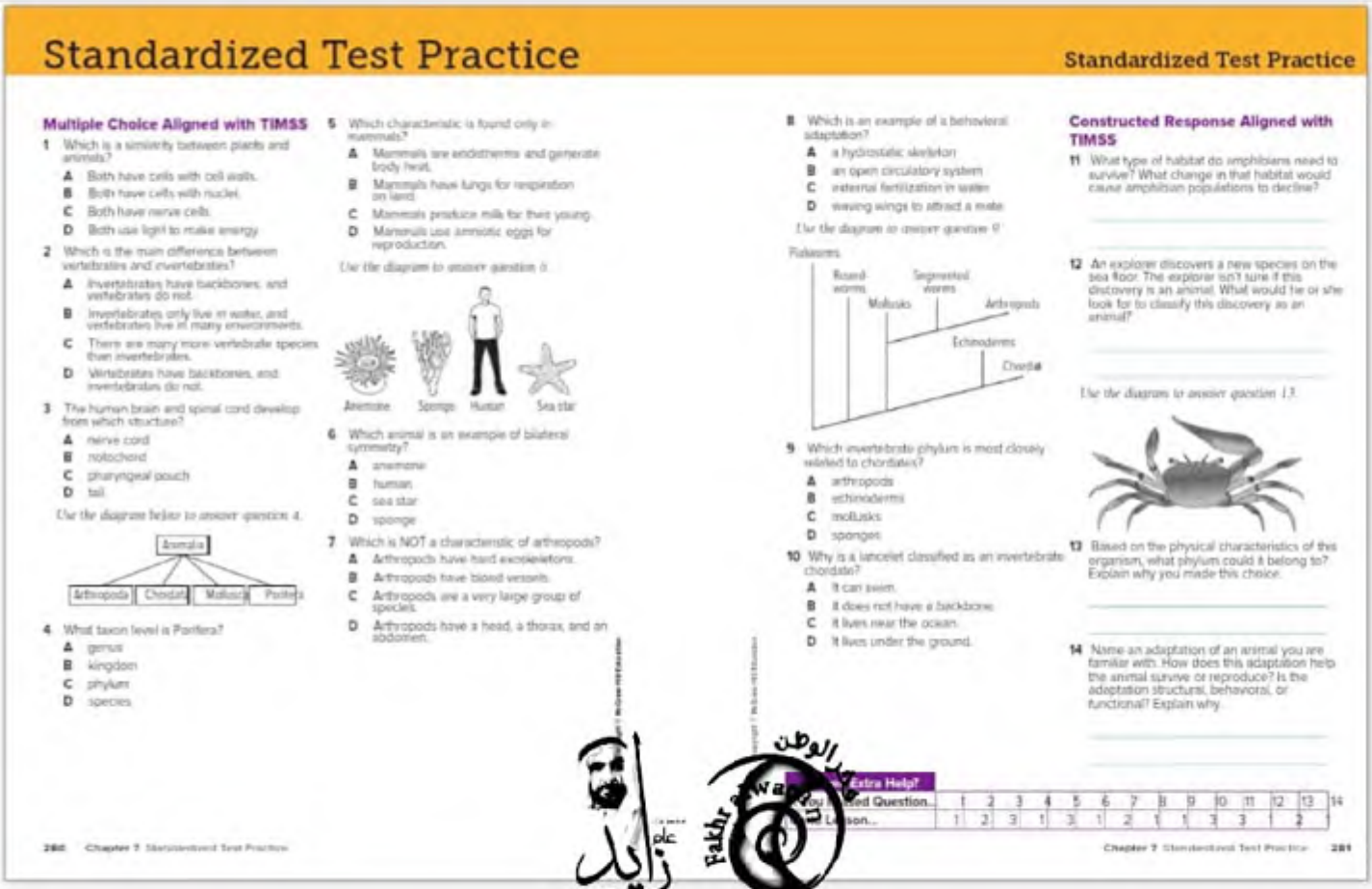
19. A person could determine if a new organism was an animal by checking to see if it was multicellular, had collagen connecting its cells, and needed to ingest food to get energy. Looking for other unique characteristics could help determine what kind of animal had been found. For example, birds have backbones, are endotherms, and have bilateral symmetry, but only birds have feathers. Cnidarians do not have backbones and have radial symmetry, but only cnidarians have special stinging cells called nematocysts.

Math Skills

Use a Formula

20. density $= \frac{76.8\text{g}}{40\ \text{cm}^3} = \frac{1.92\text{g}}{\text{cm}^3}$

21. density $= \frac{46.25\text{g}}{25\ \text{cm}^3} = \frac{1.85\text{g}}{\text{cm}^3}$



Standardized Test Practice

Standardized Test Practice

Multiple Choice Aligned with TIMSS

1 Which is a similarity between plants and animals?
A Both have cells with cell walls.
B Both have cells with nuclei.
C Both have nerve cells.
D Both use light to make energy.

2 Which is the main difference between vertebrates and invertebrates?
A Invertebrates have backbones, and vertebrates do not.
B Invertebrates only live in water, and vertebrates live in many environments.
C There are many more vertebrate species than invertebrates.
D Vertebrates have backbones, and invertebrates do not.

3 The human brain and spinal cord develop from which structure?
A nerve cord
B notochord
C pharyngeal pouch
D tail

Use the diagram below to answer question 4.

Animalia
Arthropoda | Chordata | Mollusca | Porifera

4 What taxon level is Porifera?
A genus
B kingdom
C phylum
D species

5 Which characteristic is found only in mammals?
A Mammals are endotherms and generate body heat.
B Mammals have lungs for respiration on land.
C Mammals produce milk for their young.
D Mammals use amniotic eggs for reproduction.

Use the diagram to answer question 6.

Anemone Sponge Human Sea star

6 Which animal is an example of bilateral symmetry?
A anemone
B human
C sea star
D sponge

7 Which is NOT a characteristic of arthropods?
A Arthropods have hard exoskeletons.
B Arthropods have blood vessels.
C Arthropods are a very large group of species.
D Arthropods have a head, a thorax, and an abdomen.

8 Which is an example of a behavioral adaptation?
A a hydrostatic skeleton
B an open circulatory system
C external fertilization in water
D waving wings to attract a mate

Use the diagram to answer question 9.

Flatworms
Round-worms
Segmented worms
Mollusks
Arthropods
Echinoderms
Chordata

9 Which invertebrate phylum is most closely related to chordates?
A arthropods
B echinoderms
C mollusks
D sponges

10 Why is a lancelet classified as an invertebrate chordate?
A It can swim.
B It does not have a backbone.
C It lives near the ocean.
D It lives under the ground.

Constructed Response Aligned with TIMSS

11 What type of habitat do amphibians need to survive? What change in that habitat would cause amphibian populations to decline?

12 An explorer discovers a new species on the sea floor. The explorer isn't sure if this discovery is an animal. What would he or she look for to classify this discovery as an animal?

Use the diagram to answer question 13.

13 Based on the physical characteristics of this organism, what phylum could it belong to? Explain why you made this choice.

14 Name an adaptation of an animal you are familiar with. How does this adaptation help the animal survive or reproduce? Is the adaptation structural, behavioral, or functional? Explain why.

Extra Help?

Question...	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lesson...	1	2	3	1	3	1	2	1	1	3	3	1	2	1

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Chapter 7 Standardized Test Practice 281

Multiple Choice

1 **B—Correct.** A, C, D—All plants and animals have cells with nuclei at some point in their life cycle. A and D are characteristics of plant cells only. C is a characteristic of animals only. **DOK 1**

2 **D—Correct.** A, B, C—A backbone is the common trait among vertebrates. A incorrectly reverses this distinction. B is not correct because invertebrates live in many environments. C is not correct because 95 percent of all species are invertebrates. **DOK 1**

3 **A—Correct.** B, C, D—The human brain and spinal cord develop from the nerve cord. B, C, and D are structures that develop into other features. **DOK 1**

4 **C—Correct.** A, B, D—A, B, and D are taxons at other levels. **DOK 2**

5 **C—Correct.** A, B, D—A, B, and D are charactertistics shared by other groups of vertebrate chordates. **DOK 1**

6 **B—Correct.** A, C, D—The human can be divided into only two parts that are mirror images of each other. A and C have bilateral symmetry. D is asymmetrical. **DOK 2**

7 **B—Correct.** A, C, D—Arthropods do not have blood vessels. A, C, and D are all characteristics of arthropods. **DOK 1**

8 **D—Correct.** A, B, C—A and B are structural adaptations. C is a functional adaptation. **DOK 1**

9 **B—Correct.** A, C, D—A, C, and D are farther back on the tree diagram. **DOK 1**

10 **B—Correct.** A, C, D—A, C, and D are characteristics of a lancelet, but do not distinguish it as an invertebrate. **DOK 2**

Constructed Response

11 Amphibians need a wet habitat that has areas of shallow water, like a marsh or swamp. They need water to reproduce and to keep their skin moist. The population would decline if the habitat dried out. **DOK 3**

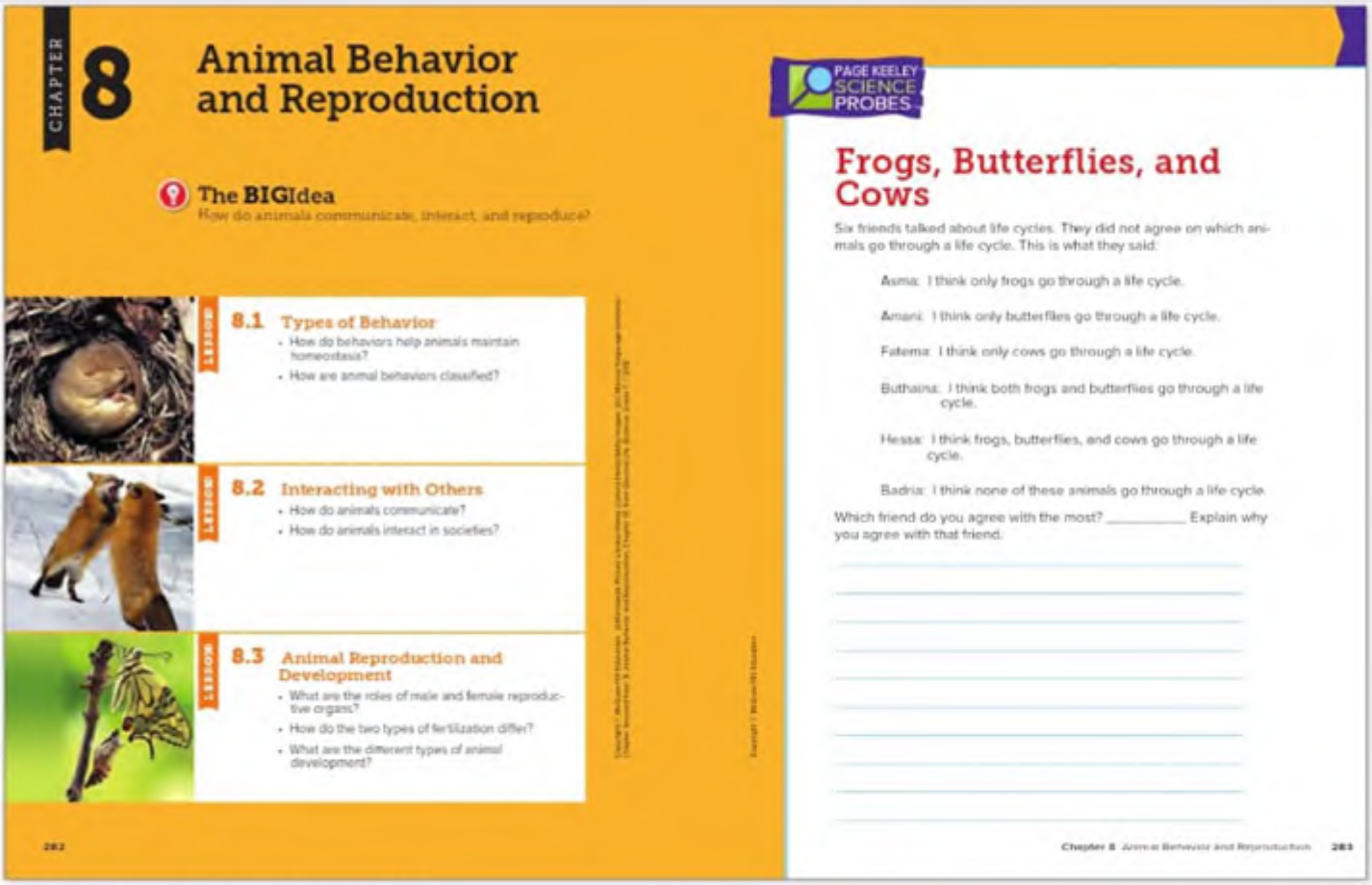
12 Sample answer: I would need to find out if its cells contained collagen, if it had muscle and nerve cells, and if it got energy from food it takes in. **DOK 1**

13 It has the characteristics of an arthropod. It appears to have a hard exoskeleton and segmented legs attached to its body. **DOK 2**

14 The answer should include specific traits that help an animal survive or reproduce in its environment. Sample answer: In the spring, some birds build nests. The birds need to build nests to protect their young. This is a behavioral adaptation because it is the result of instincts **DOK 3**

Answer Key

Question	Answer
1	B
2	D
3	A
4	C
5	C
6	B
7	B
8	D
9	B
10	B
11	See extended answer.
12	See extended answer.
13	See extended answer.
14	See extended answer.


CHAPTER 8

Animal Behavior and Reproduction

The BIGIdea

How do animals communicate, interact, and reproduce?

LESSON 8.1 Types of Behavior
- How do behaviors help animals maintain homeostasis?
- How are animal behaviors classified?

LESSON 8.2 Interacting with Others
- How do animals communicate?
- How do animals interact in societies?

LESSON 8.3 Animal Reproduction and Development
- What are the roles of male and female reproductive organs?
- How do the two types of fertilization differ?
- What are the different types of animal development?

PAGE KEELEY SCIENCE PROBES

Frogs, Butterflies, and Cows

Six friends talked about life cycles. They did not agree on which animals go through a life cycle. This is what they said:

Asma: I think only frogs go through a life cycle.

Amani: I think only butterflies go through a life cycle.

Fatema: I think only cows go through a life cycle.

Buthaina: I think both frogs and butterflies go through a life cycle.

Hessa: I think frogs, butterflies, and cows go through a life cycle.

Badria: I think none of these animals go through a life cycle.

Which friend do you agree with the most? _____ Explain why you agree with that friend.

Animal Behavior and Reproduction

The BIG Idea

There are no right or wrong answers to these questions. Write student-generated questions produced during the discussion on chart paper and return to them throughout the chapter.

Guiding Questions

AL What are some examples of animal behavior?	*Use this question to initiate a discussion about different types of animal behavior and to point out that some behaviors are inherited while others are learned.*
OL What are some ways animals communicate?	*Students might suggest that animals communicate through sound and through body position. Use this question to emphasize that communication can be verbal or nonverbal.*
BL Do all animals reproduce sexually? Explain your answer.	*No; some animals reproduce by asexual reproduction, which results in an exact copy of the parent.*

PAGE KEELEY SCIENCE PROBES

Frogs, Butterflies, and Cows

Answers to the Page Keeley Science Probe can be found in the Teacher's Edition of the *Activity Lab Workbook*.

LESSON

8.1 Types of Behavior

INQUIRY

Sleeping?

This dormouse appears to be sleeping, but it is actually in a state of inactivity called hibernation. A dormouse hibernates during cold weather to conserve energy when food is scarce. Do you think the dormouse learned or was born knowing to hibernate during cold weather? What other behaviors might a dormouse exhibit?

Write your response in your interactive notebook.

Explore Activity

What happens when you touch a pill bug?

Pill bugs are arthropods that live under leaf litter and rocks. They have a special behavior that helps them defend themselves against other animals that might eat them.

Procedure

1. Read and complete a lab safety form.
2. Obtain a **pill bug** and gently place it in a **petri dish** for behavior observation. Study the pill bug without touching it, and draw its behavior in your Science Journal.
3. Use a **cotton swab** to gently touch the pill bug, and observe it again. Draw the pill bug's reaction next to the first drawing you realized.

Think About This

1. How did the pill bug react when you touched its back?

2. What stimulus did you provide that was different from the pill bug's natural environment?

3. **Key Concept** What other stimuli do you think might affect the pill bug?

Essential Questions

- How do behaviors help animals maintain homeostasis?
- How are animal behaviors classified?

Vocabulary

behavior
innate behavior
instinct
migration
hibernation
imprinting
conditioning

INQUIRY

About the Photo **Sleeping?** The dormouse in the photo would be very hard to rouse. Its body temperature, heart rate, and breathing have greatly decreased. Hibernation is a behavior that animals have evolved to survive through the winter. As an animal hibernates, its body needs very little energy, so its stored body fat will support it until spring.

Guiding Questions

AL	Why do you think a hibernating animal is so hard to "wake up"?	*In colder seasons, some animals have much lower body temperatures, use much less energy, and sleep more deeply*
OL	Bears are the best-known hibernators, but some scientists say that bears do not really hibernate. Why do you think that is?	*During the winter, bears sometimes get up and move around. Bears go into a state called torpor or winter lethargy, which is much less extreme than true hibernation.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Apply a Term to Humans

1. Write the word migration on chart paper or the board.
2. As the lesson will explain, some animals make annual migrations, or instinctive seasonal movements, when winter is approaching. They return to their "home base" with the coming of spring.
3. In a more general sense, humans migrate too, although many do not return to their point of origin. At least 100,000 years ago, early modern humans migrated out of Africa. Since then, human migrations have populated the entire Earth.
4. Lead a classroom discussion about migration. Ask students what sort of human and animal migrations might result from climate change.

ExploreActivity

What happens when you touch a pill bug?

Purpose
To observe how organisms respond to external stimuli found in the environment to maintain homeostasis.

Materials
Student: living pill bugs (can be found in the woods under rocks, in damp or moist leaf litter, under wet bark from rotting trees); cotton swabs; petri dishes

Before You Begin
Put one or two pill bugs and litter into petri dishes for each group. Tell students that pill bugs are not true bugs. True bugs are one family of the order Insecta. Pill bugs are not insects, but are members of the order Isopoda, which include wood lice.

Guide the Investigation

- Read and check students' lab safety forms.
- Remind students that the isopods are laboratory specimens and are not to be mistreated. When they have completed their observations, students should return the pill bugs to their container.
- Remind students not to handle the isopods with their hands; instead they should use the cotton swabs. In addition, their push should be gentle to avoid harming the bugs.
- **Troubleshooting** When students are hiking in the woods and looking under rocks and leaf litter, they often will find isopods. Point out that not all isopods are pill bugs; not all will roll up into a ball when touched.

Think About This

1. The bug rolled inside its armorlike shell and looked like a tiny ball.
2. The cotton swab was a stimulus to which the bug would respond.
3. Sample answers might include light, temperature, and the presence of predators.

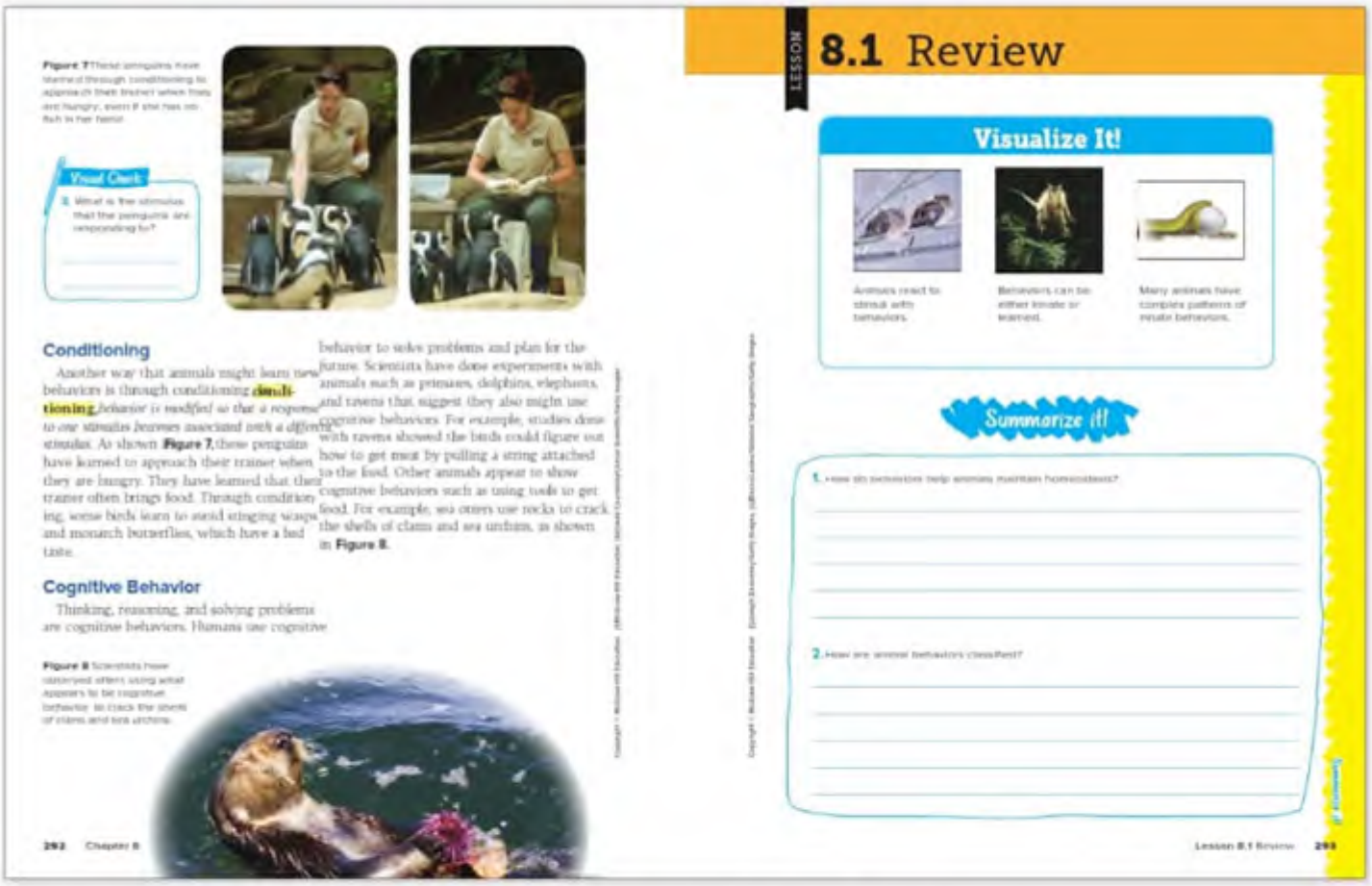


Figure 7 These penguins have learned through conditioning to approach their trainer when they are hungry, even if she has no fish in her hand.

Visual Check
1. What is the stimulus that the penguins are responding to?

Conditioning

Another way that animals might learn new behaviors is through conditioning. **Conditioning** *behavior is modified so that a response to one stimulus becomes associated with a different stimulus.* As shown **Figure 7**, these penguins have learned to approach their trainer when they are hungry. They have learned that their trainer often brings food. Through conditioning, some birds learn to avoid stinging wasps and monarch butterflies, which have a bad taste.

behavior to solve problems and plan for the future. Scientists have done experiments with animals such as primates, dolphins, elephants, and ravens that suggest they also might use cognitive behaviors. For example, studies done with ravens showed the birds could figure out how to get meat by pulling a string attached to the food. Other animals appear to show cognitive behaviors such as using tools to get food. For example, sea otters use rocks to crack the shells of clams and sea urchins, as shown in **Figure 8**.

Cognitive Behavior

Thinking, reasoning, and solving problems are cognitive behaviors. Humans use cognitive

Figure 8 Scientists have observed otters using what appears to be cognitive behavior to crack the shells of clams and sea urchins.

292 Chapter 8

LESSON 8.1 Review

Visualize It!

Animals react to stimuli with behaviors.

Behaviors can be either innate or learned.

Many animals have complex patterns of innate behaviors.

Summarize it!

1. How do behaviors help animals maintain homeostasis?

2. How are animal behaviors classified?

Lesson 8.1 Review 293

Conditioning

Make sure students understand the meaning of the word *modified*. In this context, it means "changed." In conditioning, behavior is modified, or changed. Ask students the following scaffolded questions.

Guiding Questions

AL What is conditioning?	*It is what happens when a response to one stimulus becomes associated with a different stimulus.*
BL How does conditioning benefit an animal?	*Animals learn which responses result in something positive and which result in something negative, and respond in the future accordingly.*

Visual Literacy: Figure 7

Have students read the paragraph. Direct students' attention to Figure 7. After reading the caption with students, ask the following question to assess their comprehension.

Ask: What is the stimulus that the penguins are responding to? *The penguins are responding to the presence of their trainer, and they associate this with being fed.*

Cognitive Behavior

Ask all students who solved a math problem today to raise their hand. Explain that humans use cognitive behavior—or thinking behavior—to solve problems and plan for the future. Share that animals also show problem-solving skills. Have students read the paragraph. Direct their attention to **Figure 8,** read the caption, and discuss cognitive behavior displayed by the otter and other animals.

Guiding Questions

AL What is an example of cognitive behavior?	*Answers will vary. Students should suggest an activity that requires thinking, reasoning, or problem solving.*
OL How are animal behaviors classified?	*Animal behaviors are either innate or learned.*
BL How is cognitive behavior demonstrated?	*Students should suggest examples of activities that require problem solving, such as the use of a tool shown by the primate on the first page of the chapter.*

Summarize it!

The information needed to complete this graphic organizer can be found in the following sections:

- Type of behaviour

Types of Behavior

Use Vocabulary

1. **Define** *innate behavior* in your own words.

2. **Use the term** *migration* in a sentence.

3. **Distinguish** between conditioning and cognitive behavior.

Understand Key Concepts

4. Which is a learned behavior?
   - A. conditioning
   - B. instinct
   - C. migration
   - D. reflexes

5. **Classify** the following behaviors as innate or learned: birds flying to warmer climates for winter, a mussel closing its shell, a duckling following its mother, a spider spinning a web.

6. **Compare** learning by trial and error and conditioning.

Interpret Graphics

7. **Explain** Use the image below to explain how conditioning works in animals.

8. **Identify** Fill in the table below with examples of the types of behavior.

Innate Behavior	Learned Behavior

Critical Thinking

9. **Design an experiment** to determine if a goldfish can learn by conditioning.

My Notes

Use Vocabulary

1. Sample answer: Innate behavior is a behavior that an animal is born with. **DOK 1**
2. Sample answer: You might see the migration of birds in the spring or fall. **DOK 2**
3. In conditioning, behavior is modified so that a response to one stimulus becomes associated with a different stimulus. Cognitive behavior is thinking, reasoning, and solving problems. **DOK 1**

Understand Key Concepts

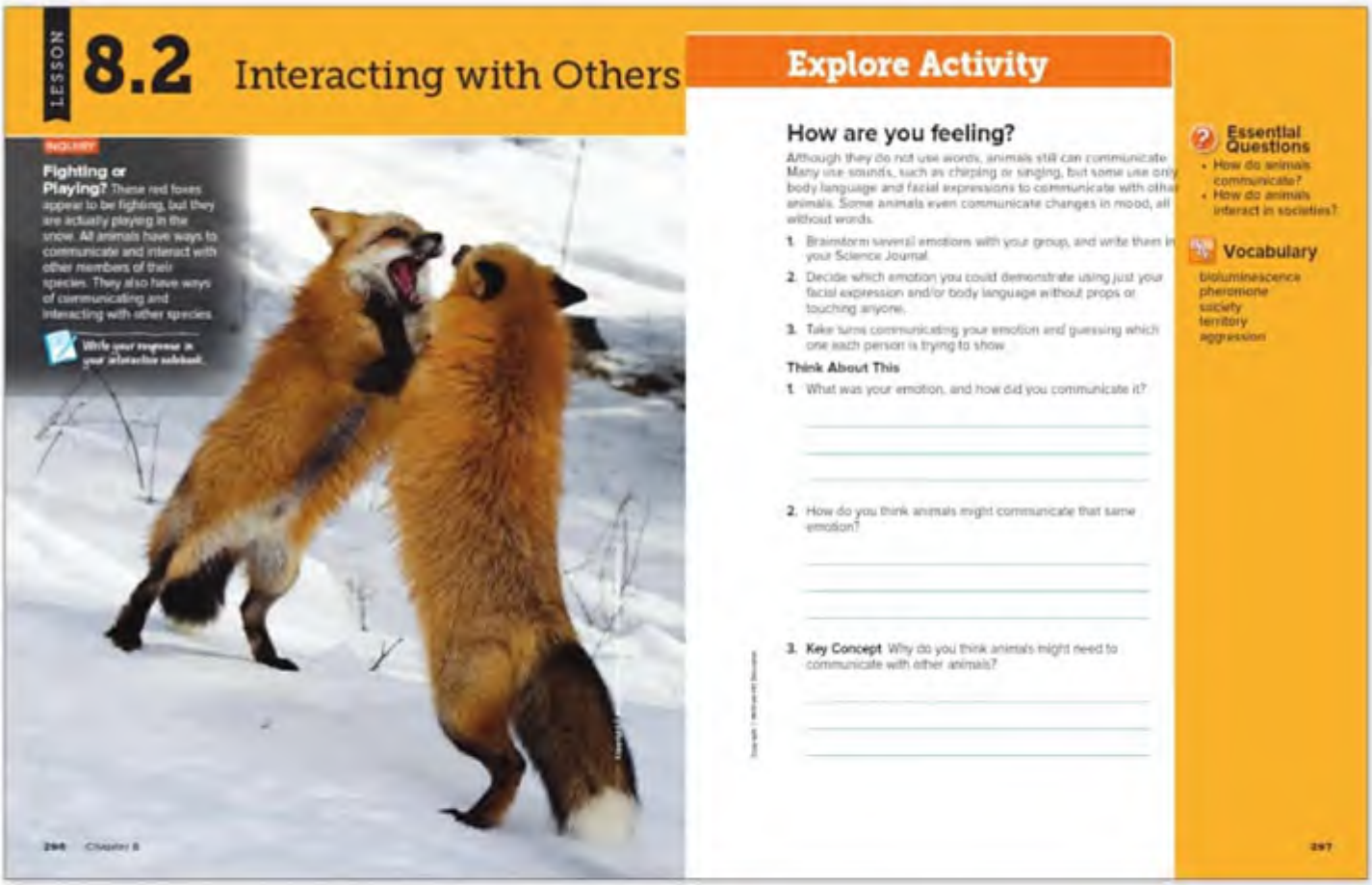
4. A. conditioning **DOK 1**
5. Innate: birds flying to warmer climates for winter, mollusk shell closing, spider spinning a web; Learned: baby duck following its mother **DOK 1**
6. Sample answer: In learning by trial and error, an animal learns by trying different techniques for doing something and remembering the one that works. In learning by conditioning, an animal responds to a stimulus, associates the response with a new stimulus, and learns to respond in the same way to the new stimulus. **DOK 1**

Interpret Graphics

7. The penguins have been conditioned to approach their trainer because they associate their trainer with being fed. **DOK 2**
8. Innate behaviors: reflexes, instincts, migration, hibernation; Learned behaviors: imprinting, trial and error, conditioning, cognitive behavior **DOK 2**

Critical Thinking

9. Sample answers might include an experiment around feeding the goldfish. Tap the tank just before feeding. Repeat for several feedings. Then just tap the tank. Observe behavior. The goldfish will still come to the surface expecting the food. **DOK 3**



INQUIRY

About the Photo **Fighting or Playing?** The two red foxes might be play-fighting, but actual fighting is an important behavior for many animals. Fighting can help animals such as foxes determine which individual is stronger or has more authority in a group. Animals also can fight over territory or mates and to defend against intruders.

Guiding Questions

AL When have you seen other animals fighting? Why were they fighting?	*Use this question to begin a discussion of why animals fight. Students might have seen birds, dogs, cats, or other animals fighting over food or territory.*
OL What do you think these foxes are trying to communicate?	*Students might propose that they are trying to communicate strength or acceptance.*
BL Why do some animals play-fight?	*Use this question to begin a discussion of animals learning where they fit into the group or who's in charge. Animals also play-fight to practice for when fighting is necessary for survival.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Build a Class Definition

1. Write the word *society* on chart paper or the board. Add descriptions and examples as students answer the questions.
2. Explain that *society* usually refers to a group of individuals and their relationships. The group might be all people on Earth, all people living at a certain time, people living together in a certain city or country, people who get together because they have a common interest, or people who are leaders in a community. The groups usually work together and are organized in some way.
3. Ask: **What do you think a society of animals might be made up of?** *all of a species of animals living together and interacting*
4. Agree on a class definition of a *society* of animals. Students should record the accepted definition in their Science Journals.

ExploreActivity

How are you feeling?

Prep: *none* **Class:** *10 min*

Purpose
To dramatize communication between animals without using words.

Before You Begin
Ask students what they know about silent movies, mimes, and charades. Let them share how they know what is going on even though there is no sound.

Guide the Investigation

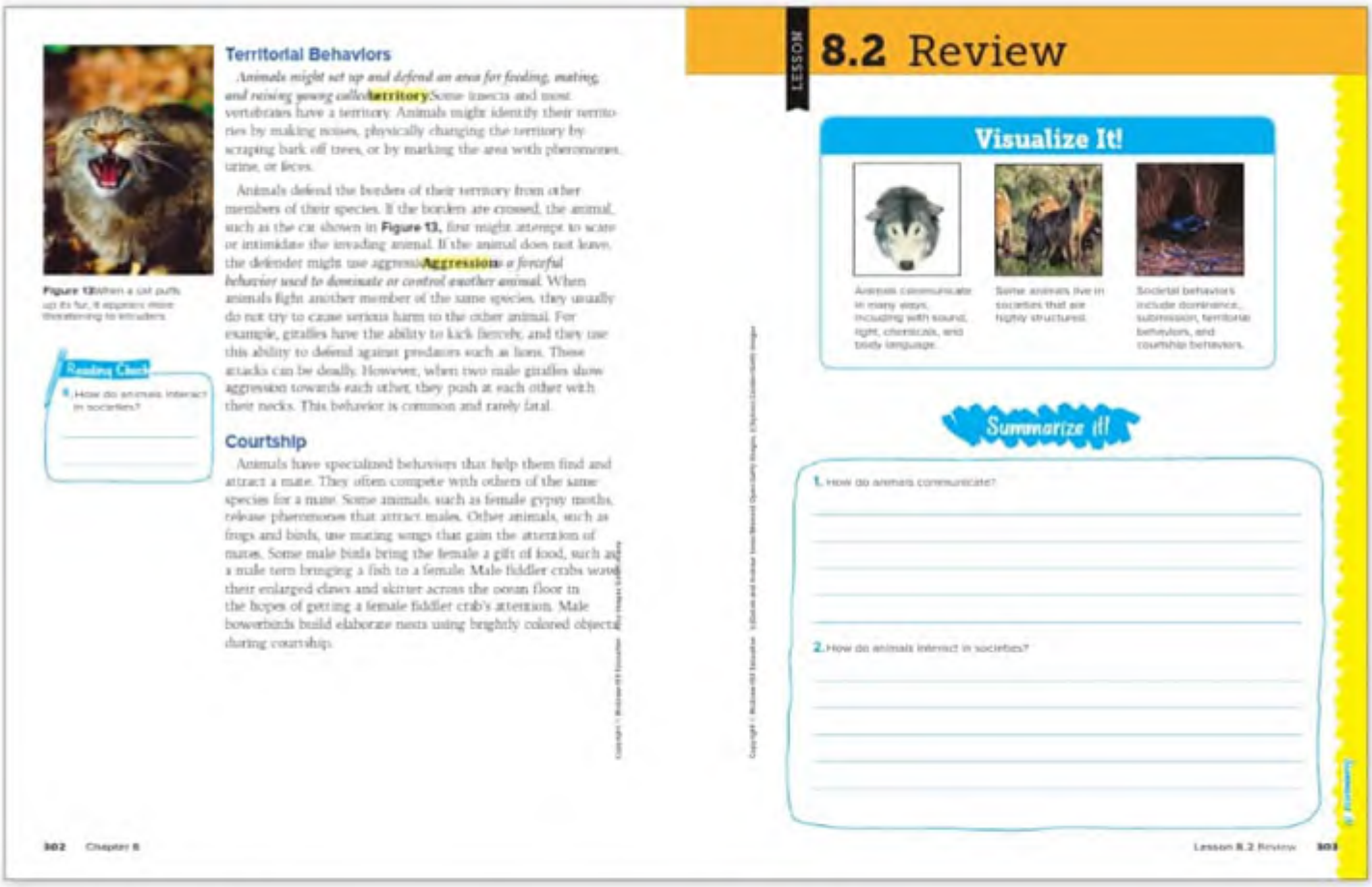
- Suggest that students try to think of emotions before they go to the next step.
- Students should not use any body language that would make them fall and should not touch other students.
- **Troubleshooting** Remind students that they should not make fun of others because they think they look funny or believe they did not communicate what they wanted to show.

Think About This

1. Answers will vary, but the most obvious would be sadness, anger, and joy. Expressions will vary.
2. Answers will vary, but facial expressions would be difficult for many animals to use to show moods. Stance for anger or determination could be common for body language. Also, dances for mating.
3. Answers will vary, but students should know some specifics, such as warning of danger, finding food, and mating.

Extension
To extend this investigation, have students share some unusual ways animals communicate that they have read about or seen in nature shows or documentaries.

Teacher Notes



Territorial Behaviors

Animals might set up and defend an area for feeding, mating, and raising young called **territory.** Some insects and most vertebrates have a territory. Animals might identify their territories by making noises, physically changing the territory by scraping bark off trees, or by marking the area with pheromones, urine, or feces.

Animals defend the borders of their territory from other members of their species. If the borders are crossed, the animal, such as the cat shown in **Figure 13,** first might attempt to scare or intimidate the invading animal. If the animal does not leave, the defender might use aggression. **Aggression** *is a forceful behavior used to dominate or control another animal.* When animals fight another member of the same species, they usually do not try to cause serious harm to the other animal. For example, giraffes have the ability to kick fiercely, and they use this ability to defend against predators such as lions. These attacks can be deadly. However, when two male giraffes show aggression towards each other, they push at each other with their necks. This behavior is common and rarely fatal.

Courtship

Animals have specialized behaviors that help them find and attract a mate. They often compete with others of the same species for a mate. Some animals, such as female gypsy moths, release pheromones that attract males. Other animals, such as frogs and birds, use mating songs that gain the attention of mates. Some male birds bring the female a gift of food, such as a male tern bringing a fish to a female. Male fiddler crabs wave their enlarged claws and skitter across the ocean floor in the hopes of getting a female fiddler crab's attention. Male bowerbirds build elaborate nests using brightly colored objects during courtship.

Reading Check

1. How do animals interact in societies?

302 Chapter 8

LESSON 8.2 Review

Visualize It!

Animals communicate in many ways, including with sound, light, chemicals, and body language.

Some animals live in societies that are highly structured.

Societal behaviors include dominance, submission, territorial behaviors, and courtship behaviors.

Summarize it!

1. How do animals communicate?

2. How do animals interact in societies?

Lesson 8.2 Review 303

Territorial Behaviors

Explain that animals set up a territory and defend it against others of their own species. Many other species of animals will live in their territory. However, there are some different species that do not share territory. For example, foxes and coyotes use the same resources and usually don't occupy the same territory

Guiding Questions

AL	What is an animal's territory?	*An animal's territory is an area it uses for feeding, mating, and raising its young. It will defend its territory.*
BL	How is aggression against the same species often different from aggression against another species?	*Usually, aggression does not lead to death when it is against the same species. When it is against another species, death could result.*

Courtship

Have students read the paragraph about courtship. Then use the following questions to assess their understanding

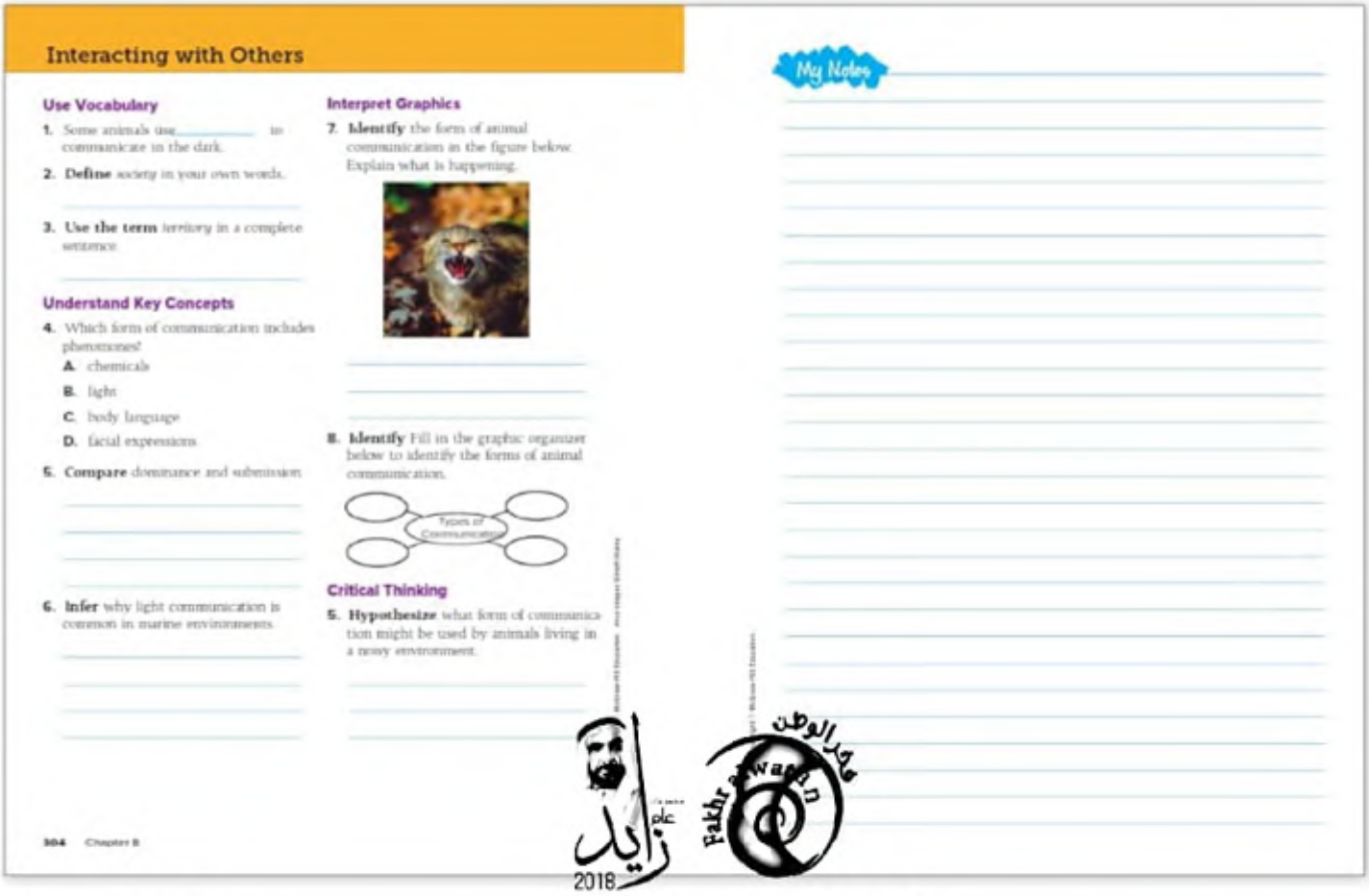
Guiding Questions

AL	Why do animals have specialized behaviors to find and attract a mate?	*They may have to compete with others of the same species for a mate. If students don't mention it, remind them that finding and attracting a mate is important for the survival of the species.*
BL	How do animals interact in societies?	*Answers should reflect examples of interactions in the text, including behaviors in organized groups, dominance and submission, territorial behaviors, and courtship behaviors.*

Summarize it!

The information needed to complete this graphic organizer can be found in the following sections:

- Interacting with Others



Interacting with Others

Use Vocabulary

1. Some animals use _____ to communicate in the dark.
2. **Define** society in your own words.
3. **Use the term** territory in a complete sentence.

Understand Key Concepts

4. Which form of communication includes pheromones?
   A. chemicals
   B. light
   C. body language
   D. facial expressions
5. **Compare** dominance and submission.
6. **Infer** why light communication is common in marine environments.

Interpret Graphics

7. **Identify** the form of animal communication in the figure below. Explain what is happening.

8. **Identify** Fill in the graphic organizer below to identify the forms of animal communication.

Critical Thinking

9. **Hypothesize** what form of communication might be used by animals living in a noisy environment.

My Notes

304 Chapter 8

Use Vocabulary

1. bioluminescence **DOK 1**
2. Answers may vary. Sample answer: A society is a group of animals that live and work together. **DOK 2**
3. Answers may vary. Sample answer: The cardinal chased another cardinal out of its territory. **DOK 2**

Understand Key Concepts

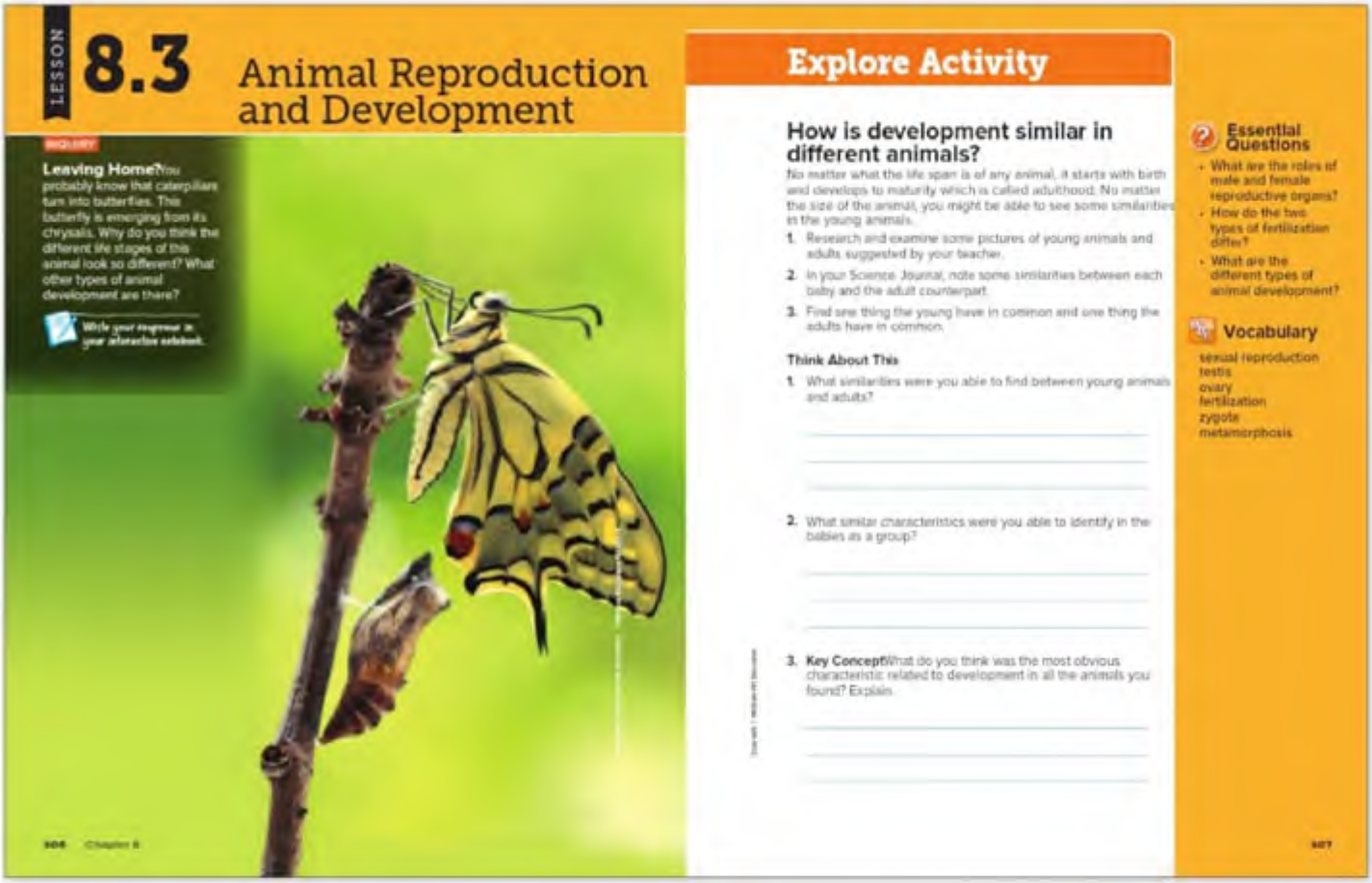
4. **A.** chemicals **DOK 1**
5. Answers may vary. Sample answer: Dominance is the power one animal has over a submissive animal. **DOK 2**
6. Answers may vary. Sample answer: Light communication is common in marine environments because it allows animals to be seen in the dimly lit ocean environment. **DOK 2**

Interpret Graphics

7. Answers may vary. Sample answer: The cat is displaying territorial behavior. It is displaying aggression to dominate or control another animal by laying its ears back, crouching down, baring its teeth, and probably hissing and growling. **DOK 2**
8. sound, light, chemicals, body language (in any order) **DOK 1**

Critical Thinking

9. Answers may vary. Sample answer: Animals in a noisy environment may use chemicals and body language to communicate. **DOK 3**



INQUIRY

About the Photo **Leaving Home?** This butterfly has been pupating—or developing—as it has changed from a caterpillar to a butterfly. Through the stages of metamorphosis, it has experienced structural changes. The butterfly has gone through complete metamorphosis. Its appearance has changed substantially throughout its life.

Guiding Questions

AL	What is the living organism shown in the image?	*a butterfly*
OL	What is the butterfly emerging from?	*Use this question to clarify students' understanding of where butterflies pupate. Explain that most butterflies pupate in a chrysalis—and most moths pupate in a cocoon.*
BL	What are two types of metamorphosis? How do they differ? Which type has the butterfly experienced?	*Use this question to launch a discussion about complete and incomplete metamorphosis, stressing that in complete metamorphosis, the adult organism has an appearance that differs substantially from that of the organism just after birth.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Relating to Personal Experience

1. Write the word *fertilization* on the board. Circle the suffix *-ation*.
2. Tell students that the suffix *-ation* means "action or process," so *fertilization* means "the action or process of fertilizing."
3. **Ask: What do you know about the meaning of the word *fertilize*?** *Students might mention fertilizing a garden or fertilizing an egg.* Lead a class discussion to guide students to understand that fertilization of a garden refers to adding nutrients plants need to grow. Fertilization as related to sexual reproduction means "the fusion of an egg cell with a sperm cell." Explain that students will learn more about fertilization as it applies to male and female animals' reproductive systems in the lesson.

ExploreActivity

How is development similar in different animals?

Prep: *none* **Class:** *15 min*

Purpose
To compare development of organisms from infant to adult.

Materials
Optional: additional photographs of animals at birth and as adults

Before You Begin
Show a picture of snake eggs, and ask students what will come from the eggs. Let them speculate and then show them a photo of an adult snake.

Guide the Investigation

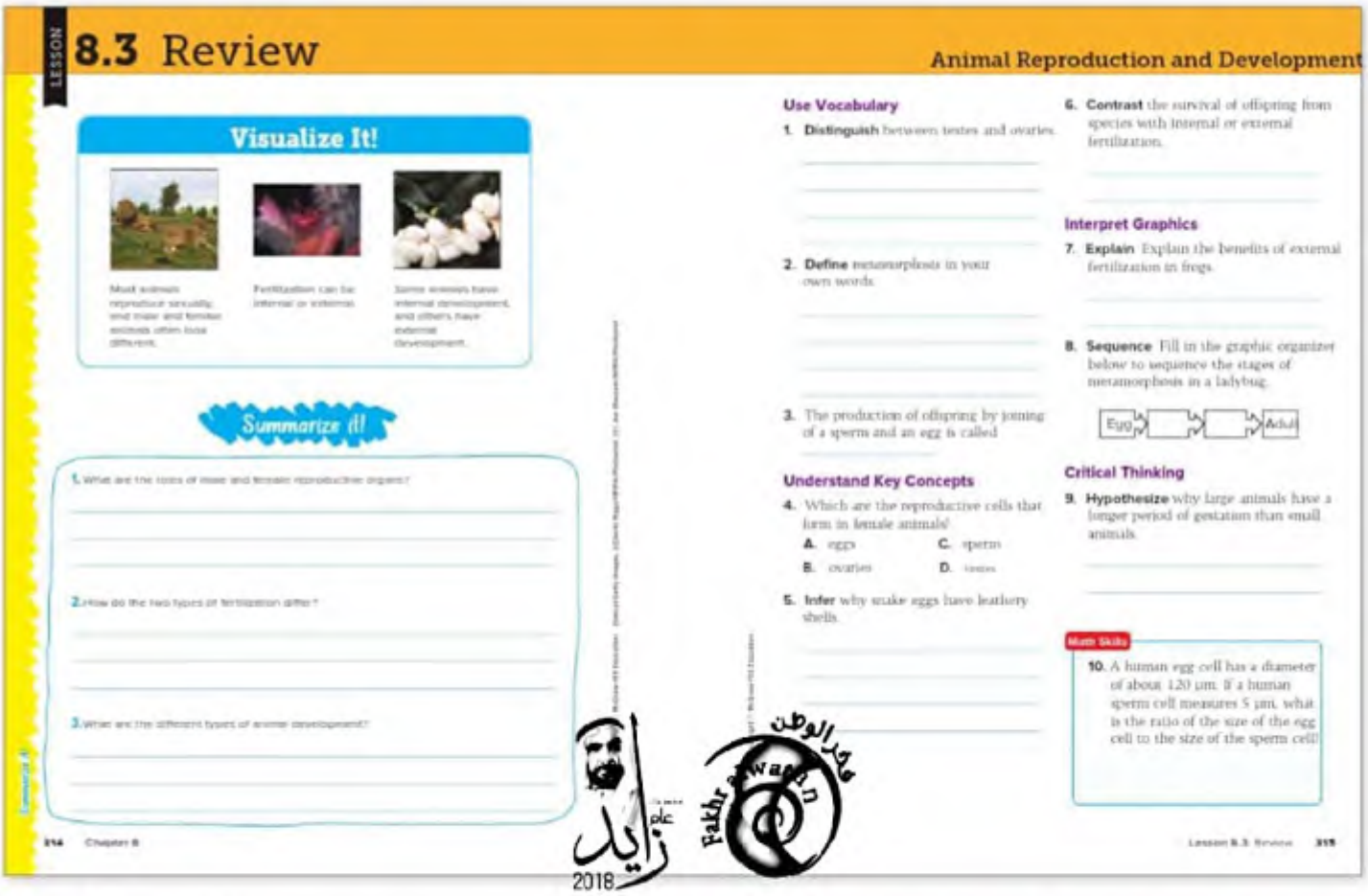
- Remind students that sharing ideas with each other will broaden their outcomes.
- **Troubleshooting** Make sure students are aware that some animals live many years, and some live only 24 hours; but they all have birth and development.

Think About This

1. Possible answers: The nestling and the adult tern (bird) both have bills that are yellowish orange; bear cubs look very similar to the adult; the tadpole and frog have similar coloring.
2. Possible answer: All the baby animals seem to need protection, with the possible exception of the bears.
3. **Key Concept** Every animal as an adult is larger and more developed. All animals grow and develop from birth to maturity.

Extension
Have students research and view pictures of one kind of animal as it develops from birth to adulthood.

Teacher Notes



LESSON 8.3 Review

Animal Reproduction and Development

Visualize It!

Summarize it!

1. What are the roles of male and female reproductive organs?
2. How do the two types of fertilization differ?
3. What are the different types of animal development?

Use Vocabulary

1. **Distinguish** between testes and ovaries.
2. **Define** metamorphosis in your own words.
3. The production of offspring by joining of a sperm and an egg is called

Understand Key Concepts

4. Which are the reproductive cells that form in female animals?
   A. eggs C. sperm
   B. ovaries D. testes
5. **Infer** why snake eggs have leathery shells.
6. **Contrast** the survival of offspring from species with internal or external fertilization.

Interpret Graphics

7. **Explain** Explain the benefits of external fertilization in frogs.
8. **Sequence** Fill in the graphic organizer below to sequence the stages of metamorphosis in a ladybug.

Egg → ? → ? → Adult

Critical Thinking

9. **Hypothesize** why large animals have a longer period of gestation than small animals.

Math Skills

10. A human egg cell has a diameter of about 120 µm. If a human sperm cell measures 5 µm, what is the ratio of the size of the egg cell to the size of the sperm cell?

314 Chapter 8

Lesson 8.3 Review 315

Visual Summary

Concepts and terms are easier to remember when they are associated with an image. **Ask: Which Key Concept does each image relate to?**

Summarize it!

Answers may vary.

Use Vocabulary

1. Testes are the male reproductive organs. Ovaries are the female reproductive organs. **DOK 1**
2. Sample answers should include an understanding that metamorphosis is a developmental process in which the animal's body changes form from egg to adult. **DOK 2**
3. sexual reproduction **DOK 1**

Understand Key Concepts

4. A. eggs **DOK 1**
5. Snake eggs have leathery shells to protect them from drying out because the environment in which they are laid is dry. **DOK 2**
6. Internal fertilization ensures that an embryo is protected and nourished until it leaves the female's body. This increases the chance that an embryo will survive, develop into an adult, and reproduce. In external fertilization, the eggs and young are exposed to predators and other dangers in the environment, reducing their chances of surviving. A large number of eggs must be produced to ensure that some survive to become adults and reproduce. **DOK 2**

Interpret Graphics

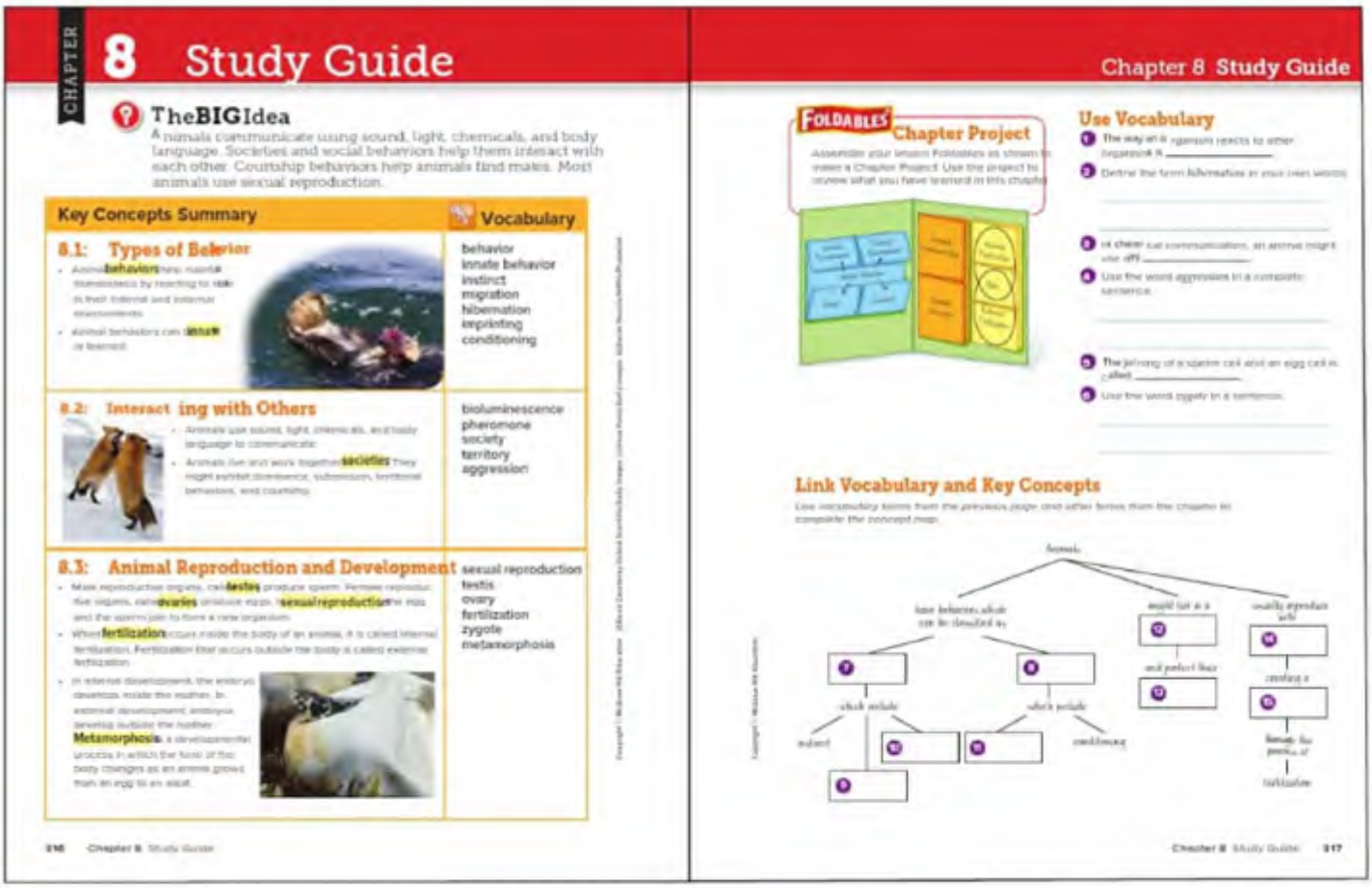
7. A female frog releases a large number of eggs. External fertilization allows more eggs to be fertilized quickly and more eggs to develop than if they were internally fertilized. **DOK 2**
8. larva; pupa **DOK 1**

Critical Thinking

9. Sample answer: Because they are bigger at birth, development takes longer. **DOK 3**

Math Skills

10. 24:1 **DOK 1**


CHAPTER 8 Study Guide

The BIG Idea

Key Concepts Summary

Vocabulary

8.1: Types of Behavior

behavior
innate behavior
instinct
migration
hibernation
imprinting
conditioning

8.2: Interacting with Others

bioluminescence
pheromone
society
territory
aggression

8.3: Animal Reproduction and Development

sexual reproduction
testis
ovary
fertilization
zygote
metamorphosis

Chapter 8 Study Guide

FOLDABLES Chapter Project

Use Vocabulary

Link Vocabulary and Key Concepts

Key Concepts Summary

Study Strategy: Self-Assessment

Self-assessment helps students practice metacognition, increasing their awareness of their understanding.

1. Ask students to create a chart similar to the one below.
2. Have students list the Key Concept questions found on the first page of each lesson in the first column and prompt students to write their own answer for each Key Concept question in the second column.
3. Then have them read the Key Concept Summary for each Key Concept question and self-assess their answers. Ask students to write their selfassessment in the third column.

Example:

Lesson KC Questions	My Answers	My Self-Assessment
How do behaviors help animals maintain homeostasis?	Behaviors allow animals to react to changes in the environment around them and in their bodies.	My answer means the same thing as the KC Summary. I used my own words instead of stimuli, internal, and external.

Vocabulary

Study Strategy: In Your Own Words

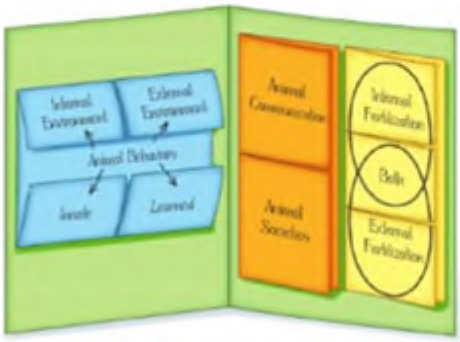
Ask students to work in pairs to write vocabulary definitions in their own words. Connecting vocabulary words to students' own language promotes understanding more effectively than memorizing.

1. Have students create a two-column table like the one below in their Science Journals.
2. Have them write the vocabulary words in the Study Guide in the left column.
3. Ask students to review the definition of each word in the chapter and read how it is used in the Key Concept Summary.
4. Then have students use their own words to write a definition for each vocabulary word, including any notes that will help them remember its meaning.

Example:

Vocabulary Word	My Definition and Notes
behavior	A behavior is the way an animal acts. It might be a reaction to its surroundings, its own body, or another organism.

FOLDABLES®



Use the Foldables® Chapter Project as a way to connect Key Concepts.

1. Ask students to organize their Foldables® in a way that reflects how the concepts in each Foldable relate to each other.
2. Use glue or staples to hold the sheets together as needed.
3. When complete, ask students to place their Foldables® Chapter Project at the front of the room. Have the class critique and discuss the way in which students have organized their Foldables®.

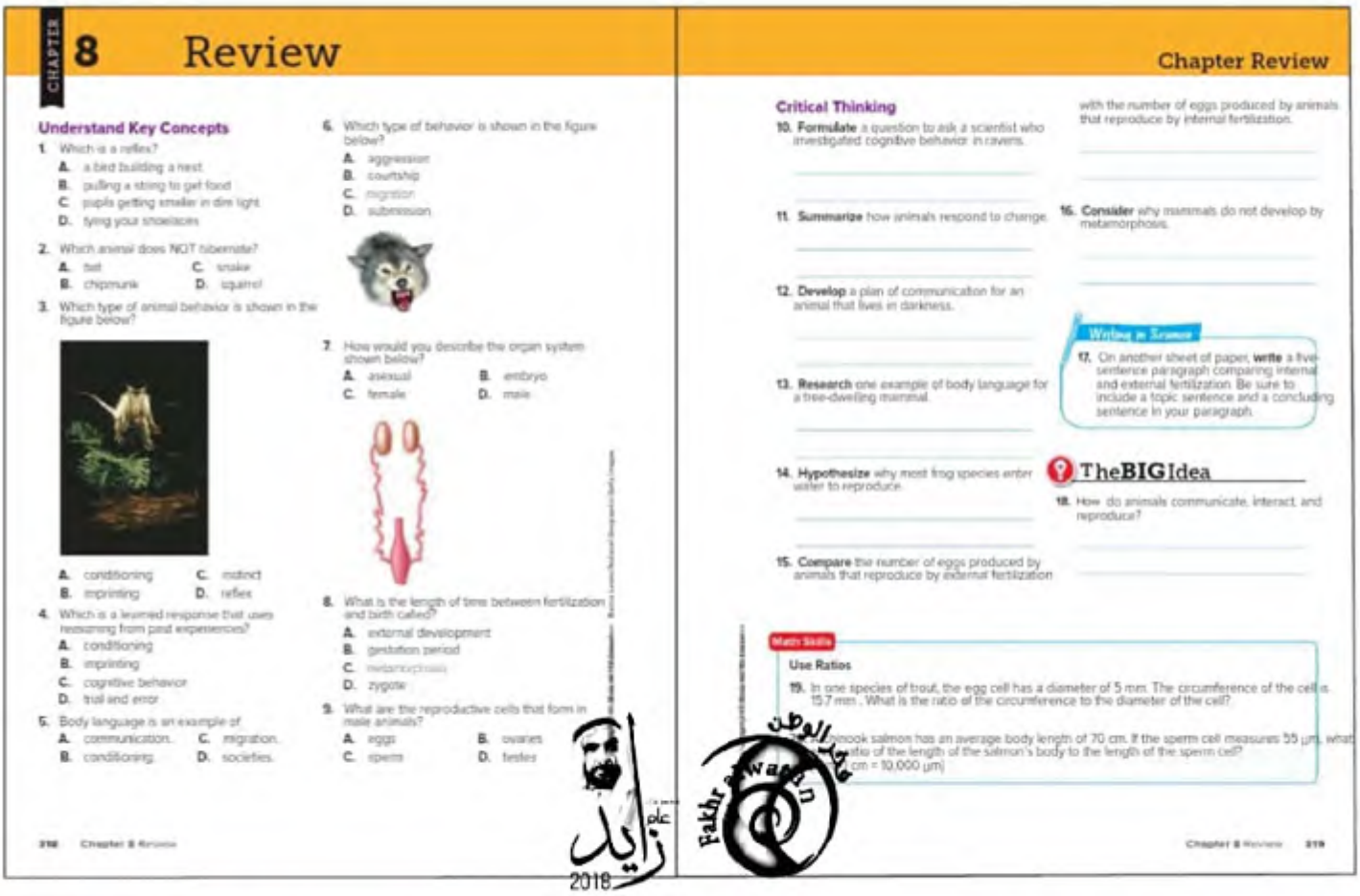
Teacher Notes

Use Vocabulary

1. behavior
2. Sample answers might include: Hibernation is a way that an animal responds to cold temperature. It might decrease its heart and breathing rate.
3. pheromone
4. Sample answer: Animals use aggression to defend themselves or their territories
5. fertilization
6. Sample answer: The zygote develops into a new organism

Link Vocabulary and Key Concepts

7. innate
8. learned
9. reflex [or behavior pattern]
10. behavior pattern [or reflex]
11. imprinting, trial and error, or cognitive behavior
12. society or groups
13. territory
14. sexual reproduction
15. zygote



CHAPTER 8 Review

Understand Key Concepts

1. Which is a reflex?
   A. a bird building a nest
   B. pulling a string to get food
   C. pupils getting smaller in dim light
   D. tying your shoelaces
2. Which animal does NOT hibernate?
   A. bat C. snake
   B. chipmunk D. squirrel
3. Which type of animal behavior is shown in the figure below?

   A. conditioning C. instinct
   B. imprinting D. reflex
4. Which is a learned response that uses reasoning from past experiences?
   A. conditioning
   B. imprinting
   C. cognitive behavior
   D. trial and error
5. Body language is an example of
   A. communication. C. migration.
   B. conditioning. D. societies.
6. Which type of behavior is shown in the figure below?
   A. aggression
   B. courtship
   C. migration
   D. submission

7. How would you describe the organ system shown below?
   A. asexual B. embryo
   C. female D. male

8. What is the length of time between fertilization and birth called?
   A. external development
   B. gestation period
   C. metamorphosis
   D. zygote
9. What are the reproductive cells that form in male animals?
   A. eggs B. ovaries
   C. sperm D. testes

318 Chapter 8 Review

Chapter Review

Critical Thinking

10. **Formulate** a question to ask a scientist who investigated cognitive behavior in ravens.
11. **Summarize** how animals respond to change.
12. **Develop** a plan of communication for an animal that lives in darkness.
13. **Research** one example of body language for a tree-dwelling mammal.
14. **Hypothesize** why most frog species enter water to reproduce.
15. **Compare** the number of eggs produced by animals that reproduce by external fertilization with the number of eggs produced by animals that reproduce by internal fertilization.
16. **Consider** why mammals do not develop by metamorphosis.

Writing in Science

17. On another sheet of paper, **write** a five-sentence paragraph comparing internal and external fertilization. Be sure to include a topic sentence and a concluding sentence in your paragraph.

The BIG Idea

18. How do animals communicate, interact, and reproduce?

Math Skills

Use Ratios

19. In one species of trout, the egg cell has a diameter of 5 mm. The circumference of the cell is 15.7 mm. What is the ratio of the circumference to the diameter of the cell?

[illegible] chinook salmon has an average body length of 70 cm. If the sperm cell measures 55 µm, what [illegible] ratio of the length of the salmon's body to the length of the sperm cell? (1 cm = 10,000 µm)

Chapter 8 Review 319

Understand Key Concepts

1 C. pupils getting smaller in dim light
2 C. snake
3 D. reflex
4 D. trial and error
5 A. communication
6 A. aggression
7 D. male
8 B. gestation
9 C. sperm

Critical Thinking

10 Sample answers: How did you decide on using ravens? Could the raven be using trial-and-error learning?
11 Sample answer: Animals respond to changes and maintain homeostasis in different ways. For example, a deer might flee from danger. Ectotherms become less active in the fall.
12 Students' hypotheses should include selecting sound, light, or chemicals and explaining how the animal would use that form of communication.
13 Sample answer: Birds that offer a gift are showing how they would be a good mate.
14 Answers will vary with the animal that is chosen. Responses should include specific descriptions of the animal, the setting in which it lives, how the animal moves, and might include what the student thinks the behavior means.
15 Students' hypotheses should include the fact that frogs use external fertilization and that development occurs in the water, so fertilizing eggs in the water ensures that some eggs will not dry out and will survive to be adults and reproduce
16 More eggs are produced by animals using external fertilization than by animals using internal fertilization. This adaptation is beneficial and ensures that some offspring will survive to adulthood.
17 Answers will vary. Sample answer: Many mammals are large and would be vulnerable and helpless if they went through metamorphosis. Because many of them develop internally, they are protected..

Writing in Science

18 Sample answer: Internal fertilization ensures that an embryo is protected and nourished until it leaves the female's body. This increases the chance that an embryo will survive, develop into an adult, and reproduce. In external fertilization, the eggs and young are exposed to predators and other dangers in the environment. This reduces their chances of survival. A large number of eggs must be produced to ensure that some survive to become adults and reproduce.

The **BIG** Idea

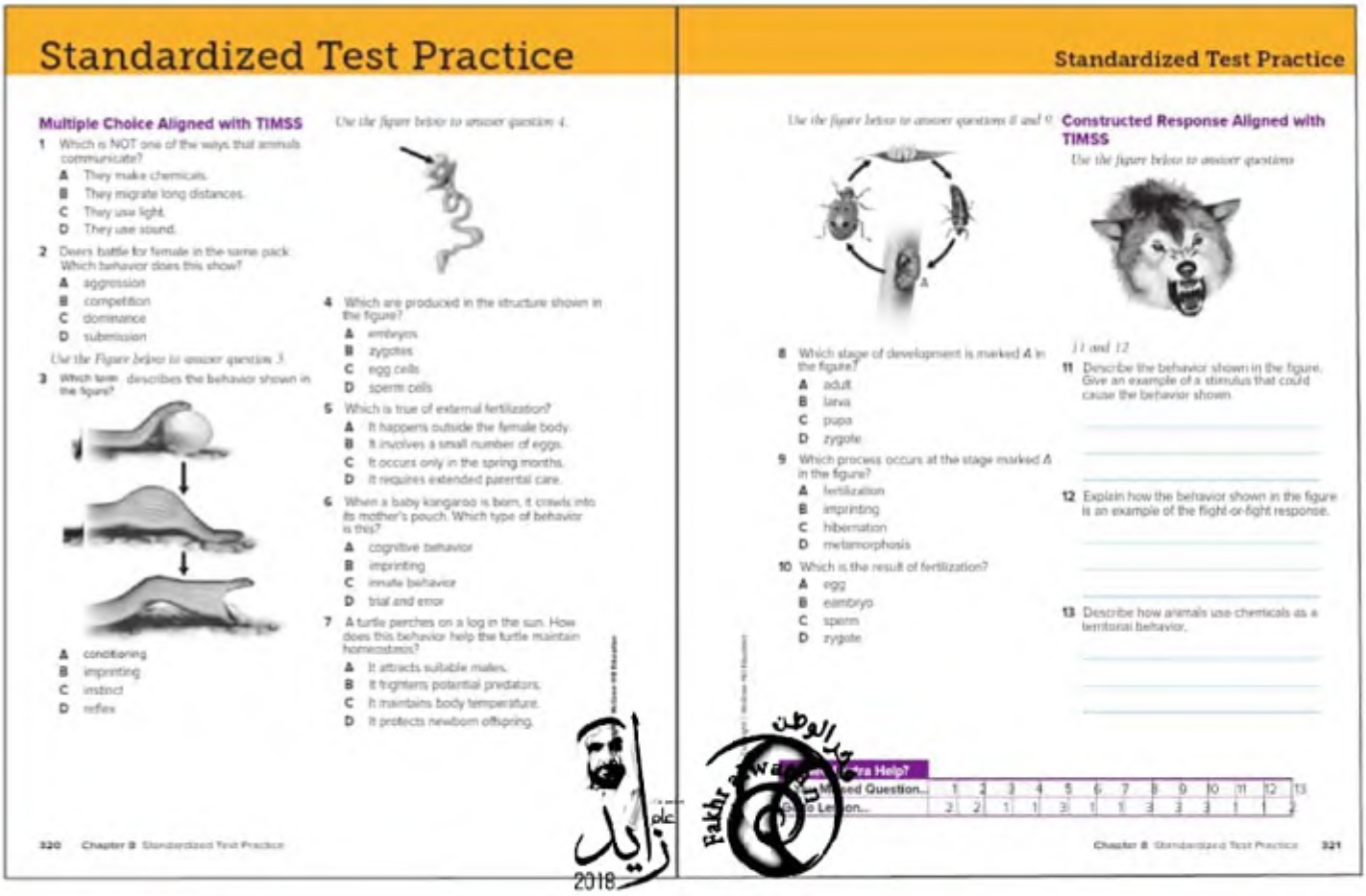
19 Animals communicate with sound, light, chemicals, and body language. Some animals live and interact in highly structured societies. Most animals reproduce sexually through internal or external fertilization.

Math Skills

Use Ratios

20. 3.14:1

21. 12,727:1



Standardized Test Practice

Multiple Choice Aligned with TIMSS

1 Which is NOT one of the ways that animals communicate?
A They make chemicals.
B They migrate long distances.
C They use light.
D They use sound.

2 Deers battle for female in the same pack. Which behavior does this show?
A aggression
B competition
C dominance
D submission

Use the figure below to answer question 3.

3 Which term describes the behavior shown in the figure?

A conditioning
B imprinting
C instinct
D reflex

Use the figure below to answer question 4.

4 Which are produced in the structure shown in the figure?
A embryos
B zygotes
C egg cells
D sperm cells

5 Which is true of external fertilization?
A It happens outside the female body.
B It involves a small number of eggs.
C It occurs only in the spring months.
D It requires extended parental care.

6 When a baby kangaroo is born, it crawls into its mother's pouch. Which type of behavior is this?
A cognitive behavior
B imprinting
C innate behavior
D trial and error

7 A turtle perches on a log in the sun. How does this behavior help the turtle maintain homeostasis?
A It attracts suitable mates.
B It frightens potential predators.
C It maintains body temperature.
D It protects newborn offspring.

320 Chapter 8 Standardized Test Practice

Standardized Test Practice

Use the figure below to answer questions 8 and 9.

8 Which stage of development is marked A in the figure?
A adult
B larva
C pupa
D zygote

9 Which process occurs at the stage marked A in the figure?
A fertilization
B imprinting
C hibernation
D metamorphosis

10 Which is the result of fertilization?
A egg
B embryo
C sperm
D zygote

Constructed Response Aligned with TIMSS

Use the figure below to answer questions 11 and 12.

11 Describe the behavior shown in the figure. Give an example of a stimulus that could cause the behavior shown.

12 Explain how the behavior shown in the figure is an example of the fight-or-flight response.

13 Describe how animals use chemicals as a territorial behavior.

Extra Help?

Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12	13
Go to Lesson...	2	2	1	1	3	1	1	3	3	3	1	1	2

Chapter 8 Standardized Test Practice 321

Multiple Choice

1 **B—Correct.** A, C, D—These are all ways that animals communicate. Migration is a behavior that enables animals to find food, return to breeding locations, and move to more suitable climates as the weather changes. **DOK 2**

2 **D—Correct.** A, B, C—These are other forms of interactive behavior that occur in societies. **DOK 2**

3 **C—Correct.** A, B—These are learned behaviors. D—Reflexes occur without conscious control. **DOK 1**

4 **C—Correct.** A, B—Both develop from an egg and a sperm. D—These are produced in the testes. **DOK 1**

5 **A—Correct.** B, D—These are true of internal fertilization. C—This is not a requirement for fertilization. **DOK 1**

6 **C—Correct.** A, B, D—These are terms for learned behaviors. The baby kangaroo instinctively knows to move to its mother's pouch. **DOK 3**

7 **C—Correct.** A, B, D—These are related to different kinds of behavior. Turtles are cold blooded animals so perching on a log in the sun will help it maintain a constant internal temperature. **DOK 2**

8 **C—Correct.** A, B—These name other stages of the life cycle that are shown in the figure. D is not shown in the figure. **DOK 1**

9 **D—Correct.** A, B, C—All name other processes not related to the pupa. **DOK 1**

10 **D—Correct.** A, C—These join to form a zygote during fertilization. B develops from a zygote. **DOK 1**

Constructed Response

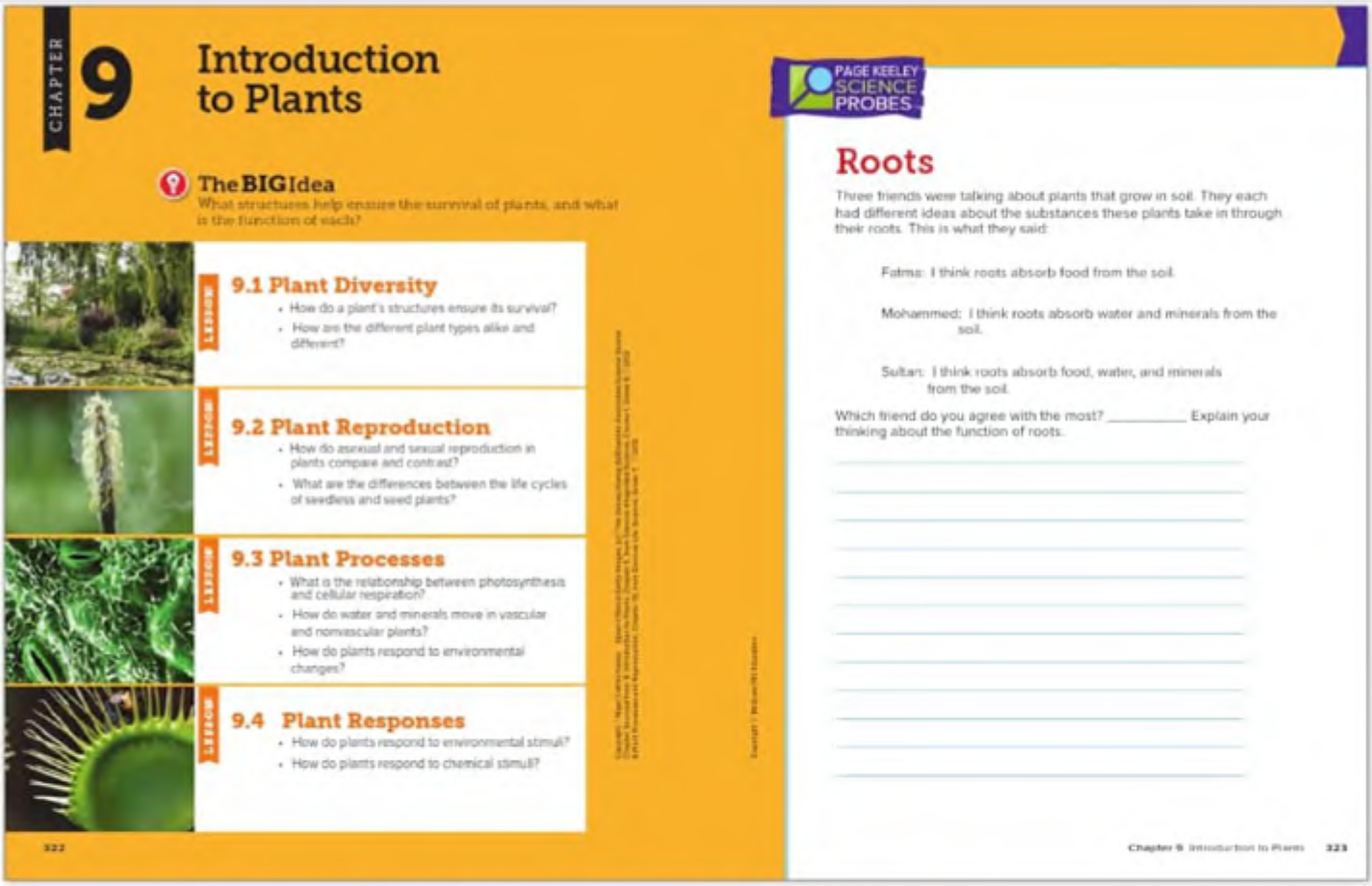
11 The wolf is showing aggression. Examples of stimuli are the presence of an unwanted intruder or a challenge for domination within the pack. The aggressive responses include narrowing the eyes, showing the teeth, and tensing the body. **DOK 2**

12 Aggression is a response to a perceived threat. In this case, the aggressive response prepares the wolf to fight rather than run. **DOK 2**

13 Certain animals use pheromones to signal others of their territory or to establish a new territory. **DOK 2**

Answer Key

Question	Answer
1	B
2	D
3	C
4	C
5	A
6	C
7	C
8	C
9	D
10	D
11	See extended answer.
12	See extended answer.
13	See extended answer.



CHAPTER 9

Introduction to Plants

The BIG Idea

What structures help ensure the survival of plants, and what is the function of each?

9.1 Plant Diversity

- How do a plant's structures ensure its survival?
- How are the different plant types alike and different?

9.2 Plant Reproduction

- How do asexual and sexual reproduction in plants compare and contrast?
- What are the differences between the life cycles of seedless and seed plants?

9.3 Plant Processes

- What is the relationship between photosynthesis and cellular respiration?
- How do water and minerals move in vascular and nonvascular plants?
- How do plants respond to environmental changes?

9.4 Plant Responses

- How do plants respond to environmental stimuli?
- How do plants respond to chemical stimuli?

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PAGE KEELEY SCIENCE PROBES

Roots

Three friends were talking about plants that grow in soil. They each had different ideas about the substances these plants take in through their roots. This is what they said:

Fatma: I think roots absorb food from the soil.

Mohammed: I think roots absorb water and minerals from the soil.

Sultan: I think roots absorb food, water, and minerals from the soil.

Which friend do you agree with the most? _____ Explain your thinking about the function of roots.

Chapter 9 Introduction to Plants 323

Introduction to plants

The BIG Idea

There are no right or wrong answers to these questions. Write student-generated questions produced during the discussion on chart paper and return to them throughout the chapter.

Guiding Questions

AL	What are three different kinds of plants?	*Use this question to initiate a discussion of the diversity of plants. Students might suggest a flowering plant, a tree, and a cactus, for example. List the plants as they are identified.*
OL	What are plant structures?	*Use this question to assess student understanding of plant structures. Create a list of identified structures to revisit as students work through the chapter.*
BL	What is meant by plant diversity?	*Students might respond that there are many different types of plants and that plants grow in many different environments.*

PAGE KEELEY SCIENCE PROBES

Roots

Answers to the Page Keeley Science Probe can be found in the Teacher's Edition of the *Activity Lab Workbook*.

INQUIRY

About the Photo **Why Such Diversity?** How many kinds of plants do you think are shown in this photo? A dozen, at least. Explain that land plants evolved at least 450 million years ago from green algae. Today there are an estimated 300,000 species of land plants.

Guiding Questions

BL What similarities do the plants in the photo share?	*Students will recognize that the plants are green, but elicit from them why this is so. Lead a brief discussion of chlorophyll and photosynthesis. Other students may recognize that most of the plants in the photo are flowering plants.*
BL What difference do the plants have?	*Student responses may include that the leaf shape of the plants are different, as well as the stem type (soft and green or brown and woody). Some of the plants are trees, others are shrubs.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Build a Class Definition

1. Write the word *stoma* on chart paper or the board.
2. Explain that stomata (the plural of *stoma*) are tiny pores on plant leaves that enable a plant to exchange gases with the atmosphere.
3. The word stoma comes from the Greek word *stoma*, meaning "mouth." The mouthlike opening of some tiny animals, such as roundworms, is called a stoma.
4. Build a class definition for *stoma*. Students should record the accepted definition in their Science Journals.

ExploreActivity

What does a plant need to grow?

Prep: *5 min* **Class:** *15 min*

Purpose
To create a plan for growing plants.

Materials
Student Pair: radish seeds, petri dish, paper towels, poster board, masking tape

Before You Begin
This lab is meant to assess the students' knowledge and preconceptions about plants. Assemble the materials students will need to plant and grow radish seeds. You may throw in some extra, unnecessary items if you wish, in order to challenge students to select the proper items.

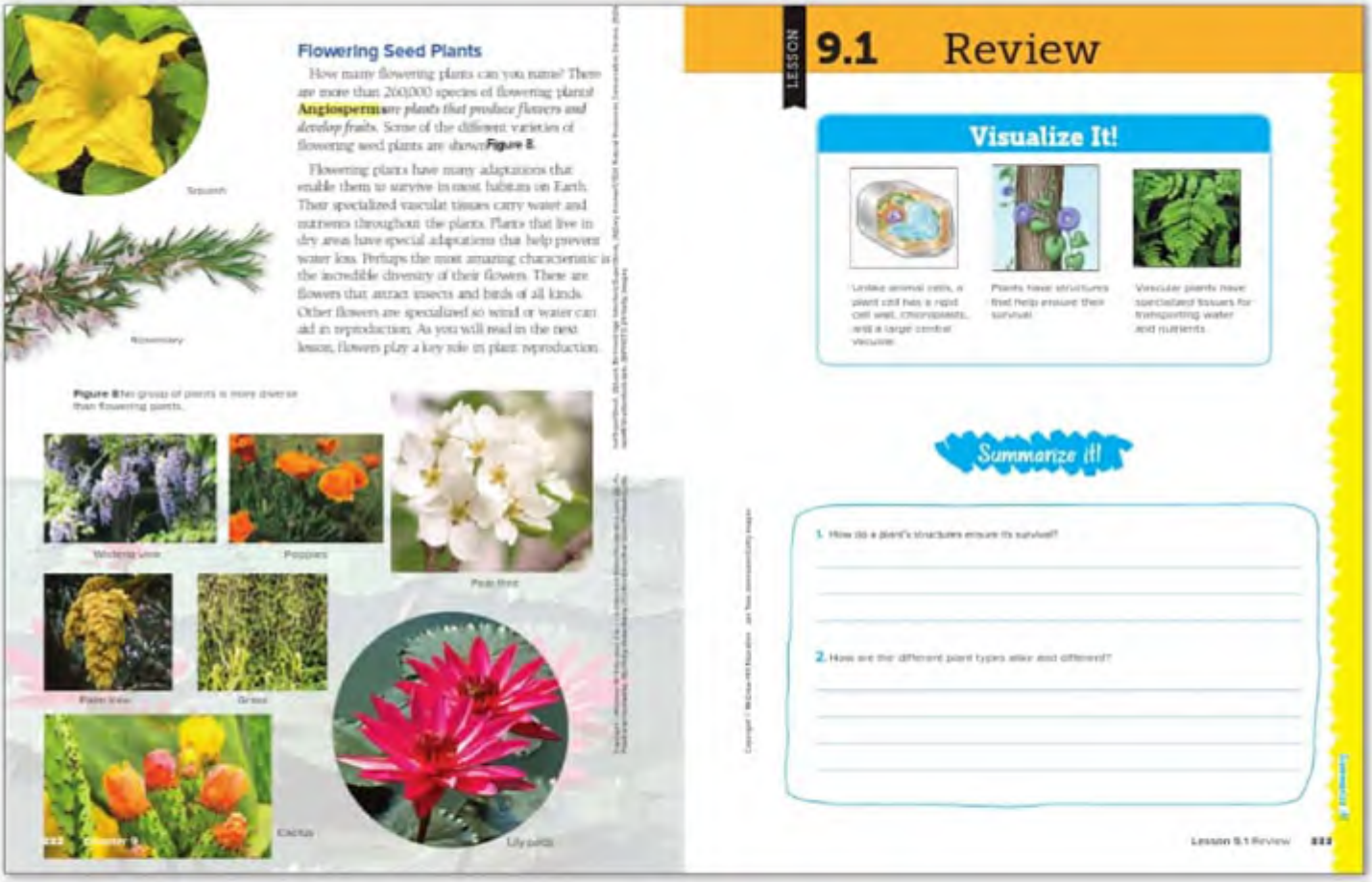
Guide the Investigation

- Read and check students' lab safety forms.
- Begin the lab by starting a discussion about what plants need to survive. Have each student brainstorm a list. Use these lists to create a comprehensive class list by asking the students to volunteer answers on their brainstorming lists.
- Make sure students clean up their areas after completing the lab and dispose of the waste materials properly.
- Find a good location to keep the growing radish plants and have students continue to water them and care for them. The growing plants will be used in another lab in this chapter.

Think About This

1. Answers will vary. Students should recognize that both humans and plants need air, water, food, energy, and a place to live.
2. Students should have used water to moisten the soil or paper around their seeds. They should also have placed their container in a sunny area. These steps will ensure that the seeds get water and the emerging plants get sunlight.
3. **Key Concept** Answers will vary. Students should understand that leaves are used to collect sunlight for energy, and roots are used to collect water and possibly minerals. Students may understand that stems are structures that transport and/or support the plant.

Teacher Notes



Flowering Seed Plants

How many flowering plants can you name? There are more than 260,000 species of flowering plants! **Angiosperms** *are plants that produce flowers and develop fruits.* Some of the different varieties of flowering seed plants are shown in **Figure 8.**

Flowering plants have many adaptations that enable them to survive in most habitats on Earth. Their specialized vascular tissues carry water and nutrients throughout the plants. Plants that live in dry areas have special adaptations that help prevent water loss. Perhaps the most amazing characteristic is the incredible diversity of their flowers. There are flowers that attract insects and birds of all kinds. Other flowers are specialized so wind or water can aid in reproduction. As you will read in the next lesson, flowers play a key role in plant reproduction.

Figure 8 Her group of plants is more diverse than flowering plants.

Squash

Rosemary

Wishing vine

Poppies

Peach tree

Palm tree

Cactus

Lily pads

LESSON 9.1 Review

Visualize It!

Unlike animal cells, a plant cell has a rigid cell wall, chloroplasts, and a large central vacuole.

Plants have structures that help ensure their survival.

Vascular plants have specialized tissues for transporting water and nutrients.

Summarize it!

1. How do a plant's structures ensure its survival?

2. How are the different plant types alike and different?

Lesson 9.1 Review

Flowering Seed Plants

Students should realize that almost every plant they see, with the exception of evergreens, is a flowering seed plant. Use the following questions to start a discussion about these plants.

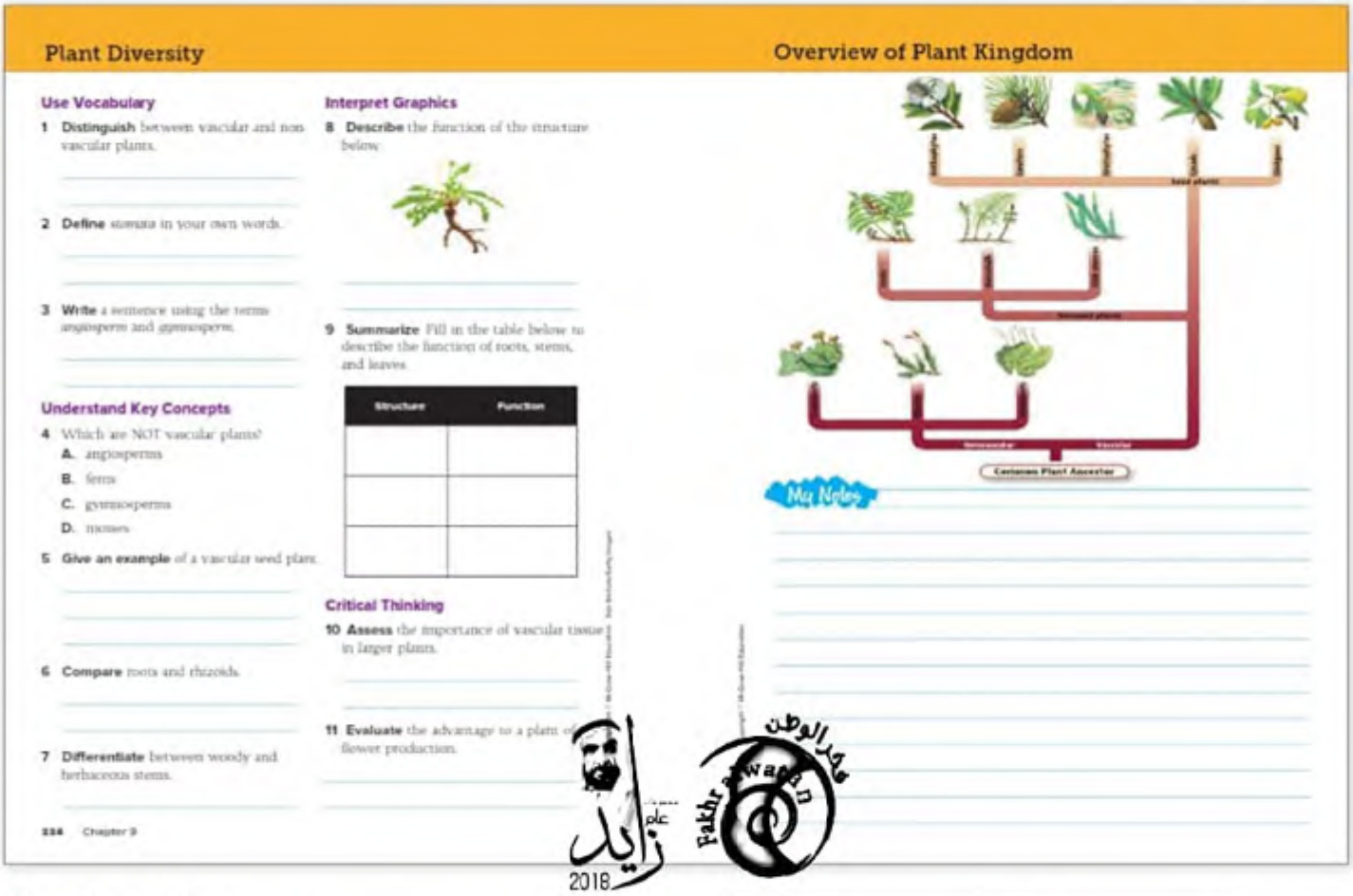
Guiding Questions

AL	What is the scientific name for flowering seed plants?	*They are called angiosperms.*
AL	What do all flowering seed plants produce in addition to flowers?	*fruits*
OL	In what plant function do flowers play a key role?	*They play an important part in reproduction.*
OL	Give examples of the many adaptations of flowering seed plants.	*Possible answers include: specialized vascular tissues that carry water and nutrients throughout the plant; adaptations that prevent water loss; flowers that attract insects and birds in order to reproduce; flowers that are adapted so that wind and water enable them to reproduce*
BL	How do the different plant types compare and contrast?	*Plants are grouped into types. The nonvascular types include mosses, liverworts, and hornworts. The nonvascular plants do not have vascular tissue to transport water and nutrients throughout the plants. There are also types of vascular plants, or plants that have specialized vascular tissue to transport water and nutrients throughout the plant. Some vascular plants produce seeds, while others do not.*

Summarize it!

The information needed to complete this graphic organizer can be found in the following sections:

- Plant Diversity



Plant Diversity

Use Vocabulary

1 **Distinguish** between vascular and non-vascular plants.

2 **Define** stomata in your own words.

3 **Write** a sentence using the terms angiosperm and gymnosperm.

Understand Key Concepts

4 Which are NOT vascular plants?
A. angiosperms
B. ferns
C. gymnosperms
D. mosses

5 **Give an example** of a vascular seed plant.

6 **Compare** roots and rhizoids.

7 **Differentiate** between woody and herbaceous stems.

Interpret Graphics

8 **Describe** the function of the structure below.

9 **Summarize** Fill in the table below to describe the function of roots, stems, and leaves.

Structure	Function

Critical Thinking

10 **Assess** the importance of vascular tissue in larger plants.

11 **Evaluate** the advantage to a plant of flower production.

334 Chapter 9

Overview of Plant Kingdom

My Notes

Use Vocabulary

1. Vascular plants have specialized tissue for transporting water and nutrients and nonvascular plants do not. **DOK 1**
2. Answers will vary but should relate to the passage of gases into and out of a leaf. **DOK 1**
3. Answers will vary, but the student should show an understanding that gymnosperms are nonflowering seed plants and angiosperms are seed plants that produce flowers and fruits. **DOK 1**

Understand Key Concepts

4. D. mosses **DOK 1**
5. Answers will vary. Possible answers are conifer, grass, palm tree, and cactus. **DOK 1**
6. Roots absorb water and nutrients from the soil. Rhizoids anchor a nonvascular seedless plant to a surface. **DOK 1**
7. Woody stems are stiff. Herbaceous stems are green and flexible. **DOK 1**

Interpret Graphics

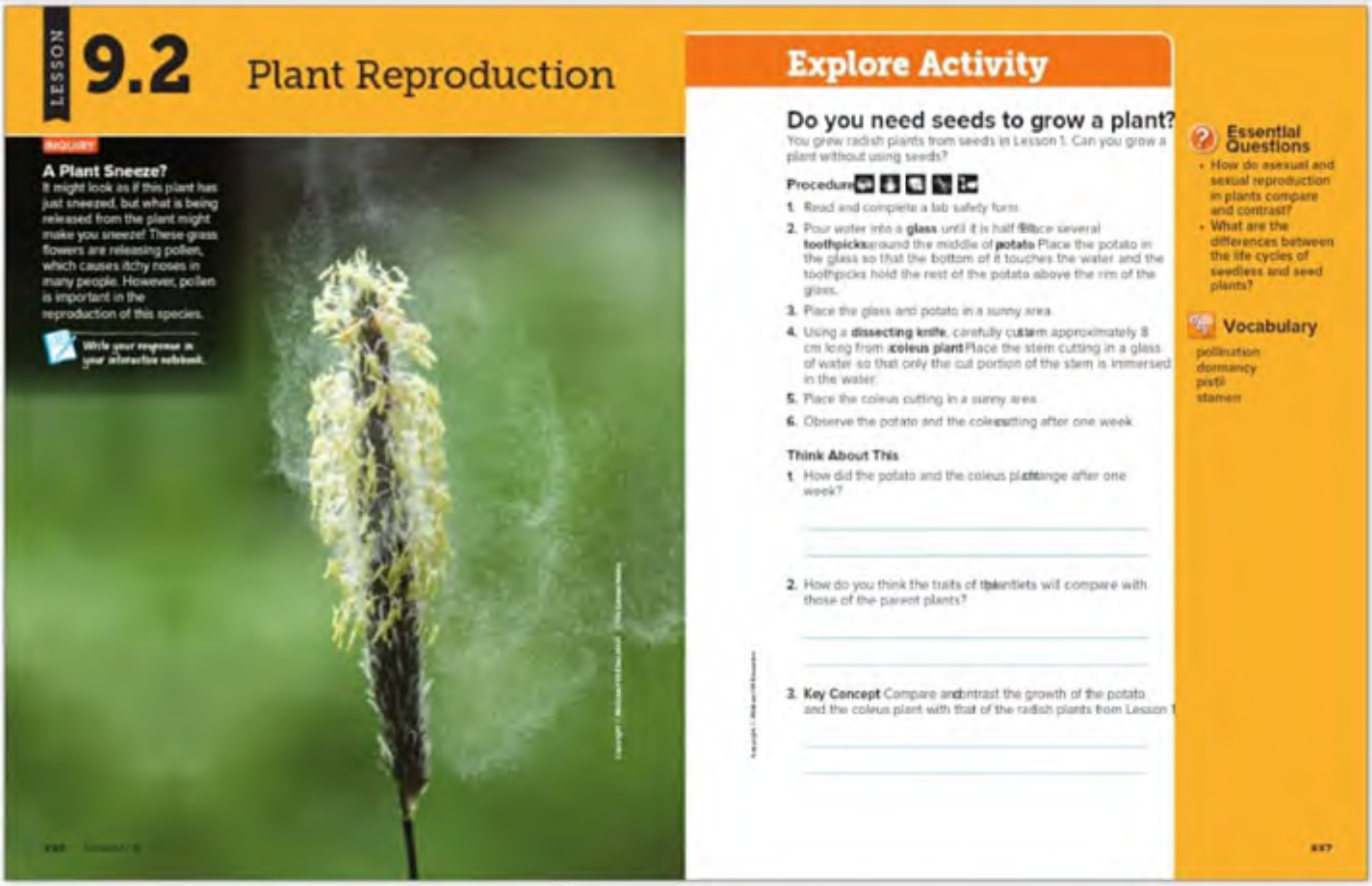
8. It is a taproot. It anchors the plant in the soil, absorbs water and nutrients, and can store food for the plant. **DOK 2**

9.

Structure	Function
roots	Absorb water and nutrients
stems	Transport water from roots to leaves and sugar from leaves to roots
leaves	Perform photosynthesis

Critical Thinking

10. Larger plants need vascular tissue to transport water and nutrients throughout the plant. Larger plants would not survive if all substances could only move through osmosis and diffusion. Vascular tissue makes movement of materials more efficient. **DOK 3**
11. Flowers can help attract pollinators that ensure reproduction. **DOK 3**


LESSON 9.2 Plant Reproduction

INQUIRY

A Plant Sneeze?

It might look as if this plant has just sneezed, but what is being released from the plant might make you sneeze! These grass flowers are releasing pollen, which causes itchy noses in many people. However, pollen is important in the reproduction of this species.

Write your response in your interactive notebook.

Explore Activity

Do you need seeds to grow a plant?

You grew radish plants from seeds in Lesson 1. Can you grow a plant without using seeds?

Procedure

1. Read and complete a lab safety form.
2. Pour water into a glass until it is half full. Place several toothpicks around the middle of a potato. Place the potato in the glass so that the bottom of it touches the water and the toothpicks hold the rest of the potato above the rim of the glass.
3. Place the glass and potato in a sunny area.
4. Using a dissecting knife, carefully cut a stem approximately 8 cm long from a coleus plant. Place the stem cutting in a glass of water so that only the cut portion of the stem is immersed in the water.
5. Place the coleus cutting in a sunny area.
6. Observe the potato and the coleus cutting after one week.

Think About This

1. How did the potato and the coleus plant change after one week?
2. How do you think the traits of the plantlets will compare with those of the parent plants?
3. Key Concept Compare and contrast the growth of the potato and the coleus plant with that of the radish plants from Lesson 1.

Essential Questions

- How do asexual and sexual reproduction in plants compare and contrast?
- What are the differences between the life cycles of seedless and seed plants?

Vocabulary

pollination
dormancy
pistil
stamen

INQUIRY

About the Photo **A Plant Sneeze?** Grass flowers are an example of the many thousands of plant species that reproduce using pollen.

Guiding Questions

OL	In what ways is a plant's pollen spread?	*Students might understand that wind, rain, animals, and insects cause the spreading of pollen.*
BL	How is pollen important in the reproduction of grass?	*This question can be used to introduce the topic of plant reproduction. You can gauge prior knowledge with this discussion.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Related Words

1. Write pollen and pollination on chart paper or the board. Add descriptions of each word as students answer the questions.
2. Point out that pollen is a noun. **Ask: What do you know about pollen?** *Pollen is a powdery substance produced by the male parts of a plant. It consists of pollen grains that contain sperm. It must be moved to the female parts of a plant before fertilization can occur.*
3. Tell students that *pollination* is also a noun. Point out the variation of the word *pollen* and the suffix *–ation* in the word *pollination*. **Ask: What does the suffix –ation mean?** *The suffix* –ation *means action or process.* **Ask: What action or process is the word referring to?** *It refers to pollen moving or being moved from the male part of a plant to the female part of a plant.*

ExploreActivity

Do you need seeds to grow a plant?

Prep: 5 *min* **Class:** 10 *min*

Purpose
To produce plants using asexual reproduction.

Materials
Student: transparent glasses, seed potatoes, coleus plant, toothpicks, dissecting knife

Before You Begin
Obtain seed potatoes and a coleus plant from a garden store. Do not use potatoes from a grocery store; they have often been sprayed to prevent them from sprouting. You may wish to keep the seed potatoes for several weeks before this activity so that they begin to sprout before the lab.

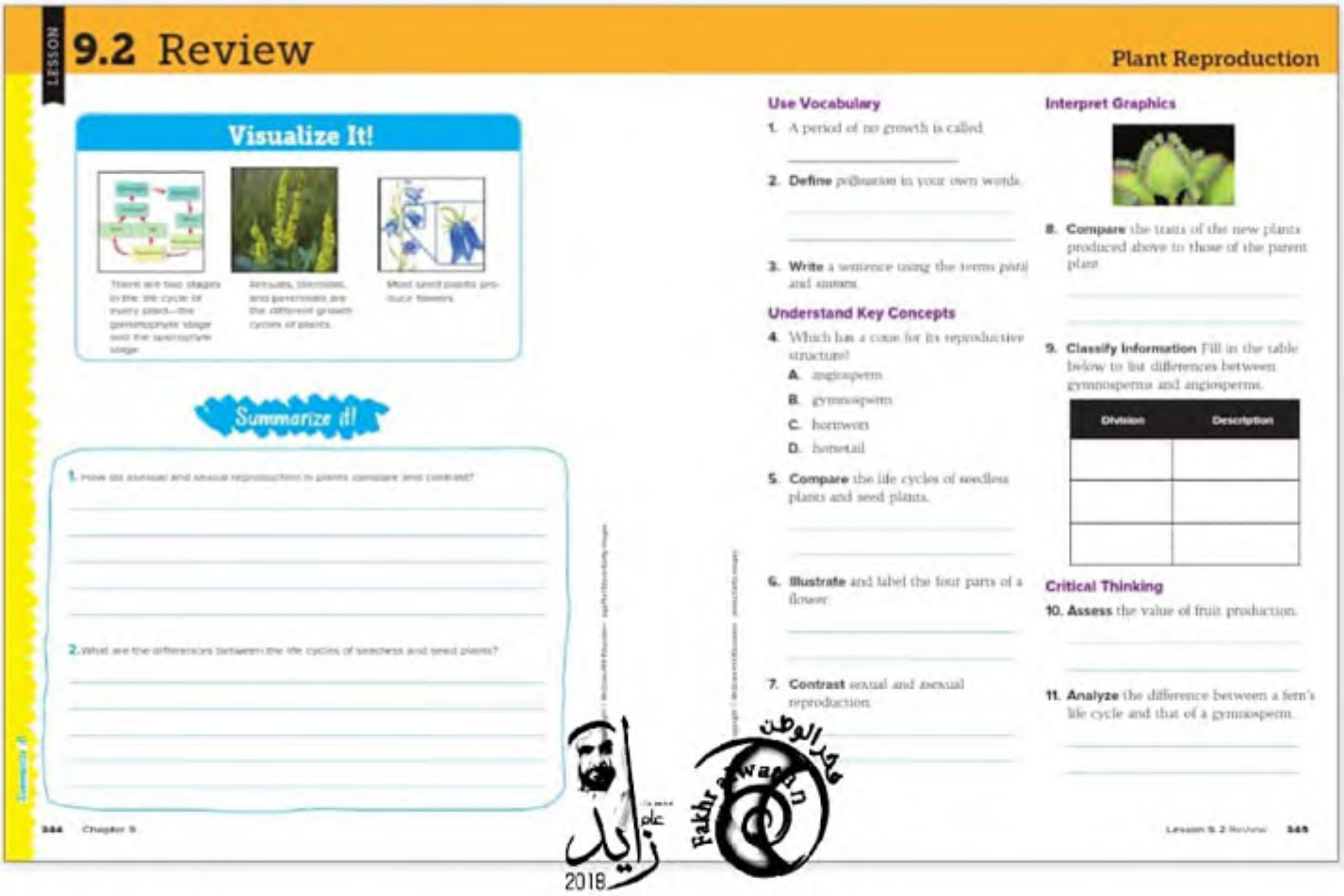
Guide the Investigation

- Read and check students' lab safety forms.
- If the potatoes have sprouts, have students remove all but three or four of them and suspend the potato in the water so that at least one sprout is under water.
- The coleus cutting should include 2 or 3 healthy leaves and have at least 8 cm of intact stem. The cut should be made just below the swollen area where leaves are growing from the stem. Make sure the students do not simply pull off a leaf or part of a leaf. Extra leaves should be removed from the bottom of the stem.
- Caution students to cut away from themselves when using the dissecting knife.
- Make sure to maintain the water levels in the glasses as the plants grow.

Think About This

1. Answers will vary. Students should see roots forming and growing from the tubers and cuttings.
2. Answers will vary. Students should realize that the plants are grown using asexual reproduction and will be exactly the same as the parent plant.
3. Answers will vary. Sample answer: All three plants form roots, shoots, and leaves as they grow. The coleus plant and potato plant are grown asexually using pieces of an adult plant. The radish plants are grown from seeds that were produced sexually from two parent plants.

Teacher Notes



LESSON

9.2 Review

Plant Reproduction

Visualize It!

There are two stages in the life cycle of every plant—the gametophyte stage and the sporophyte stage.

Annuals, biennials, and perennials are the different growth cycles of plants.

Most seed plants produce flowers.

Summarize it!

1. How do asexual and sexual reproduction in plants compare and contrast?

2. What are the differences between the life cycles of seedless and seed plants?

Use Vocabulary

1. A period of no growth is called _____.

2. **Define** *pollination* in your own words.

3. **Write** a sentence using the terms *plant* and *stamen*.

Understand Key Concepts

4. Which has a cone for its reproductive structure?
   - A. angiosperm
   - B. gymnosperm
   - C. hornwort
   - D. horsetail

5. **Compare** the life cycles of seedless plants and seed plants.

6. **Illustrate** and label the four parts of a flower.

7. **Contrast** sexual and asexual reproduction.

Interpret Graphics

8. **Compare** the traits of the new plants produced above to those of the parent plant.

9. **Classify Information** Fill in the table below to list differences between gymnosperms and angiosperms.

Division	Description

Critical Thinking

10. **Assess** the value of fruit production.

11. **Analyze** the difference between a fern's life cycle and that of a gymnosperm.

Use Vocabulary

1. dormancy **DOK 1**
2. Answers will vary. Sample answer: Pollination is the moving of pollen to the female part of a flower. **DOK 1**
3. Answers will vary. Sample answer: Pollen from a stamen is moved to a pistil. **DOK 1**

Understand Key Concepts

4. **B.** gymnosperm **DOK 1**
5. Seedless plants alternate between sexual reproduction and asexual reproduction by means of spores. Most seed plants reproduce sexually by the process of pollination. **DOK 1**
6. Drawings will vary, but should show a flower with petals, sepals, pistil, and stamen labeled. **DOK 2**
7. Sexual reproduction involves male and female sex cells and produces offspring that are not identical to the parent or parents while asexual reproduction involves only one parent and produces offspring that are identical to the parent. **DOK 2**

Interpret Graphics

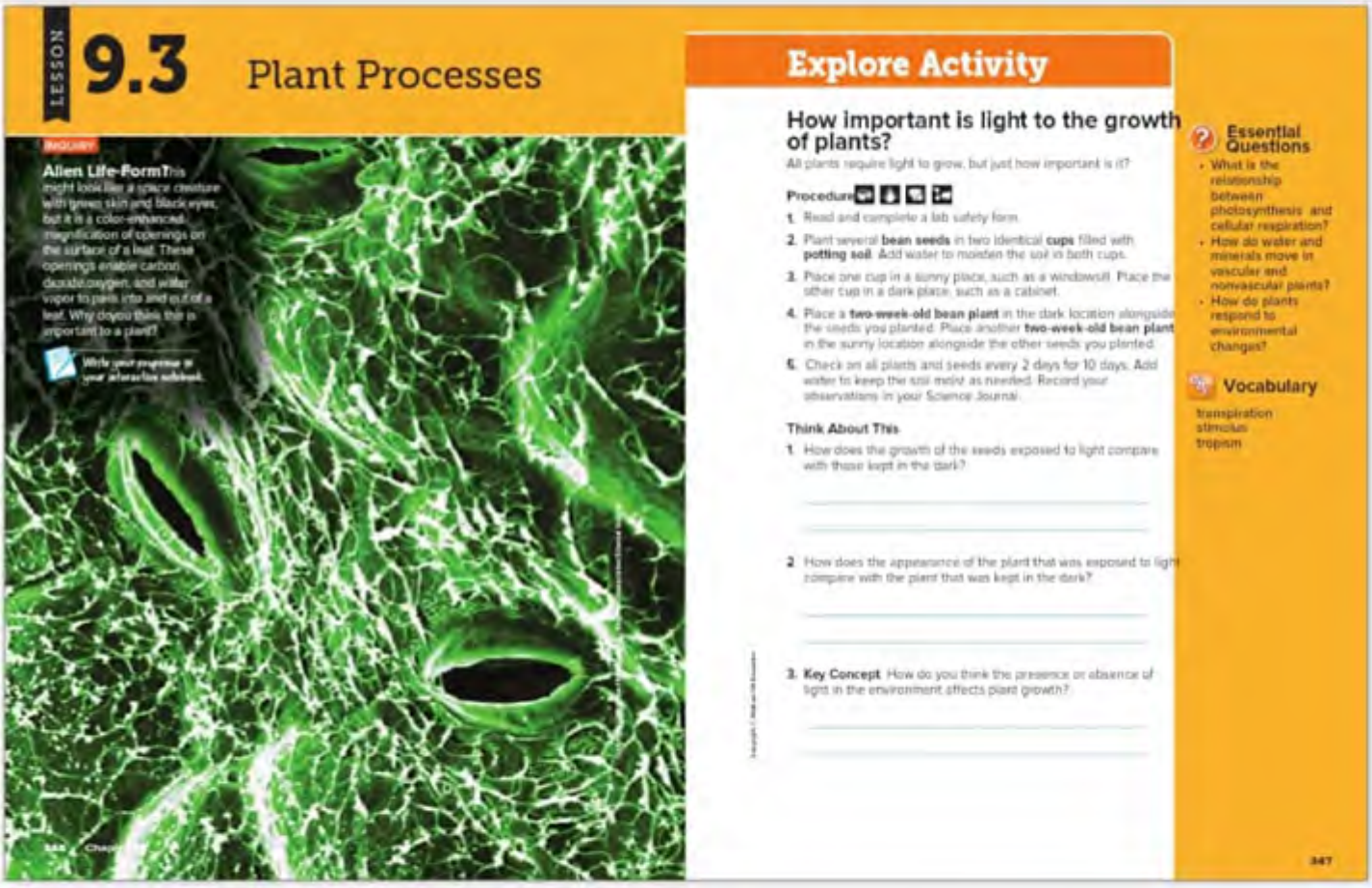
8. The traits are identical because the plant reproduces asexually. **DOK 2**
9.

Division	Description
Gymnosperms	Produce seeds in cones
Angiosperms	Produce seeds within fruits

DOK 2

Critical Thinking

10. Answers will vary. Sample answer: Fruits attract animals that can eat them or carry them to new locations. This helps disperse the seeds that are contained within the fruit. **DOK 3**
11. Answers will vary. Sample answer: Ferns do not produce seeds, and gymnosperms do produce seeds. Since seeds are often a source of food for animals they can be carried to new locations. Therefore, gymnosperms are likely to be spread greater distances. **DOK 2**


LESSON 9.3 Plant Processes

INQUIRY

Alien Life-Form? This might look like a space creature with green skin and black eyes, but it is a color-enhanced magnification of openings on the surface of a leaf. These openings enable carbon dioxide, oxygen, and water vapor to pass into and out of a leaf. Why do you think this is important to a plant?

Write your response in your interactive notebook.

Explore Activity

How important is light to the growth of plants?

All plants require light to grow, but just how important is it?

Procedure

1. Read and complete a lab safety form.
2. Plant several **bean seeds** in two identical **cups** filled with **potting soil**. Add water to moisten the soil in both cups.
3. Place one cup in a sunny place, such as a windowsill. Place the other cup in a dark place, such as a cabinet.
4. Place a **two-week-old bean plant** in the dark location alongside the seeds you planted. Place another **two-week-old bean plant** in the sunny location alongside the other seeds you planted.
5. Check on all plants and seeds every 2 days for 10 days. Add water to keep the soil moist as needed. Record your observations in your Science Journal.

Think About This

1. How does the growth of the seeds exposed to light compare with those kept in the dark?
2. How does the appearance of the plant that was exposed to light compare with the plant that was kept in the dark?
3. **Key Concept** How do you think the presence or absence of light in the environment affects plant growth?

Essential Questions

- What is the relationship between photosynthesis and cellular respiration?
- How do water and minerals move in vascular and nonvascular plants?
- How do plants respond to environmental changes?

Vocabulary

transpiration
stimulus
tropism

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INQUIRY

About the Photo **Alien Life-Form?** Students will notice that the texture of the leaf is rough. Point out that the surface may look much smoother without magnification.

Guiding Questions

OL	Surface openings on a leaf allow gases and moisture to pass into and out of the leaf. Why do you think this is important to the plant?	*Students should recognize that these openings are necessary for the plant to get what it requires to survive.*
BL	Why do you think there are so many folds and pockets on the leaf's surface?	*Students may see that the texture may help the leaf hold moisture.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Connect to Prior Knowledge

Ask students to tell what has happened to indoor plants they have seen when the plants have been placed near sunlight or away from sunlight. Then have students explain the effect of watering or failure to water plants. Point out that sunlight and water are examples of stimuli, changes in a plant's environment that cause a response. Explain that students will learn more about stimuli and their effect on plants.

ExploreActivity

How important is light to the growth of plants?

Prep: 10 *min* **Class:** 5 *min*

Purpose
To determine how light affects the growth of plants.

Materials
Student: bean seeds, potting soil, plant pots or cups, fully grown bean plants

Before You Begin

- Plant some bean seeds several weeks in advance, so that fully grown bean plants are ready for this lab. If preparation time is not available, you can perform the lab using only the seeds and disregard observing the fully grown plants.
- Obtain bean seeds and potting soil from a garden center. Obtain small pots or paper or foam cups to plant the seeds. Do not use seeds treated with pesticides or weed killer.
- Revisit the list the class made of plant needs at the beginning of the chapter. If students listed *light*, ask them to explain why they think light is necessary. Follow up by asking what would happen if a plant did not receive *light*. If students did not include light as part of their lists, ask them why they think it is not necessary.

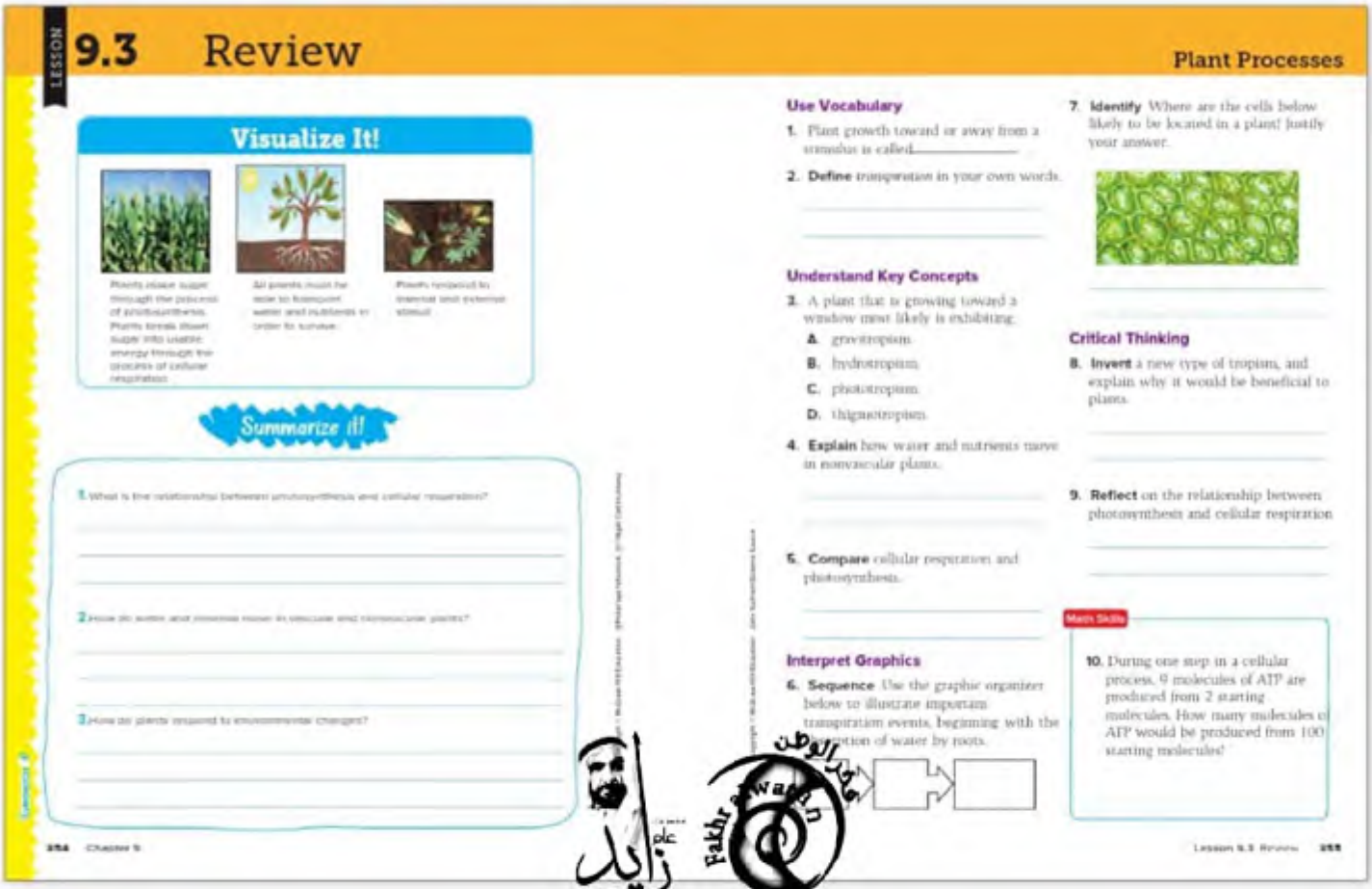
Guide the Investigation

- Read and check students' lab safety forms.
- Have students plant three or four seeds about one inch deep in the potting soil. Make sure they cover the seeds with soil and add enough water to keep the soil moist.
- Make sure to maintain the soil's moisture level. Seeds should sprout in 2–3 days.
- Have students keep notes on the progress of both sets of plants and seeds. At the end of the week, tell students to note the size and state of the growing seeds. For the fully grown plants, have them compare the color and state of the leaves.

Think About This

1. Students should notice that the seedlings in the lighted area grow very well, while the seedlings in the dark area will sprout, but then have trouble growing.
2. Students should notice that the plant in the light grows well, while the plant in the dark will have yellowish leaves and might even begin to wilt.
3. Answers will vary. Students should understand that plants need light in order to grow. Specifically, they might understand that plants need sunlight in order to manufacture food, and this activity is indicated by the presence of green pigment in the leaves.

Teacher Notes



LESSON 9.3 Review

Plant Processes

Visualize It!

Summarize it!

1. What is the relationship between photosynthesis and cellular respiration?

2. How do water and minerals move in vascular and nonvascular plants?

3. How do plants respond to environmental changes?

Use Vocabulary

1. Plant growth toward or away from a stimulus is called _____.

2. **Define** transpiration in your own words.

Understand Key Concepts

3. A plant that is growing toward a window most likely is exhibiting

A. gravitropism.

B. hydrotropism.

C. phototropism.

D. thigmotropism.

4. **Explain** how water and nutrients move in nonvascular plants.

5. **Compare** cellular respiration and photosynthesis.

Interpret Graphics

6. **Sequence** Use the graphic organizer below to illustrate important transpiration events, beginning with the absorption of water by roots.

7. **Identify** Where are the cells below likely to be located in a plant? Justify your answer.

Critical Thinking

8. **Invent** a new type of tropism, and explain why it would be beneficial to plants.

9. **Reflect** on the relationship between photosynthesis and cellular respiration.

Math Skills

10. During one step in a cellular process, 9 molecules of ATP are produced from 2 starting molecules. How many molecules of ATP would be produced from 100 starting molecules?

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Lesson 9.3 Review 355

Summarize it!

The information needed to complete this graphic organizer can be found in the following sections:

- Plant process

Use Vocabulary

1. tropism **DOK 1**

2. Answers will vary. Sample answer: Transpiration happens when water vapor is released from leaves. **DOK 1**

Understand Key Concepts

3. **C.** phototropism **DOK 1**

4. The movement of water and nutrients in nonvascular plants takes place by osmosis and diffusion. **DOK 1**

5. Photosynthesis produces glucose and oxygen. These are the reactants of cellular respiration. Cellular respiration produces carbon dioxide and water vapor, which are needed to carry out photosynthesis. **DOK 2**

Interpret Graphics

6. absorption of water by roots; water travels up the stem in vascular tissue; release of excess water vapor through stomata in leaves **DOK 2**

7. They are most likely located in a leaf—because they contain chloroplasts that need sunlight to carry on photosynthesis. There is more exposure to sunlight in the leaf. **DOK 3**

Critical Thinking

8. Answers will vary, but should describe some type of response to a stimulus. **DOK 2**

9. The sugars that plants make during photosynthesis provide them and the animals that eat them with energy. The sugars are converted during cellular respiration into a form that cells can use called ATP. Both plants and animals ultimately depend on the process of photosynthesis for energy. **DOK 2**

Math Skills

10. $\frac{2 \text{ starting mol.}}{9 \text{ mol. ATP}} = \frac{100 \text{ starting mol.}}{x \text{ mol. ATP}}$

$2x = 9 \times 100 = \frac{900 \text{ mol. ATP}}{2} = 450 \text{ mol. ATP}$ **DOK 2**

LESSON

9.4 Plant Responses

Explore Activity

How do plants respond to stimuli?

Plants use light energy and make their own food during photosynthesis. How else do plants respond to light in their environment?

Procedure

1. Read and complete a lab safety form.
2. Choose a **pot of young radish seedlings**.
3. Place **toothpicks** parallel to a few of the seedlings in the pot in the direction of growth.
4. Place the pot near a **light source**, such as a gooseneck lamp or next to a window. The light source should be to one side of the pot, not directly above the plants.
5. Check the position of the seedlings in relation to the toothpicks after 30 minutes. Record your observations in your Science Journal.
6. Observe the seedlings when you come to class the next day. Record your observations.

Think About This

1. What happened to the position of the seedlings after the first 30 minutes? What is your evidence of change?
2. What happened to the position of the seedlings after a day?
3. **Key Concept** Why do you think the position of the seedlings changed?

Essential Questions

- How do plants respond to environmental stimuli?
- How do plants respond to chemical stimuli?

Vocabulary

stimulus
tropism
photoperiodism
plant hormone

INQUIRY

About the Photo A dandelion that looks yellow to human eyes has a two-tone appearance to bees. Bees' eyes are sensitive to ultraviolet (UV) light, which humans cannot see. In UV light, most flowers exhibit a pattern with a central target that draws bees in to obtain nectar and pollen. In return, the bees spread the flower's pollen. Thus, the coloration of most flowers evolved to attract bees, not to please the human eye.

Start the lesson with questions about the ways plants reproduce, including their strategies for attracting pollinators.

Guiding Questions

AL	**Does a dandelion appear yellow to bees? Explain your answer.**	*No. A dandelion appears white with a red center to bees, because they can see UV light.*
OL	**How is having flowers that show up well in UV light an advantage for plants?**	*The flowers attract bees because the bees can see the UV light. This is an advantage because the bees help the flowers reproduce.*

Essential Questions

After this lesson, students should understand the Essential Questions and be able to answer them. Have students write each question in their interactive notebooks. Revisit each question as you cover its relevant content.

Vocabulary

Build a Class Definition

1. Write the word embryo on chart paper or the board.
2. Explain that most people think of an embryo as the early stage of development in a human or other animal; but, many plants also develop from embryos.
3. The word embryo is derived from the Greek word embryon (or embruon), meaning "to swell" or "to be full to bursting."
4. The adjectival form of the English word—embryonic—is often used to describe something, such as a plan, that is in an early stage of development.
5. **Build class definitions for** both *embryo* **and** *embryonic*

Summary of Plant Hormones

Have students read the paragraph. Ask students for the names and effects of the hormones explained in the lesson. Write the name of each hormone and its effect on the board or chart paper as they are identified and explained. Ask the following questions to review the content of the paragraph.

Guiding Questions

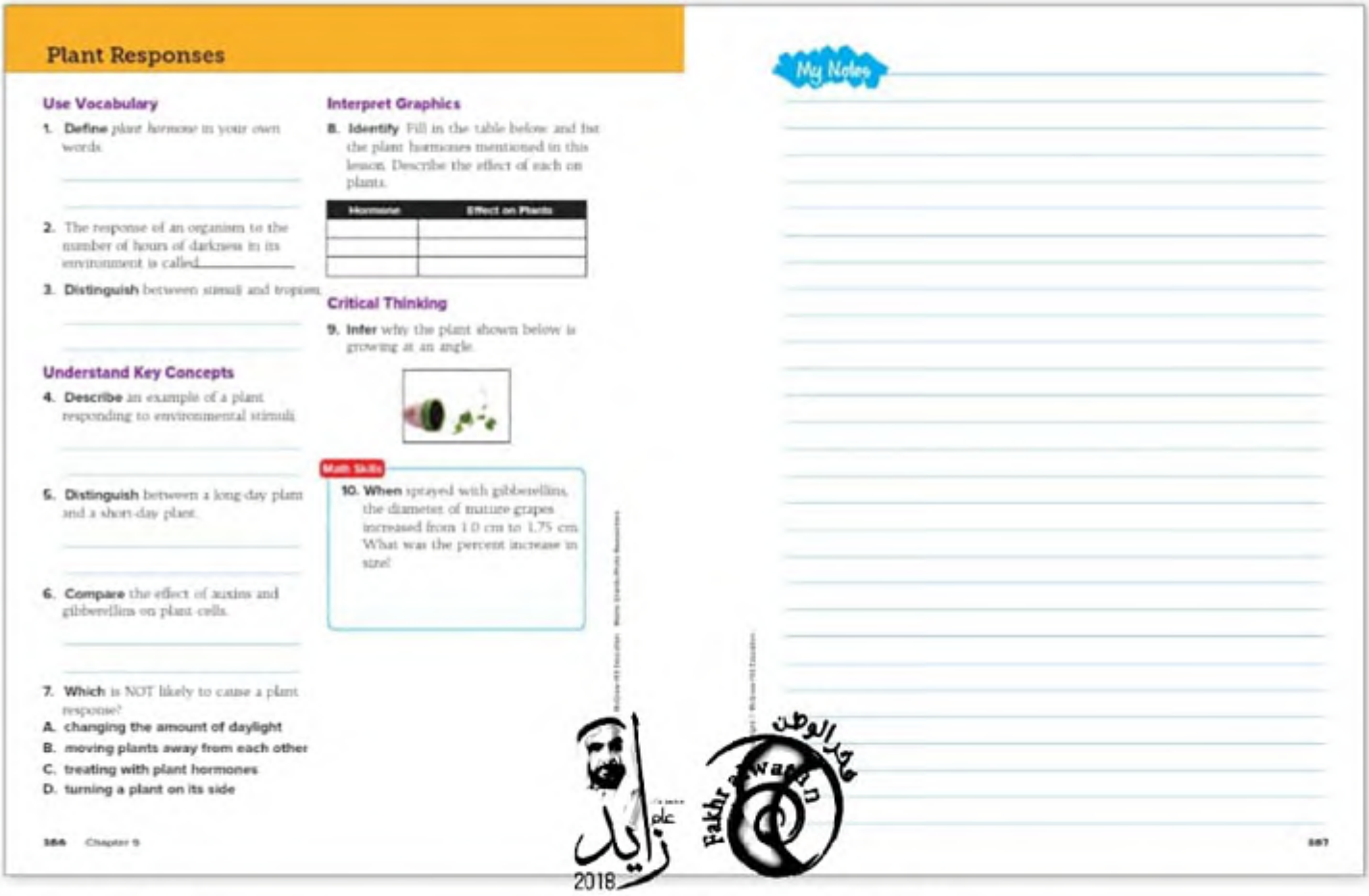
AL	How many different hormones do plants produce?	*many different ones*
OL	Is a plant response always caused by one hormone? Explain your answer.	*No; often two or more hormones interact and cause a response.*
BL	What does the statement that plant hormones have similar compounds mean?	*They are related in some way that enables them to interact.*

Visual Summary

Concepts and terms are easier to remember when they are associated with an image. **Ask: Which Key Concept does each image relate to?**

Summarize it!

Answer may vary.



Plant Responses

Use Vocabulary

1. **Define** *plant hormone* in your own words.

2. The response of an organism to the number of hours of darkness in its environment is called _____.

3. **Distinguish** between *stimuli* and *tropism*.

Understand Key Concepts

4. **Describe** an example of a plant responding to environmental stimuli.

5. **Distinguish** between a long-day plant and a short-day plant.

6. **Compare** the effect of auxins and gibberellins on plant cells.

7. **Which** is NOT likely to cause a plant response?
A. changing the amount of daylight
B. moving plants away from each other
C. treating with plant hormones
D. turning a plant on its side

Interpret Graphics

8. **Identify** Fill in the table below and list the plant hormones mentioned in this lesson. Describe the effect of each on plants.

Hormone	Effect on Plants

Critical Thinking

9. **Infer** why the plant shown below is growing at an angle.

Math Skills

10. **When** sprayed with gibberellins, the diameter of mature grapes increased from 1.0 cm to 1.75 cm. What was the percent increase in size?

My Notes

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Use Vocabulary

1. Answers will vary but should include something about a chemical that can carry a message from one part of a plant to another. **DOK 1**

2. photoperiodism **DOK 2**

3. Stimuli are changes in the environment that cause a response; tropisms are one type of response. **DOK 2**

Understand Key Concepts

4. A. Answers will vary, but may include descriptions of tropisms, such as phototropism, gravitropism, and thigmotropism. Answers will vary, but may include descriptions of tropisms, such as phototropism, gravitropism, and thigmotropism. **DOK 1**

5. A short-day plant will flower when the nights are long, and a long-day plant will flower when the nights are short **DOK 2**

6. Both can cause cell elongation **DOK 1**

7. B. moving plants away from each other **DOK 1**

Interpret Graphics

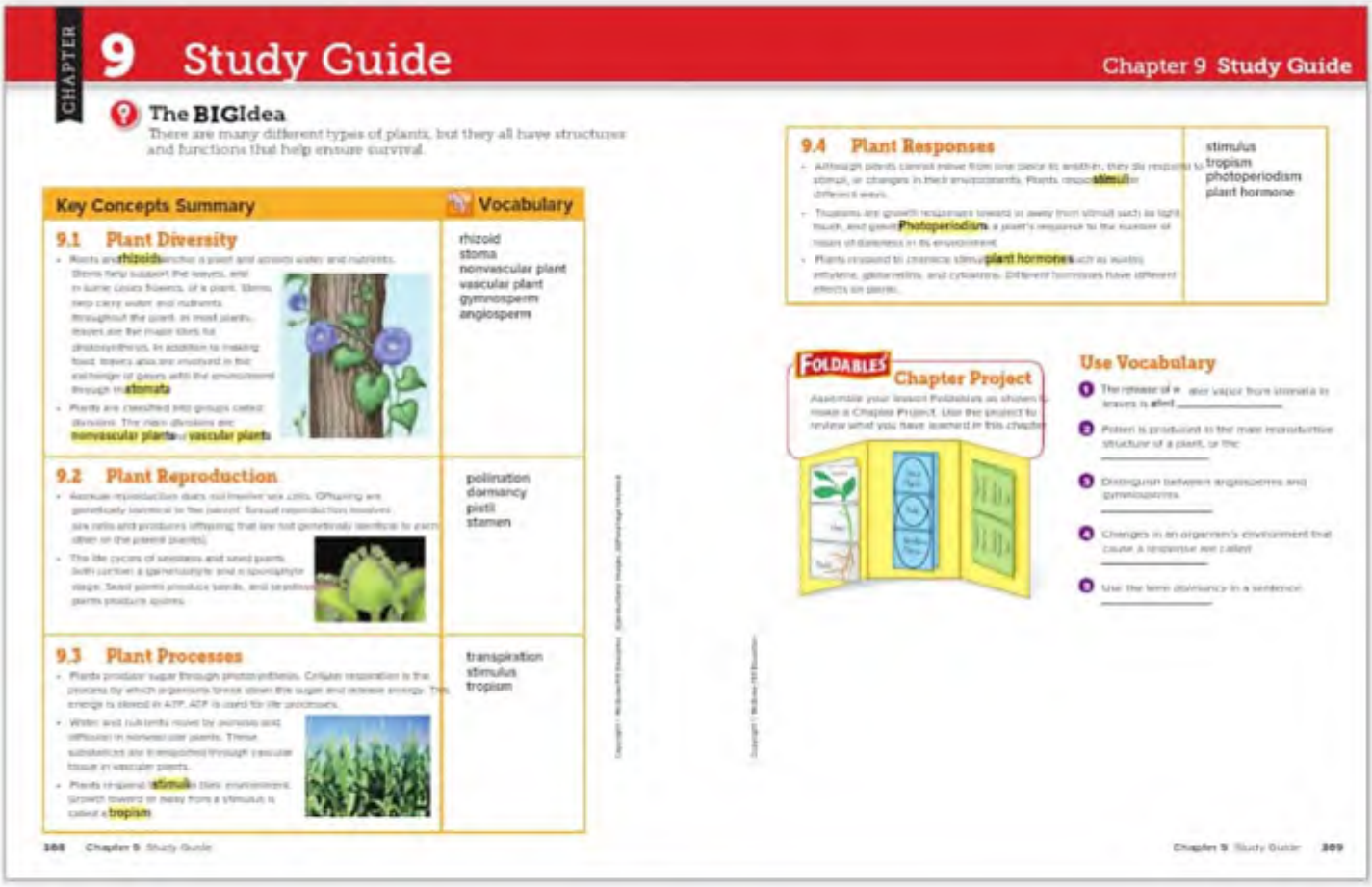
Hormone	Effect on Plants
Auxins	Cause cell elongation
Ethylene	Stimulates the ripening of fruit
Gibberellins	Cause cell division and elongation
Cytokinins	Increase cell division

Critical Thinking

9. The plant has been turned on its side, so the tip is trying to grow up (away from gravity) **DOK 2**

Math Skills

10. $1.75\text{ cm} - 1.0\text{ cm} = 0.75\text{ cm}$; $\frac{.75\text{ cm}}{1\text{ cm}} = 0.75$; $0.75 \times 100 = 75\%$ **DOK 1**


CHAPTER 9 Study Guide

Chapter 9 Study Guide

The BIGIdea

There are many different types of plants, but they all have structures and functions that help ensure survival.

Key Concepts Summary

Vocabulary

9.1 Plant Diversity

- Roots and rhizoids anchor a plant and absorb water and nutrients. Stems help support the leaves, and in some cases flowers, of a plant. Stems also carry water and nutrients throughout the plant. In most plants, leaves are the major sites for photosynthesis. In addition to making food, leaves also are involved in the exchange of gases with the environment through tiny stomata.
- Plants are classified into groups called divisions. The main divisions are nonvascular plants and vascular plants.

rhizoid
stoma
nonvascular plant
vascular plant
gymnosperm
angiosperm

9.2 Plant Reproduction

- Asexual reproduction does not involve sex cells. Offspring are genetically identical to the parent. Sexual reproduction involves sex cells and produces offspring that are not genetically identical to each other or the parent plants.
- The life cycles of seedless and seed plants both contain a gametophyte and a sporophyte stage. Seed plants produce seeds, and seedless plants produce spores.

pollination
dormancy
pistil
stamen

9.3 Plant Processes

- Plants produce sugar through photosynthesis. Cellular respiration is the process by which organisms break down this sugar and release energy. This energy is stored in ATP. ATP is used for life processes.
- Water and nutrients move by osmosis and diffusion in nonvascular plants. These substances are transported through vascular tissue in vascular plants.
- Plants respond to stimuli in their environment. Growth toward or away from a stimulus is called a tropism.

transpiration
stimulus
tropism

9.4 Plant Responses

- Although plants cannot move from one place to another, they do respond to stimuli, or changes in their environments. Plants respond to stimuli in different ways.
- Tropisms are growth responses toward or away from stimuli such as light, touch, and gravity. Photoperiodism is a plant's response to the number of hours of darkness in its environment.
- Plants respond to chemical stimuli called plant hormones such as auxins, ethylene, gibberellins, and cytokinins. Different hormones have different effects on plants.

stimulus
tropism
photoperiodism
plant hormone

FOLDABLES Chapter Project

Assemble your lesson Foldables as shown to make a Chapter Project. Use the project to review what you have learned in this chapter.

Use Vocabulary

1. The release of water vapor from stomata in leaves is called _____.
2. Pollen is produced in the male reproductive structure of a plant, or the _____.
3. Distinguish between angiosperms and gymnosperms. _____
4. Changes in an organism's environment that cause a response are called _____.
5. Use the term dormancy in a sentence. _____

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Key Concepts Summary

Study Strategy: Verbalizing Information

Divide the class into small groups. Assign each group the Key Concepts from one of the three lessons.

1. Students in each group will divide up the Key Concepts.
2. Each student or pair of students should choose and explain one of the Key Concepts to the group. Others in the group can add information as needed.
3. Students may draw pictures on the board or on chart paper to assist in their Key Concept presentations to their group.
4. Randomly change the composition of student groups. Within their new groups, have each student explain his or her Key Concept. Students who may have the same Key Concept can work as partners to explain the Key Concept to the group.
5. Randomly change the composition of the groups again and repeat the activity for the third time.

Vocabulary

Study Strategy: Categorizing

Explain that placing information into categories improves comprehension of terms and helps to clarify similarities and differences.

1. Create a T-chart on chart paper or the board. Write *vascular plants* on one side of the T and *nonvascular plants* on the other side of the T. Have students copy the chart.
2. Have students add the vocabulary words to their T-charts. Remind students that some vocabulary words may be on both sides of the chart, while others will be only under *vascular plants* or *nonvascular plants*.
3. Challenge students to add at least two other terms from each lesson to their T-charts.
4. Have students work as partners to compare and share their chart information.
5. As a class, complete the T-chart created at the start of the activity.

FOLDABLES

Use the Foldables® Chapter Project as a way to connect Key Concepts.

1. Ask students to organize their Foldables® in a way that reflects how the concepts in each Foldable relate to each other.
2. Use glue or staples to hold the sheets together as needed.
3. When complete, ask students to place their Foldables® Chapter Project at the front of the room. Have the class critique and discuss the way in which students have organized their Foldables®.

Use Vocabulary

1 transpiration

2 stamen

3 Angiosperms produce flowers and fruit and gymnosperms produce neither.

4 stimuli

5 Sample answer: Many plants go through dormancy during winter months when the temperatures drop below freezing.

Link Vocabulary and Key Concepts

6 nonvascular

7 vascular

8 gymnosperms

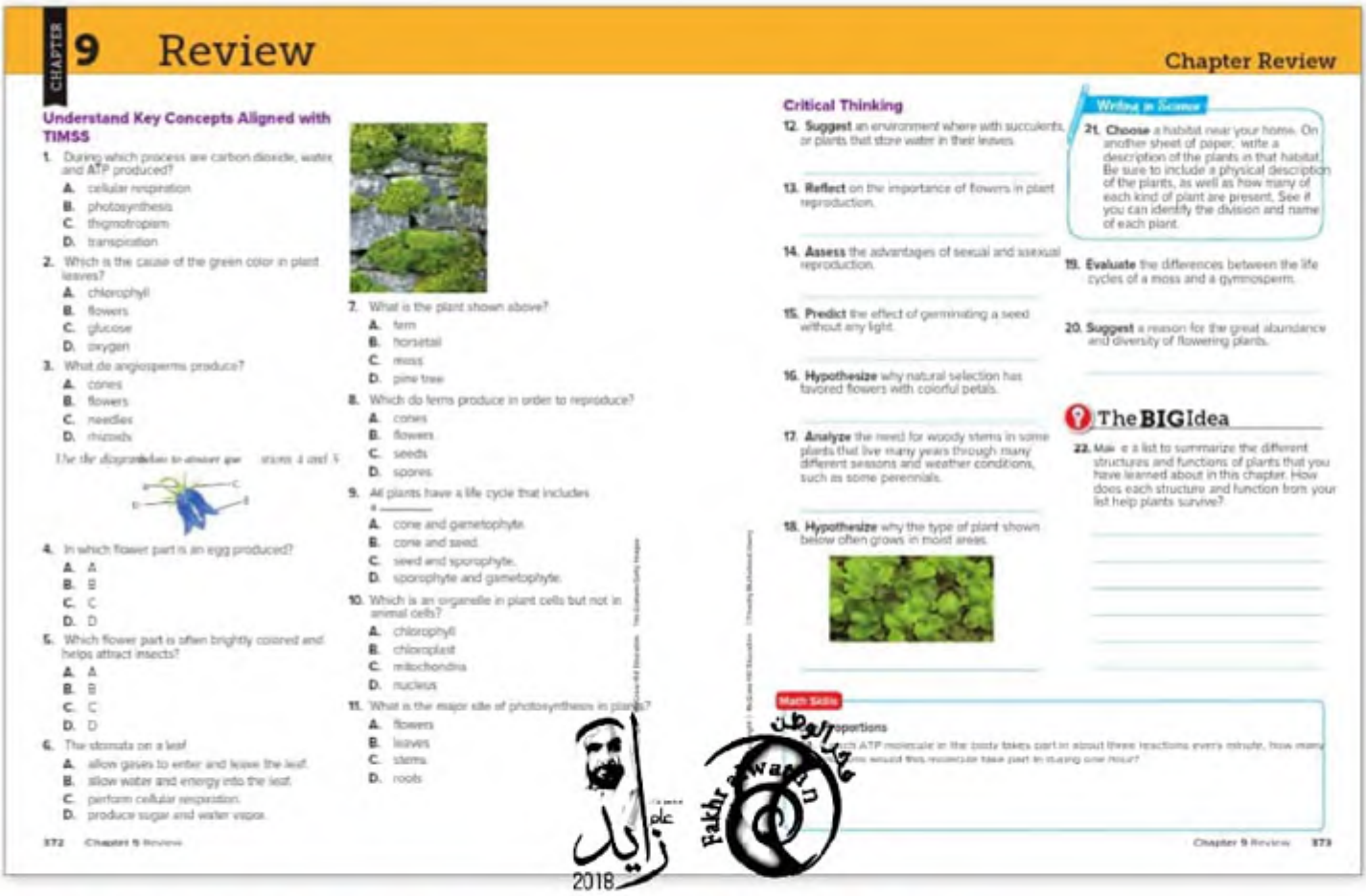
9 angiosperms

10 stimuli

11 tropism

12 transpiration

Teacher Notes


CHAPTER 9 Review

Chapter Review

Understand Key Concepts Aligned with TIMSS

1. During which process are carbon dioxide, water, and ATP produced?
   A. cellular respiration
   B. photosynthesis
   C. thigmotropism
   D. transpiration
2. Which is the cause of the green color in plant leaves?
   A. chlorophyll
   B. flowers
   C. glucose
   D. oxygen
3. What do angiosperms produce?
   A. cones
   B. flowers
   C. needles
   D. rhizoids

Use the diagram below to answer questions 4 and 5.

4. In which flower part is an egg produced?
   A. A
   B. B
   C. C
   D. D
5. Which flower part is often brightly colored and helps attract insects?
   A. A
   B. B
   C. C
   D. D
6. The stomata on a leaf
   A. allow gases to enter and leave the leaf.
   B. allow water and energy into the leaf.
   C. perform cellular respiration.
   D. produce sugar and water vapor.

7. What is the plant shown above?
   A. fern
   B. horsetail
   C. moss
   D. pine tree
8. Which do ferns produce in order to reproduce?
   A. cones
   B. flowers
   C. seeds
   D. spores
9. All plants have a life cycle that includes a _____.
   A. cone and gametophyte
   B. cone and seed
   C. seed and sporophyte
   D. sporophyte and gametophyte
10. Which is an organelle in plant cells but not in animal cells?
    A. chlorophyll
    B. chloroplast
    C. mitochondria
    D. nucleus
11. What is the major site of photosynthesis in plants?
    A. flowers
    B. leaves
    C. stems
    D. roots

Critical Thinking

12. **Suggest** an environment where with succulents, or plants that store water in their leaves.
13. **Reflect** on the importance of flowers in plant reproduction.
14. **Assess** the advantages of sexual and asexual reproduction.
15. **Predict** the effect of germinating a seed without any light.
16. **Hypothesize** why natural selection has favored flowers with colorful petals.
17. **Analyze** the need for woody stems in some plants that live many years through many different seasons and weather conditions, such as some perennials.
18. **Hypothesize** why the type of plant shown below often grows in moist areas.

Writing in Science

21. **Choose** a habitat near your home. On another sheet of paper, write a description of the plants in that habitat. Be sure to include a physical description of the plants, as well as how many of each kind of plant are present. See if you can identify the division and name of each plant.
19. **Evaluate** the differences between the life cycles of a moss and a gymnosperm.
20. **Suggest** a reason for the great abundance and diversity of flowering plants.

The BIG Idea

22. Make a list to summarize the different structures and functions of plants that you have learned about in this chapter. How does each structure and function from your list help plants survive?

Math Skills

Proportions

[illegible] each ATP molecule in the body takes part in about three reactions every minute, how many times would this molecule take part in during one hour?

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Understand Key Concepts

1. **A.** cellular respiration
2. **A.** chlorophyll
3. **B.** flowers
4. **A.** A
5. **B.** B
6. **A.** allows gases to enter and leave the leaf.
7. **C.** moss
8. **D.** spores
9. **D.** sporophyte and gametophyte.
10. **B.** chloroplast
11. **B.** leaves

Critical Thinking

12. Succulents are common in drier environments. Storing water in leaves is a beneficial adaptation to have in such an environment.
13. Flowers help attract pollinators, and that increases the likelihood that the pollen is going to be transferred.
14. Asexual reproduction can occur with only one parent and can produce multiple offspring with the same desirable trait. Sexual reproduction can produce offspring with variable and possibly new traits.
15. Answers will vary but students should say that the root will still grow down and the stem up.
16. Flowers with colorful leaves attract pollinators, thus carrying on the successful survival of the species.

17. The woody stems provide support for larger plants and can withstand harsh environmental conditions such as snow and ice.
18. It is a nonvascular plant; therefore it moves water and minerals via osmosis and diffusion, which is easier to do in a moist enviroment.
19. The gametophyte of mosses is larger than the sporophyte, while in gymnosperms the sporophyte is the larger stage. Mosses do not produce seeds and gymnosperms do.
20. Flowering plants have many adaptations such as vascular tissue, flowers, and fruits that help them survive in a variety of habitats.

Writing in Science

21. Answers will vary.

The BIG Idea

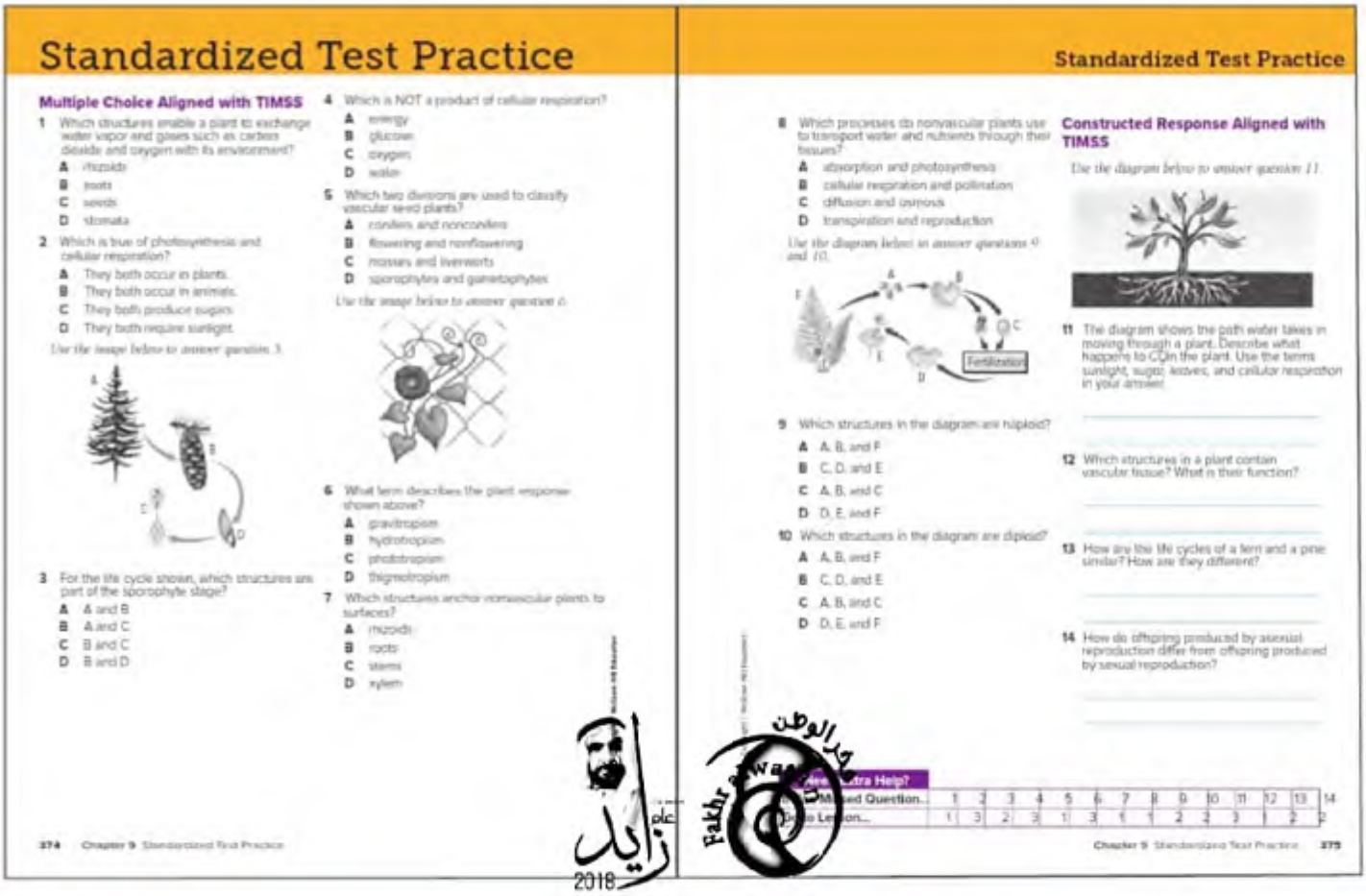
22. Students should list structures such as roots, leaves, vascular tissue, and so on, and describe their function. Students should explain that these structures are adaptations that help plants survive the different conditions of their environments.

Math Skill

23. $\frac{3 \text{ reactions}}{1 \text{ minute}} = \frac{x \text{ reactions}}{60 \text{ min.}}$

$x = 3 \times 60 = 180$ reactions

Teacher Notes



Standardized Test Practice

Multiple Choice Aligned with TIMSS

1 Which structures enable a plant to exchange water vapor and gases such as carbon dioxide and oxygen with its environment?
A rhizoids
B roots
C seeds
D stomata

2 Which is true of photosynthesis and cellular respiration?
A They both occur in plants.
B They both occur in animals.
C They both produce sugars.
D They both require sunlight.

Use the image below to answer question 3.

3 For the life cycle shown, which structures are part of the sporophyte stage?
A A and B
B A and C
C B and C
D B and D

4 Which is NOT a product of cellular respiration?
A energy
B glucose
C oxygen
D water

5 Which two divisions are used to classify vascular seed plants?
A conifers and nonconifers
B flowering and nonflowering
C mosses and liverworts
D sporophytes and gametophytes

Use the image below to answer question 6.

6 What term describes the plant response shown above?
A gravitropism
B hydrotropism
C phototropism
D thigmotropism

7 Which structures anchor nonvascular plants to surfaces?
A rhizoids
B roots
C stems
D xylem

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Standardized Test Practice

8 Which processes do nonvascular plants use to transport water and nutrients through their tissues?
A absorption and photosynthesis
B cellular respiration and pollination
C diffusion and osmosis
D transpiration and reproduction

Use the diagram below to answer questions 9 and 10.

9 Which structures in the diagram are haploid?
A A, B, and F
B C, D, and E
C A, B, and C
D D, E, and F

10 Which structures in the diagram are diploid?
A A, B, and F
B C, D, and E
C A, B, and C
D D, E, and F

Constructed Response Aligned with TIMSS

Use the diagram below to answer question 11.

11 The diagram shows the path water takes in moving through a plant. Describe what happens to CO_2 in the plant. Use the terms sunlight, sugar, leaves, and cellular respiration in your answer.

12 Which structures in a plant contain vascular tissue? What is their function?

13 How are the life cycles of a fern and a pine similar? How are they different?

14 How do offspring produced by asexual reproduction differ from offspring produced by sexual reproduction?

Need Extra Help?

If You Missed Question...	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Go to Lesson...	1	3	2	3	1	3	1	1	2	2	3	1	2	2

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Multiple Choice

1 **D—Correct.** A, B, C—Stomata allow the exchange of gases in the leaves of a plant. Rhizoids anchor a nonvascular plant. Roots anchor a vascular plant. Seeds contain plant embryos. **DOK 1**

2 **A—Correct.** B, C, D—Plants carry on both photosynthesis and cellular respiration. Photosynthesis does not occur in animal cells; cellular respiration does not produce sugars, and cellular respiration does not need energy directly from the Sun. **DOK 2**

3 **B—Correct.** A, C, D—The mature tree, the seed, and the seedling are all part of the sporophyte stage. The cone is part of the gametophyte stage. **DOK 2**

4 **C—Correct.** A, B, D—Glucose is a product of photosynthesis. Carbon dioxide, energy, and water are products of cellular respiration. **DOK 1**

5 **B—Correct.** A, C, D—The two divisions of vascular seed plants are flowering and nonflowering plants. Conifers are a type of nonflowering plant. Mosses and liverworts are nonvascular plants. Sporophytes and gametophytes are life stages in a plant's life cycle. **DOK 2**

6 **D—Correct.** A, B, C—Thigmotropism is the response to touch, which is shown by the vine wrapping around the fence. The other tropisms—responses to gravity, water, and light—are not shown in the figure. **DOK 1**

7 **A—Correct.** B, C, D—Rhizoids are the structures that anchor nonvascular plants to surfaces. Roots, stems, and xylem are structures in vascular plants. **DOK 1**

8 **C—Correct.** A, B, D—Nonvascular plants transport water and nutrients through osmosis and diffusion. Photosynthesis, cellular respiration, and reproduction are processes that do not transport water and nutrients through a plant. **DOK 1**

9 **C—Correct.** A, B, D—Spores, the gametophyte, and the reproductive cells are haploid. D, E, and F are diploid. **DOK 2**

10 **D—Correct.** A, B, C—The zygote, young sporophyte, and mature sporophyte are diploid. A, B, and C are haploid. **DOK 2**