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McGraw-Hill Education

Advanced Science Program

United Arab Emirates Edition

6

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GRADE 6 • VOLUME 2

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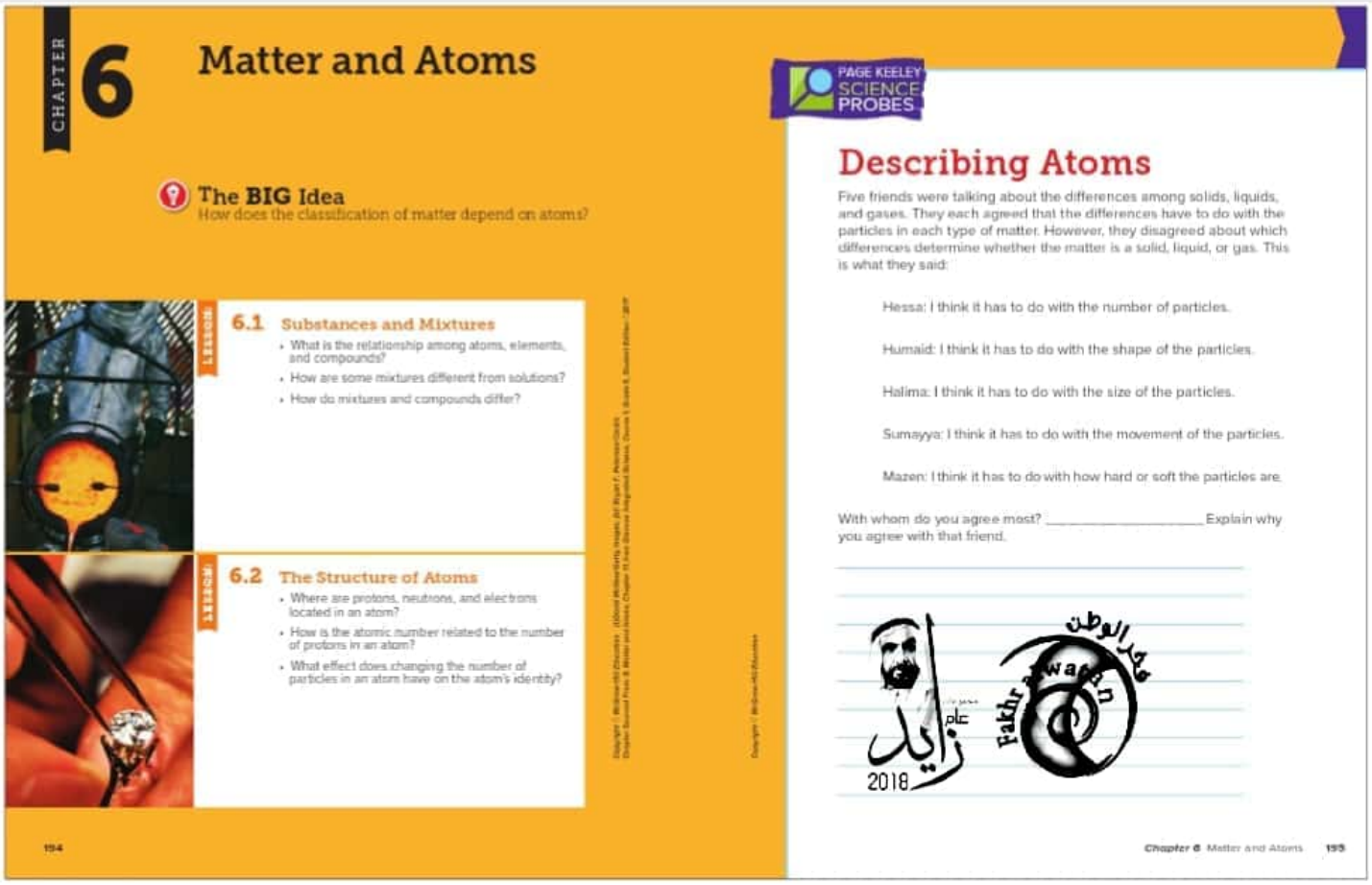

CHAPTER 6

Matter and Atoms

The BIG Idea

How does the classification of matter depend on atoms?

6.1 Substances and Mixtures

- What is the relationship among atoms, elements, and compounds?
- How are some mixtures different from solutions?
- How do mixtures and compounds differ?

6.2 The Structure of Atoms

- Where are protons, neutrons, and electrons located in an atom?
- How is the atomic number related to the number of protons in an atom?
- What effect does changing the number of particles in an atom have on the atom's identity?

PAGE KEELEY SCIENCE PROBES

Describing Atoms

Five friends were talking about the differences among solids, liquids, and gases. They each agreed that the differences have to do with the particles in each type of matter. However, they disagreed about which differences determine whether the matter is a solid, liquid, or gas. This is what they said:

Hessa: I think it has to do with the number of particles.

Humaid: I think it has to do with the shape of the particles.

Halima: I think it has to do with the size of the particles.

Sumayya: I think it has to do with the movement of the particles.

Mazen: I think it has to do with how hard or soft the particles are.

With whom do you agree most? _____ Explain why you agree with that friend.

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Chapter 6 Matter and Atoms 195

Mat ter and Atoms

The BIG Idea

There a re 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	Why does it mean to classify?	*Classify means to organize or group things in a meaningful way.*
OL	Why is it important to classify matter?	*The classification of matter helps us to study it in an organized way so that we can understand the similarities and differences between substances.*
BL	How might studying atoms help scientists classify matter?	*An atom is the smallest particle of an element that retains the properties of that element. Studying the atom might help scientists learn more about the elements, how they are different and how they are the same, and how they can be classified or combined.*

PAGE KEELEY SCIENCE PROBES **Describing Atoms**

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

Get Ready to Read

What do you think?

Use this anticipation guide to gauge students' background knowledge and preconceptions about matter and atoms. At the end of the chapter, ask students to read and evaluate their earlier responses. Students should feel comfortable changing any of their responses.

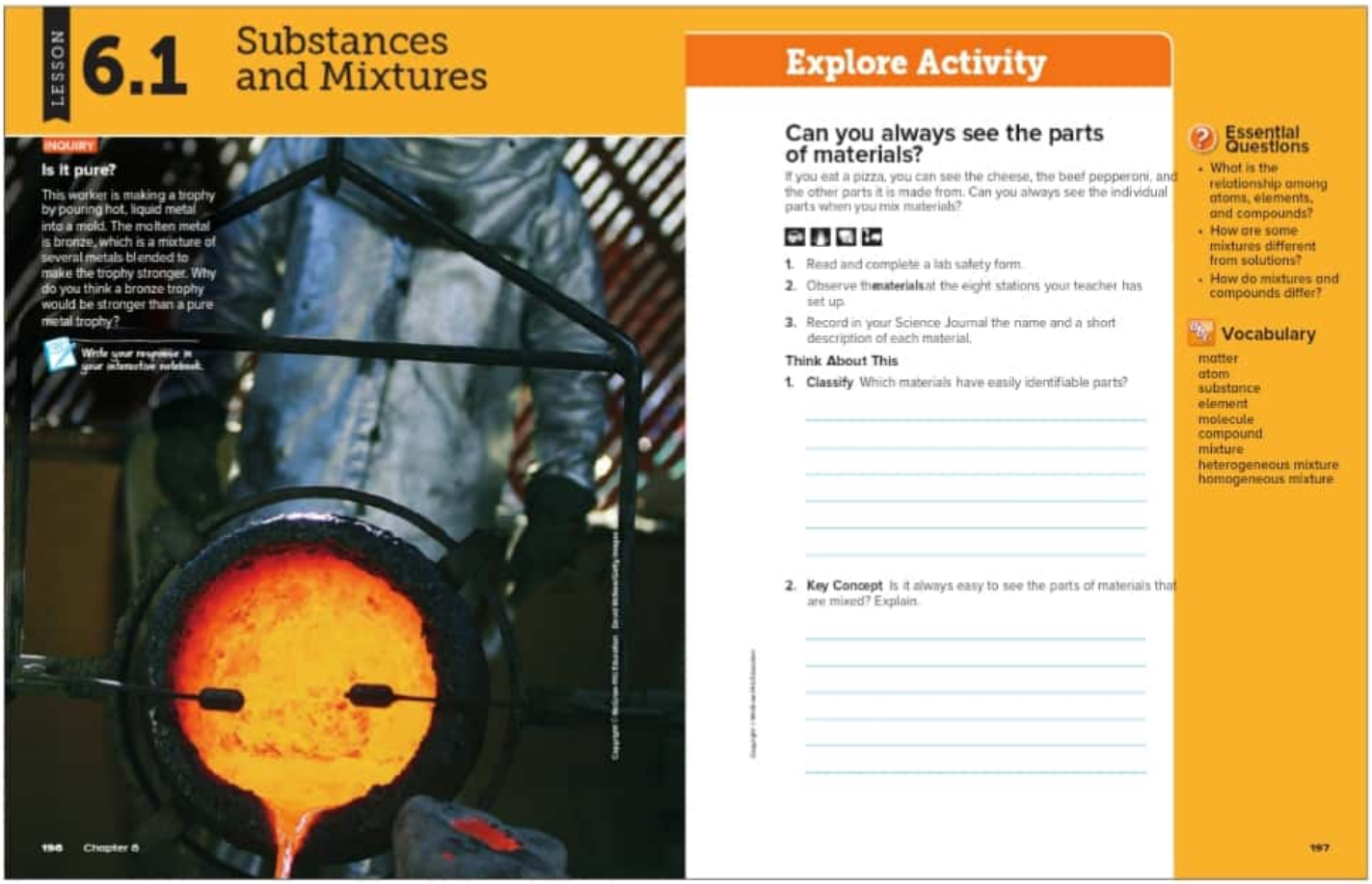
Anticipation Set for Lesson 1

1. **Things that have no mass are not matter**

   Agree. Matter is anything that takes up space and has mass.

2. **The arrangement of particles is the same throughout a mixture.**

   Disagree. The arrangement of particles is the same throughout some mixtures, but the arrangement is not the same throughout all mixtures.



LESSON 6.1 Substances and Mixtures

INQUIRY

Is it pure?

This worker is making a trophy by pouring hot, liquid metal into a mold. The molten metal is bronze, which is a mixture of several metals blended to make the trophy stronger. Why do you think a bronze trophy would be stronger than a pure metal trophy?

Write your response in your interactive notebook.

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Explore Activity

Can you always see the parts of materials?

If you eat a pizza, you can see the cheese, the beef pepperoni, and the other parts it is made from. Can you always see the individual parts when you mix materials?

1. Read and complete a lab safety form.
2. Observe the materials at the eight stations your teacher has set up.
3. Record in your Science Journal the name and a short description of each material.

Think About This

1. **Classify** Which materials have easily identifiable parts?

2. **Key Concept** Is it always easy to see the parts of materials that are mixed? Explain.

Essential Questions

- What is the relationship among atoms, elements, and compounds?
- How are some mixtures different from solutions?
- How do mixtures and compounds differ?

Vocabulary

matter
atom
substance
element
molecule
compound
mixture
heterogeneous mixture
homogeneous mixture

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INQUIRY

About the Photo **Is it pure?** The photo shows a worker making award trophies. The molten metal is bronze. Bronze is a metal alloy that is mostly copper with some other metals added for strength and durability, such as tin or aluminum. It also conducts heat and can be molded easily. These properties make bronze ideal for creating trophies, among other objects. Classifying matter and understanding the properties of materials can help you better understand their uses.

Guiding Questions

AL	Describe one property of bronze.	*Answers will vary. Possible answers include: It can melt easily, it can be molded into different shapes, it is shiny, and so on.*
OL	Why do you think a pure metal trophy would be different?	*It might not be as strong as the combination of metals and, as a result, might scratch or break more easily.*
BL	Draw a conclusion about the physical property that makes it possible for the container to hold the bronze.	*Because the molten bronze is very hot, the container must have a higher melting point than the bronze to retain its shape.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

Essential Questions

For this activity, gather a dozen objects from the classroom for students to describe, including both solids and liquids. If these are not available, bring them to class, show slides of various objects, or have students clip images from magazines. Explain that the objects are all examples of matter.

Vocabulary

Describing Matter

For this activity, gather a dozen objects from the classroom for students to describe, including both solids and liquids. If these are not available, bring them to class, show slides of various objects, or have students clip images from magazines. Explain that the objects are all examples of matter.

1. Have students examine the different objects. Ask each student to describe five of the objects, including their color, size, shape, weight, texture, and so on.

2. Discuss with students the kinds of words that they use to describe objects. Then ask them to consider other possible ways to describe matter beyond what they can observe with their senses.

Teacher Notes

ExploreActivity

Can you always see the parts of materials?

Purpose
To investigate whether the parts that make up a material are always visible.

Materials
3 magnifying lenses, 3 plastic bowls, 5 150-mL beakers, 85 mL sugar, 115 mL sand, 150 mL vegetable oil, 350 mL water, 3 plastic spoons, marker, 8 index cards

Before You Begin

- Set up eight lab stations each with an labeled index card:
  Sugar bowl with 50 mL sugar
  Sand bowl with 50 mL sand
  Sugar and Sand bowl with 25 mL sugar and 25 mL sand
  Oil beaker with 100 mL oil
  Water beaker with 100 mL water
  Water and Oil beaker with 50 mL water and 50 mL oil
  Water and Sand beaker with 100 mL water and 30 mL sand
  Water and Sugar beaker with 100 mL very warm water and 10 mL sugar
- Stir the mixtures and allow them to set. Place magnifying lenses at stations with solid materials only so students can observe the parts. Include a plastic spoon so students can move the parts around and observe.

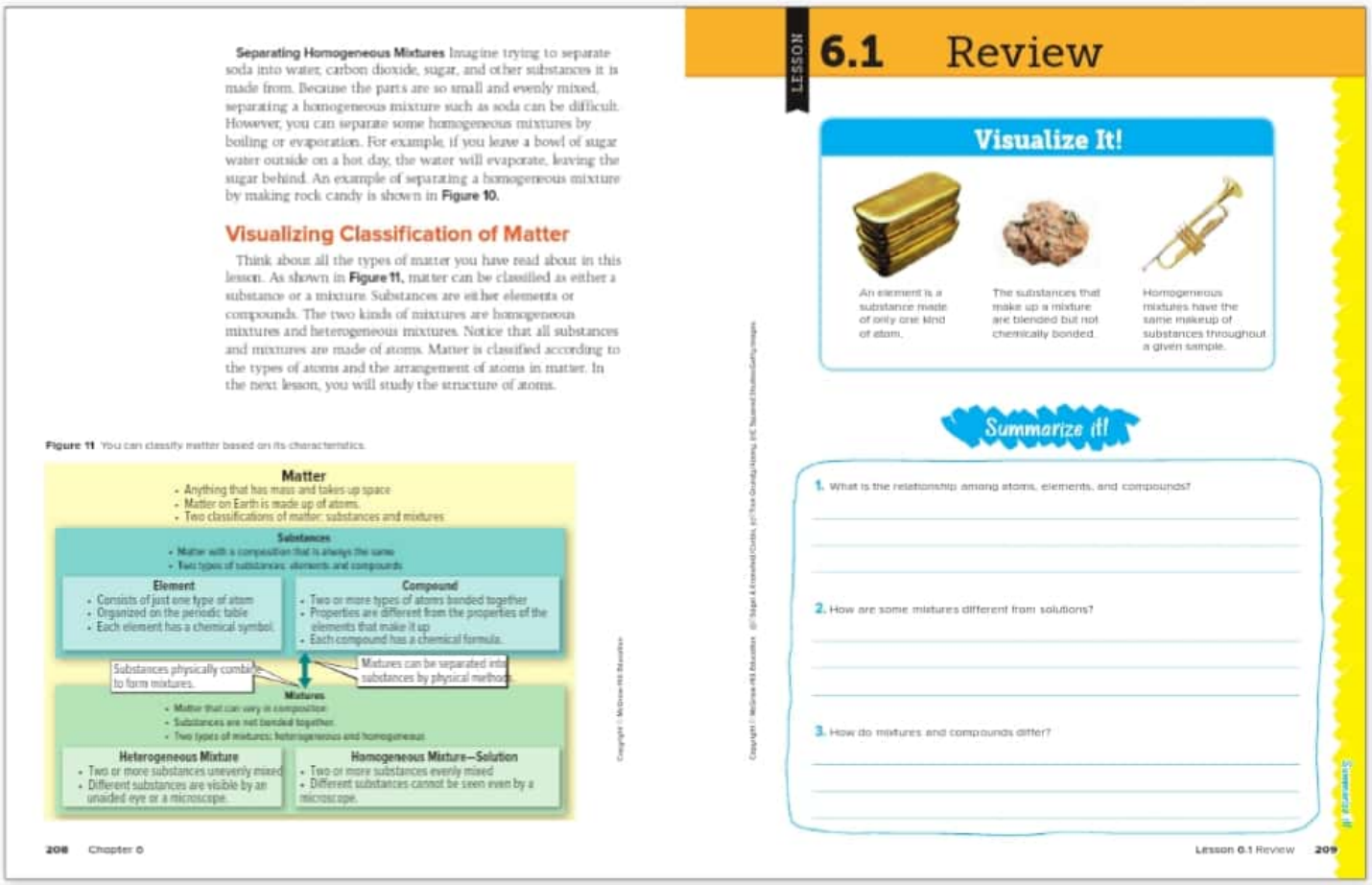
Guide the Investigation

- Before students begin, ask if they have ever stirred a drink mix into water or chocolate powder into milk. Ask them to describe the drink's appearance after they mixed parts.
- Encourage students to compare the lab materials before and after they are mixed.

Think About This

1. Accept any reasonable answers. The question prompts students think about what makes up matter. Students may note that sugar and sand are made of tiny grains. It is fairly easy to distinguish individual grains in the sugar-sand mixture. The oil/water and water/sand are also easy to distinguish.

2. **Key Concept** No; even though the water and sugar were mixed, the parts could not be seen individually.



Separating Homogeneous Mixtures Imagine trying to separate soda into water, carbon dioxide, sugar, and other substances it is made from. Because the parts are so small and evenly mixed, separating a homogeneous mixture such as soda can be difficult. However, you can separate some homogeneous mixtures by boiling or evaporation. For example, if you leave a bowl of sugar water outside on a hot day, the water will evaporate, leaving the sugar behind. An example of separating a homogeneous mixture by making rock candy is shown in **Figure 10.**

Visualizing Classification of Matter

Think about all the types of matter you have read about in this lesson. As shown in **Figure 11**, matter can be classified as either a substance or a mixture. Substances are either elements or compounds. The two kinds of mixtures are homogeneous mixtures and heterogeneous mixtures. Notice that all substances and mixtures are made of atoms. Matter is classified according to the types of atoms and the arrangement of atoms in matter. In the next lesson, you will study the structure of atoms.

Figure 11 You can classify matter based on its characteristics.

LESSON 6.1 Review

Visualize It!

An element is a substance made of only one kind of atom.

The substances that make up a mixture are blended but not chemically bonded.

Homogeneous mixtures have the same makeup of substances throughout a given sample.

Summarize it!

1. What is the relationship among atoms, elements, and compounds?

2. How are some mixtures different from solutions?

3. How do mixtures and compounds differ?

Separating Homogeneous Mixtures

Have students take a second look at the photograph of rock candy in **Figure 10.** Explain that the formation of crystals is one example of separating a homogeneous mixture. Another example of this can happen in a solution of Epsom salts and water. It occurs when the solution is boiled until the water evaporates and leaves behind salt particles that form crystals. Have students read the paragraph and answer the following questions.

Guiding Questions

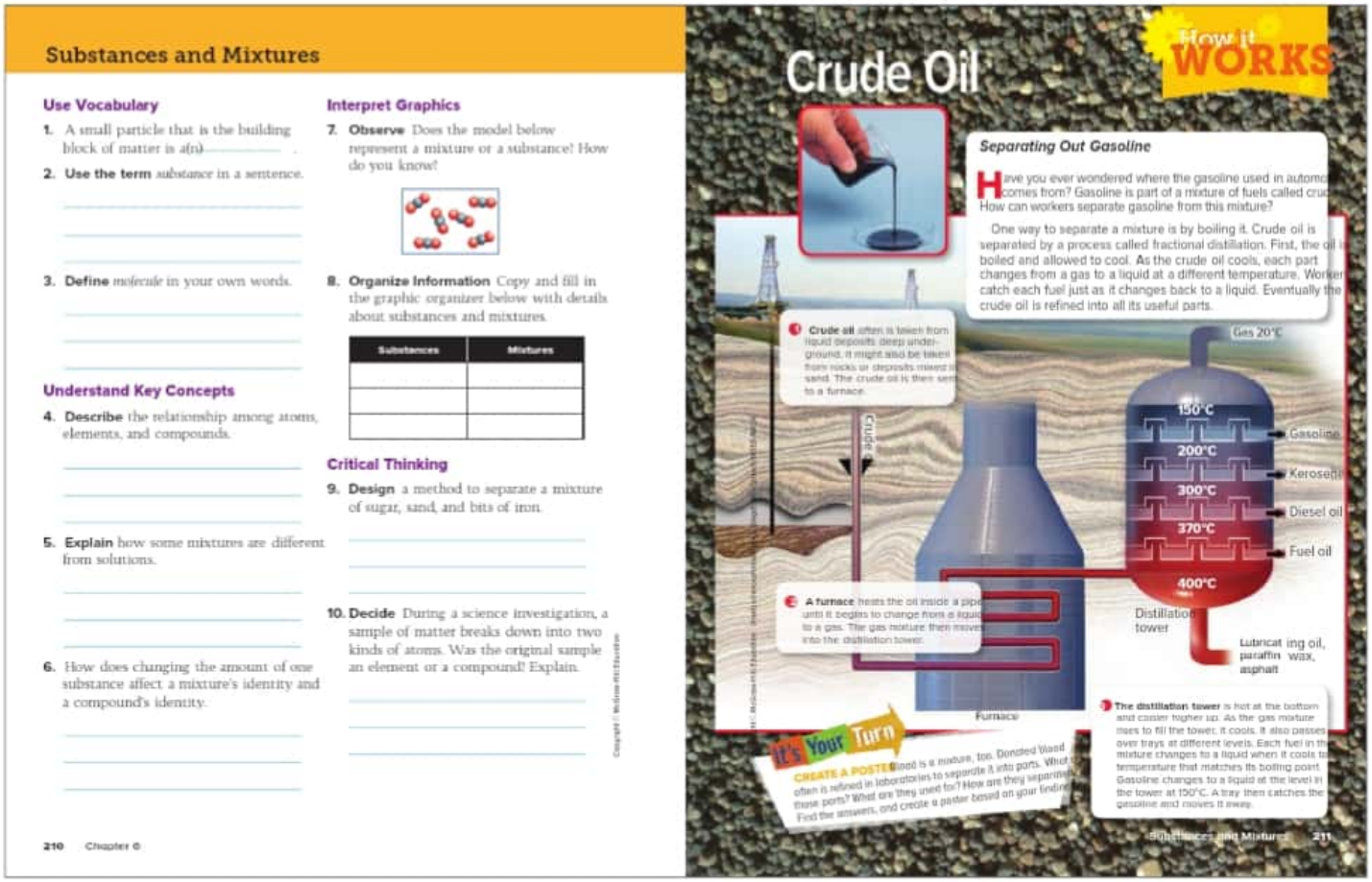
AL	Is it more difficult to separate a heterogeneous or a homogeneous mixture?	*Homogeneous mixtures are more difficult to separate because they are evenly mixed.*
OL	Name one method of separating homogeneous mixtures.	*Answers may include filtering, boiling point, melting point, magnetism, or evaporation.*
BL	In order to separate components in a homogeneous mixture, what must be true of the solutes and solvent?	*They must have boiling points that are significantly different.*

Visualizing Classification of Matter

Have students read the paragraph to review the different types of matter. Then ask the following questions.

Guiding Questions

AL	What are the two types of matter?	*Substances and mixtures*
OL	Describe the differences between substances and mixtures.	*Substances are made of one or more types of atoms in the same combination. Mixtures are made of two or more substances that are not bonded together. The combinations of the substances can vary.*
BL	What question can you ask that will immediately tell you if a mixture is a heterogeneous or homogeneous mixture?	*Are the substances within the mixture evenly mixed? If yes, it's a homogeneous mixture (a solution); if no, then it's heterogeneous mixture.*



Substances and Mixtures

Use Vocabulary

1. A small particle that is the building block of matter is a(n) _____ .
2. **Use the term** *substance* in a sentence.

3. **Define** *molecule* in your own words.

Understand Key Concepts

4. **Describe** the relationship among atoms, elements, and compounds.

5. **Explain** how some mixtures are different from solutions.

6. How does changing the amount of one substance affect a mixture's identity and a compound's identity.

Interpret Graphics

7. **Observe** Does the model below represent a mixture or a substance? How do you know?

8. **Organize Information** Copy and fill in the graphic organizer below with details about substances and mixtures.

Substances	Mixtures

Critical Thinking

9. **Design** a method to separate a mixture of sugar, sand, and bits of iron.

10. **Decide** During a science investigation, a sample of matter breaks down into two kinds of atoms. Was the original sample an element or a compound? Explain.

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Crude Oil

How it WORKS

Separating Out Gasoline

Have you ever wondered where the gasoline used in automo comes from? Gasoline is part of a mixture of fuels called cru How can workers separate gasoline from this mixture?

One way to separate a mixture is by boiling it. Crude oil is separated by a process called fractional distillation. First, the oil boiled and allowed to cool. As the crude oil cools, each part changes from a gas to a liquid at a different temperature. Worke catch each fuel just as it changes back to a liquid. Eventually the crude oil is refined into all its useful parts.

Crude oil often is taken from liquid deposits deep underground. It might also be taken from rocks or deposits mixed with sand. The crude oil is then sent to a furnace.

Crude oil

A furnace heats the oil inside a pipe until it begins to change from a liquid to a gas. The gas mixture then moves into the distillation tower.

Furnace

Gas 20°C
150°C Gasoline
200°C Kerosene
300°C Diesel oil
370°C Fuel oil
400°C
Distillation tower
Lubricating oil, paraffin wax, asphalt

The distillation tower is hot at the bottom and cooler higher up. As the gas mixture rises to fill the tower, it cools. It also passes over trays at different levels. Each fuel in the mixture changes to a liquid when it cools to temperature that matches its boiling point. Gasoline changes to a liquid at the level in the tower at 150°C. A tray then catches the gasoline and moves it away.

It's Your Turn

CREATE A POSTER Blood is a mixture, too. Donated blood often is refined in laboratories to separate it into parts. What are those parts? What are they used for? How are they separated? Find the answers, and create a poster based on your findings.

Substances and Mixtures 211

Use Vocabulary

1. atom
2. Sample answer: Hydrogen is a substance because its composition is always the same.
3. Sample answer: A molecule is a group of atoms that are chemically bonded and act as a unit.

Understand Key Concepts

4. An element is composed of just one kind of atom. A compound is composed of more than one element, each of which is composed of a different type of atom.
5. A heterogeneous mixture is not a solution because the substances that make up a heterogeneous mixture are not evenly mixed, but the substances that make up a solution are evenly mixed.
6. If the amount of one substance was changed in a mixture, the identity of the mixture does not change. If another atom bonded with a compound, the compound's identity would change. For example, if another oxygen atom was added to water (H_2O), hydrogen peroxide (H_2O_2), a new substance with different properties, is created.

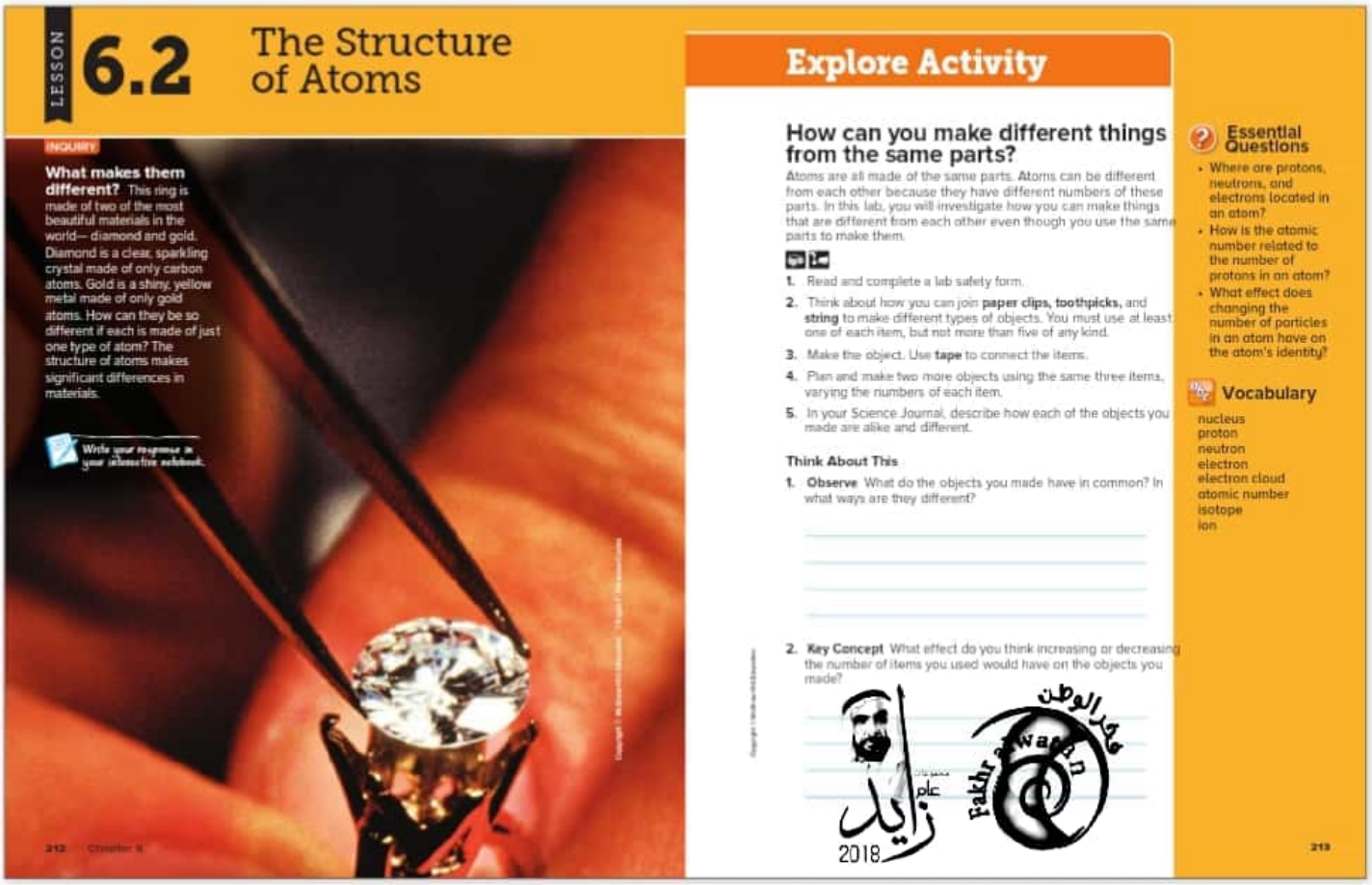
Interpret Graphics

7. The model represents a substance because all of the particles are combined in the same way.
8.

Substances	Mixtures
Made of one or more types of atoms	Made of two or more substances that are not bonded together
Has a fixed composition	Composition can vary
Can be either an element or a compound	Can be mixed evenly or unevenly

Critical Thinking

9. First, use a magnet to remove the iron. Next, stir the remaining sugar and sand into water. The sugar will dissolve, and then filter out the sand. You can boil the water away, leaving the sugar
10. A compound. Elements are made of only one kind of atom.



INQUIRY

About the Photo **What makes them different?** One of the most amazing aspects of nature is that the structure of atoms, which are on a very tiny scale, has an enormous impact on the elements they create. Understanding atoms can help you understand the elements and their properties, how they react with one another, and how they can be used.

Guiding Questions

AL	What two of the elements used to make the ring in this picture?	*carbon and gold; Gold alone is not very strong, therefore, most gold is mixed with silver to provide greater strength for a piece of jewelry.*
OL	Looking at the picture, what are some properties of gold?	*Sample answers include it being shiny, yellow, and can be shaped and molded without breaking.*
BL	Do you think a diamond could be used to make a ring band and gold be used to make a stone? Why or why not?	*Probably not, because diamonds and gold have very different properties. These properties make them suitable only for particular uses.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

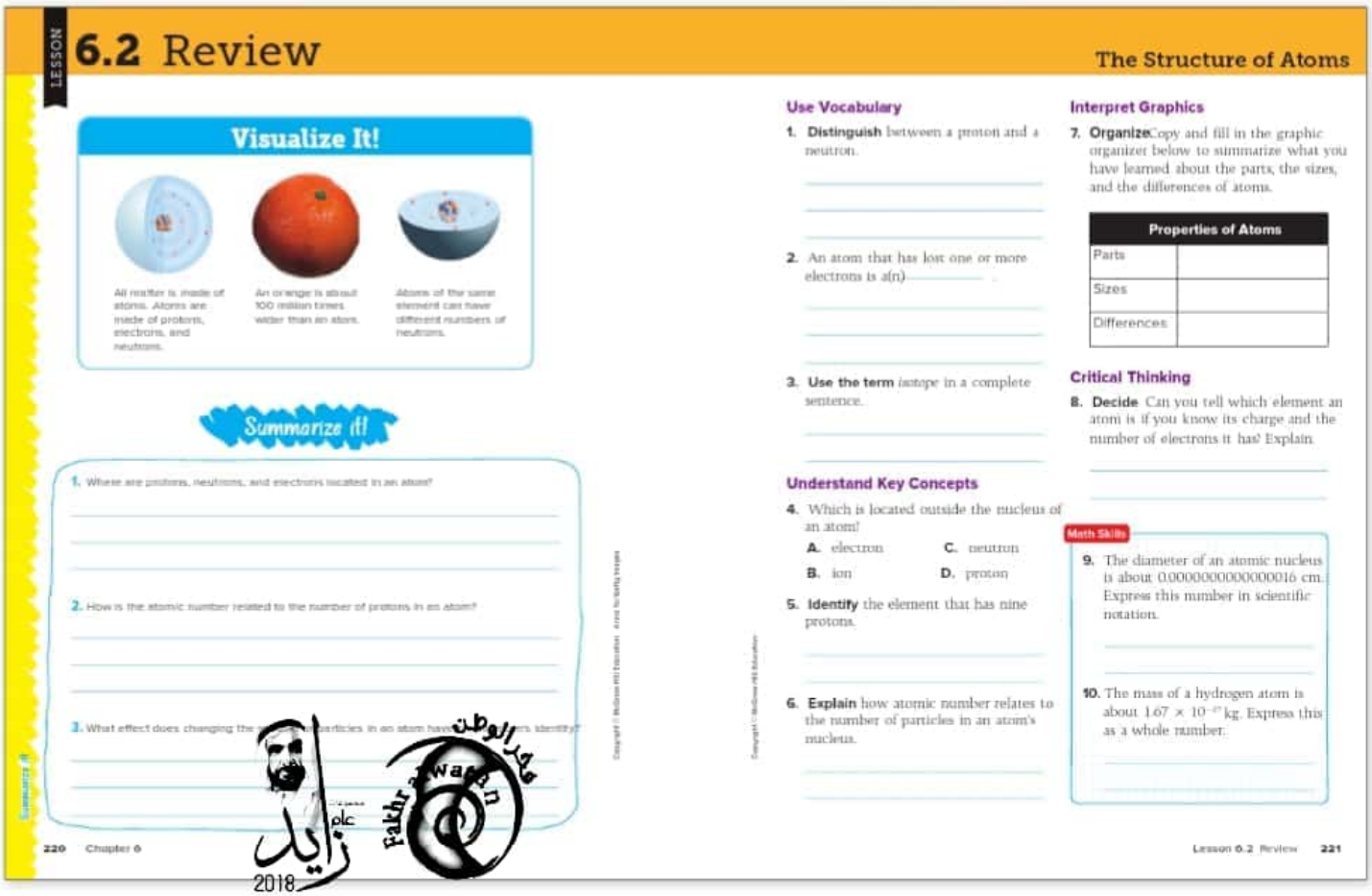
Essential Questions

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

Predicting the Particles in an Atom

1. Write the terms atom and element on the board.
2. **Ask: Think back to the last lesson. What is the definition of *atom*? What is the definition of *element*?** *An atom is a small particle that is the building block of matter. An element is a substance made of only one kind of atom.*
3. Remind students that they learned that atoms contain even smaller particles. Ask them to study the list of vocabulary words on this page. Ask them to predict which words are



LESSON 6.2 Review

The Structure of Atoms

Visualize It!

All matter is made of atoms. Atoms are made of protons, electrons, and neutrons.

An orange is about 100 million times wider than an atom.

Atoms of the same element can have different numbers of neutrons.

Summarize it!

1. Where are protons, neutrons, and electrons located in an atom?

2. How is the atomic number related to the number of protons in an atom?

3. What effect does changing the number of particles in an atom have? Identify?

Use Vocabulary

1. **Distinguish** between a proton and a neutron.

2. An atom that has lost one or more electrons is a(n) _____.

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

Understand Key Concepts

4. Which is located outside the nucleus of an atom?
   A. electron C. neutron
   B. ion D. proton

5. **Identify** the element that has nine protons.

6. **Explain** how atomic number relates to the number of particles in an atom's nucleus.

Interpret Graphics

7. **Organize** Copy and fill in the graphic organizer below to summarize what you have learned about the parts, the sizes, and the differences of atoms.

Properties of Atoms	
Parts	
Sizes	
Differences	

Critical Thinking

8. **Decide** Can you tell which element an atom is if you know its charge and the number of electrons it has? Explain.

Math Skills

9. The diameter of an atomic nucleus is about 0.0000000000000016 cm. Express this number in scientific notation.

10. The mass of a hydrogen atom is about 1.67×10^{-27} kg. Express this as a whole number.

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Lesson 6.2 Review 221

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. A proton has a positive charge. A neutron has no charge.
2. ion
3. Sample answer: Carbon-13 is an isotope of carbon which has 7 neutrons.

Understand Key Concepts

4. A. electron
5. fluorine
6. The atomic number is the number of protons in an atom's nucleus.

Interpret Graphics

7.

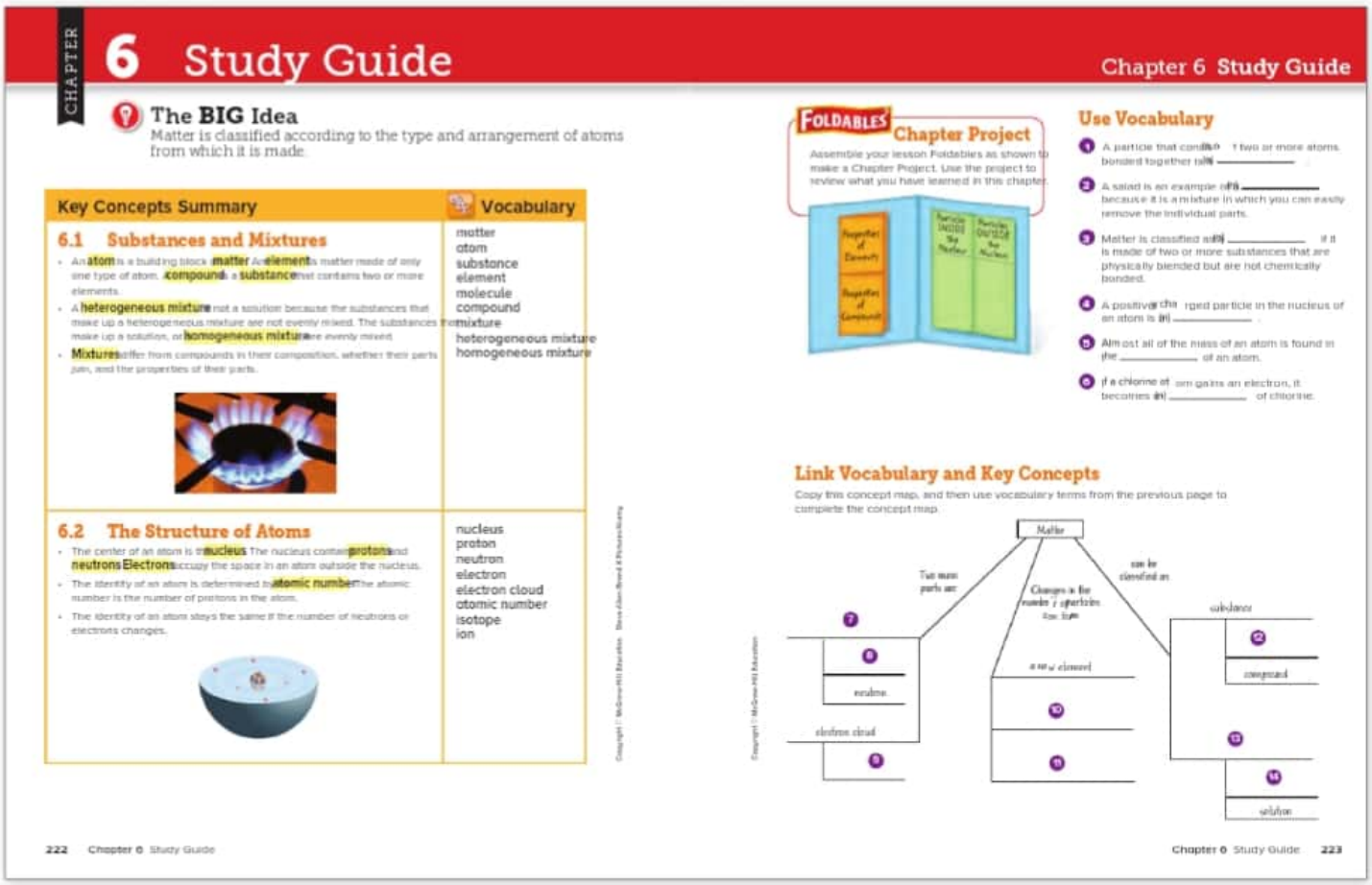
Properties of Atoms	
Parts	Protons and neutrons are in the nucleus, and electrons are in the electron cloud.
Size	A nucleus is about a trillion times smaller than the tip of a pencil.
Difference	An atom which loses or gains a proton is a different element. An atom which loses or gains a neutron is an isotope of the original atom. An atom which loses or gains an electron is an ion.

Critical Thinking

8. Yes. For a positive charge, you add the number of the charge to the number of electrons to get the atomic number. For a negative charge, you subtract the number of the charge from the number of electrons to get the atomic number. The atomic number identifies the element.

Math Skills

9. 1.6×10^{15} cm
10. 0.00000000000000000000000000167 kg



CHAPTER 6 Study Guide

Chapter 6 Study Guide

The BIG Idea

Matter is classified according to the type and arrangement of atoms from which it is made.

Key Concepts Summary

6.1 Substances and Mixtures

- An atom is a building block of matter. An element is matter made of only one type of atom. A compound is a substance that contains two or more elements.
- A heterogeneous mixture is not a solution because the substances that make up a heterogeneous mixture are not evenly mixed. The substances that make up a solution, or homogeneous mixture, are evenly mixed.
- Mixtures differ from compounds in their composition, whether their parts join, and the properties of their parts.

6.2 The Structure of Atoms

- The center of an atom is the nucleus. The nucleus contains protons and neutrons. Electrons occupy the space in an atom outside the nucleus.
- The identity of an atom is determined by its atomic number. The atomic number is the number of protons in the atom.
- The identity of an atom stays the same if the number of neutrons or electrons changes.

Vocabulary

matter
atom
substance
element
molecule
compound
mixture
heterogeneous mixture
homogeneous mixture

nucleus
proton
neutron
electron
electron cloud
atomic number
isotope
ion

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. A particle that consists of two or more atoms bonded together is a(n) _____.
2. A salad is an example of a(n) _____ because it is a mixture in which you can easily remove the individual parts.
3. Matter is classified as a(n) _____ if it is made of two or more substances that are physically blended but are not chemically bonded.
4. A positively charged particle in the nucleus of an atom is a(n) _____.
5. Almost all of the mass of an atom is found in the _____ of an atom.
6. If a chlorine atom gains an electron, it becomes a(n) _____ of chlorine.

Link Vocabulary and Key Concepts

Copy this concept map, and then use vocabulary terms from the previous page to complete the concept map.

Key Concepts Summary

Study Strategy: Check Answers to Key Concept Questions

Teach students to focus on the areas where they lack understanding 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 journal.
3. Instruct students to make note of the questions that 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 back through the chapter to locate any information relevant to the answers they circled. Have them use this information to rewrite their answers.

Example:

An ion is a charged atom that has gained or lost electrons. ✓

An isotope is one of two atoms of an element that have a different number of protons.

Vocabulary

Study Strategy: Create Vocabulary Trading Cards

Have students make trading cards using the vocabulary words from the chapter.

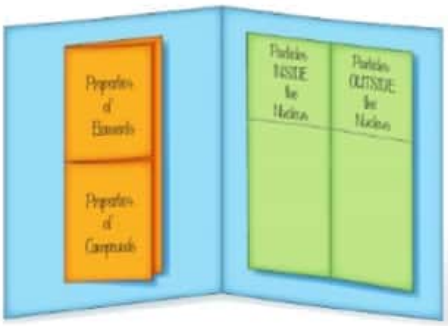
1. Ask students to write the vocabulary words on the front of index cards. Students may also wish to include a diagram or an illustration that represents each term on the front of their cards.
2. Ask them to write the definition for each term in their own words on the back of the cards. Connecting vocabulary words to students' own language promotes understanding more effectively than pure memorization.
3. After students complete their cards, have them share and exchange them with each other.

Example:

Element

something that is pure and is made up of only one kind of atom

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. molecule
2. heterogeneous mixture
3. mixture
4. proton
5. nucleus
6. ion

Link Vocabulary and Key Concepts

7. nucleus
8. proton
9. electron

10–11. ion, isotope (in any order)

12. element
13. mixture
14. heterogeneous mixture

Teacher Notes

CHAPTER 6 Review

Chapter Review

Understand Key Concepts

1. Which is a substance?
   A. fruit salad
   B. granola cereal
   C. spaghetti
   D. table salt
2. Which is the best model for a homogeneous mixture?
   A. 
   B. 
   C. 
   D. 
3. Which is a property of all atoms?
   A. more electrons than protons
   B. a nucleus with a positive charge
   C. a positively charged electron cloud
   D. same number of protons as neutrons
4. Which is another name for a solution?
   A. element
   B. compound
   C. heterogeneous mixture
   D. homogeneous mixture
5. Which would you most likely be able to separate into its parts by filtering?
   A. heterogeneous mixture of two liquids
   B. heterogeneous mixture of two solids
   C. homogeneous mixture of two liquids
   D. homogeneous mixture of two solids
6. Where is almost all the mass of an atom located?
   A. in the electrons
   B. in the neutrons
   C. in the nucleus
   D. in the protons
7. Which best describes an electron cloud?
   A. an area of charged particles with a fixed boundary
   B. electrons on a fixed path around the nucleus
   C. mostly empty space with tiny charged particles in it
   D. a solid mass of charge around the nucleus
8. Which is true about carbon-12 compared with carbon-13?
   A. Carbon-12 has more neutrons.
   B. Carbon-12 has more protons.
   C. Carbon-13 has more neutrons.
   D. Carbon-13 has more protons.
9. Look at the periodic table block below for potassium. How many electrons does an uncharged atom of potassium have?

   A. 19
   B. 20
   C. 39
   D. 40

Critical Thinking

10. **Classify** Look at the illustration below. Is this a model of a substance or a mixture? How do you know?

11. **Deduce** Each atom of protium has one proton, no neutrons, and one electron. Each atom of deuterium has one proton, two neutrons, and one electron. Are these the same or different elements? Why?
12. **Decide** Suppose you mix several liquids in a jar. After a few minutes, the liquids form layers. Is this a homogeneous mixture or a heterogeneous mixture? Why?
13. **Describe** a method for separating a mixture of salt water.
14. **Generalize** Consider the substances N_2O_5, H_2, CH_4, H_2O, KCl, and O_2. Is it possible to tell just from the symbols and the numbers which are elements and which are compounds? Explain.
15. **Suggest** how you can define an electron cloud differently from the chapter.
16. **Analyze** A substance has an atomic number of 80. How many protons and electrons do atoms of the substance have? What is the substance?

Writing in Science

17. **Write** a paragraph in which you explain the modern atomic model to an adult who has never heard of it before. Include two questions he or she might ask, and write answers to the questions.

The BIG Idea

18. Explain how compounds, elements, heterogeneous mixtures, homogeneous mixtures, matter, and substances are related.

Math Skills

Use Scientific Notation

19. The mass of one carbon atom is 0.00000000000000000000001994 g. Express this number in scientific notation.
20. The mass of an electron is about 9.11×10^{-28} kg. Write this as a whole number.
21. In 1 L of hydrogen gas, there are about 54,000,000,000,000,000,000,000 hydrogen atoms. Express the number of atoms using scientific notation.
22. Particles in chemistry are often described by the unit mole. One mole is defined as about 6.022×10^{23} particles. Write this as a whole number.
23. The mass of hydrogen-3, tritium, is about 5.01×10^{-27} kg. Write this as a whole number.

Understand Key Concepts

1 D. table salt
2 A.
3 B. a nucleus with a positive charge
4 D. homogeneous mixture
5 B. heterogeneous mixture of two liquids
6 C. in the nucleus
7 C. mostly empty space with tiny charged particles in it
8 C. Carbon-13 has more neutrons.
9 A. 19

Critical Thinking

10 The drawing is a model of a substance, specifically, a compound. You can tell because the combination of atoms is always the same.

11 They are the same element (hydrogen) because they have the same number of protons. Protium and deutrerium are isotopes of hydrogen—the number of neutrons they have varies.

12 It is a heterogeneous mixture because it contains substances that are not evenly mixed.

13 You could heat the water until it boils. The water would evaporate, leaving behind the salt.

14 Yes; an element has just one type of atom, although the molecule may contain more than one atom of that element. A compound has more than one type of atom. H_2 and O_2 are the only elements listed because they have only one type of atom.

15 Sample answer: An electron cloud is the area of negative charge around a nucleus.

16 Atoms of the substance have 80 protons and 80 electrons. The substance is mercury.

Writing in Science

17 Paragraphs should describe a positively charged nucleus surrounded by an electron cloud. Protons and neutrons are in the nucleus, and electrons are in the electron cloud. Sample questions and answers: Where are the electrons located? *The electrons are located in the empty space around the nucleus. The space is usually described as a cloud since we cannot be sure exactly where each electron is at a given moment.* Which particles have a positive charge and which particles have a negative charge? *Protons have a positive charge, electrons have a negative charge, and neutrons are neutral.*

The BIG Idea

18 Matter is classified as either a substance or a mixture. Two types of substances are elements and compounds. Two types of mixtures are heterogeneous mixtures and homogeneous mixtures.

19 The classification of matter depends on the number and arrangement of atoms. Substances are elements, which are made of one type of atom, or compounds, which are made of two or more atoms that have bonded together. On the other hand, mixtures are made of two or more substances that have not chemically bonded. The composition of a mixture may vary.

Math Skill

Use Scientific Notation

20 1.994×10^{-23} g

21 0.00000000000000000000000000000911 kg

22 5.4×10^{22} atoms

23 602,200,000,000,000,000,000,000 particles

24 0.00000000000000000000000000501 kg

Teacher Notes

Standardized Test Practice

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

Multiple Choice

Use the figure below to answer questions 1 and 2.

1 How many atoms are in the particle?
- A 1
- B 2
- C 3
- D 5

2 Which kind of matter might contain only this type of particle?
- A a compound
- B an element
- C a heterogeneous mixture
- D a homogeneous mixture

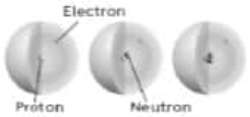
3 Which class of matter is the least evenly mixed?
- A compounds
- B heterogeneous mixtures
- C homogeneous mixtures
- D solutions

4 Which correctly describes a compound but not a mixture?
- A All the atoms are of the same element.
- B All the molecules have at least two atoms.
- C The combination of substances never changes.
- D The substances can be separated without breaking bonds.

5 A girl pours a spoonful of sugar into a glass of warm water. She stirs the water until the sugar disappears. When she tastes the water, she notices that it is now sweet. Which describes the kind of matter in the glass?
- A a compound
- B an element
- C a solution
- D a substance

6 How could you separate a mixture of stone and wooden beads that are all the same size?
- A Add water to the mixture and skim off the wooden beads, which float.
- B Heat the mixture until the stone beads melt.
- C Strain the mixture to separate out the stone beads.
- D Use a magnet to pull out the wooden beads.

Use the figure below to answer question 7.



7 The figure shows models of three different atoms. What can you conclude about the three models shown in the figure?
- A They all show positive ions.
- B They all show negative ions.
- C They all show the same element.
- D They all show the same isotope.

8 What is the atomic number of an atom that has 2 electrons, 3 protons, and 4 neutrons?
- A 2
- B 3
- C 4
- D 7

Use the table below to answer questions 9 and 10.

	Number of Protons	Number of Neutrons	Number of Electrons	
A	8	8		8
B	8	8	10	
C	8	9		8
D	9	10		9

9 The table shows the numbers of protons, neutrons, and electrons for four atoms. Which atom has a negative charge?
- A A
- B B
- C C
- D D

10 Which of the atoms is a different element than the others?
- A A
- B B
- C C
- D D

Constructed Response

11 How do protons, electrons, and neutrons differ in charge and location in the atom?

Use the figures below to answer questions 12 and 13.

A

B

C

D

12 Classify each model A–D as either an element, a compound, or a mixture. Explain your reasoning for each answer.

13 Imagine that samples A and D were reacted and formed a compound. Then imagine that the same samples were combined to form a mixture. How would the two combinations differ?

14 Suppose a neutral atom has 5 protons, 5 neutrons, and 5 electrons. List the number of protons, electrons, and neutrons for the following.
- a. a positive ion of the same element
- b. a negative ion of the same element
- c. a neutral isotope of the same element

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	1	1	1	2	2	2	2	1	1	2	2

Multiple Choice

1 D—Correct. A is the number of molecules, B is the number of different elements, C is the number of atoms of one type of element in the molecule.

2 A—Correct. B and C would have to show more than one type of particle, D would have to have atoms of all the same type.

3 B—Correct. A has molecules of all the same type and is therefore evenly mixed. C and D describe the same type of evenly mixed mixture.

4 C—Correct. A describes an element, B could describe both compounds and mixtures, and D describes only mixtures.

5 C—Correct. A would not involve parts of the mixture having the same property or sweetness before and after combining, B would involve only one kind of matter, and D describes elements and compounds but not mixtures.

6 A—Correct. B would not work because the wooden beads would be destroyed by temperatures high enough to melt stone. C would work only on beads of different sizes. D would not work because stone and wood are not magnetic materials.

7 C—Correct. A and B are incorrect because none of the models are ions, they all have just one proton and one electron, which means the atom does not have a charge. D is incorrect because the models show different isotopes of the same element, not the same isotope.

8 B—Correct. A can be used to determine charge, C can be used to determine isotope number, and D is the mass number.

9 B—Correct. A, C, and D have the same numbers of protons and electrons and are thus neutral.

10 D—Correct. A, B, and C have the same number of protons and different numbers of neutrons, which makes them isotopes of one another.

Constructed Response

11 Protons have positive charges and are located in the nucleus. Electrons have negative charges and are located in a cloud around the nucleus. Neutrons have no charge and are located in the nucleus.

12 Samples A and D are elements because their particles are made up of one kind of atom. Sample B is a compound because its particles are all the same but they are made up of more than one kind of atom. Sample C is a mixture because its particles are different.

13 Sample answer: The model for the compound would show that all the particles are the same. Each molecule would have at least one of each type of atom. The model for the mixture would show the original particles randomly mixed. No new combinations of atoms (bonds) would be shown.

14 A positive ion would have 5 protons, 5 neutrons, and 4 electrons. A negative ion would have 5 protons, 5 neutrons, and 6 electrons. A neutral isotope could have 5 protons, 5 electrons and X neutrons, where $X > 5$.

Answer Key

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

CHAPTER 7

Matter: Properties and Changes

The BIG Idea
What gives a substance its unique identity?

LESSON 7.1

7.1 Matter and Its Properties

- How do particles move in solids, liquids, and gases?
- How are physical properties different from chemical properties?
- How are properties used to identify a substance?

LESSON 7.2

7.2 Matter and Its Changes

- How are physical changes different from chemical changes?
- How do physical and chemical changes affect mass?

PAGE KEELEY SCIENCE PROBES

Ball of Clay

Hana placed a ball of clay on a table. She flattened it into the shape of a pancake. Which row in the chart best describes the properties of the clay after it was flattened?

	Weight	Mass
A	Stays the same	Increases
B	Stays the same	Decreases
C	Stays the same	Stays the same
D	Increases	Increases
E	Increases	Decreases
F	Increases	Stays the same
G	Decreases	Increases
H	Decreases	Decreases
I	Decreases	Stays the same

Explain your thinking about what happens to the mass and weight and why.

Matter: Properties and Changes

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	How would you describe a tree to someone who hasn't seen one before?	*Sample answer: A plant that has a trunk, roots, branches, and leaves. Discuss classifying trees by traits, such as whether they produce leaves and flowers or needles and cones.*
OL	Ask student to describe a tree that they can see from their classroom, or show a picture of a tree. How would this description differ from a description of what a tree is?	*Use students' responses to show how physical properties can define both a specific, unique item and a group of items with similar traits. Compare deciduous trees (that lose leaves each fall season) with evergreen trees (that keep their leaves more than one year) to show how items have certain common traits but also have unique traits.*
BL	How could you describe a tree without referring to physical characteristics?	*To answer this question, students must determine what qualifies as a physical characteristic. Guide students to consider properties such as flammability and the chemical process of photo-synthesis that occurs in tree leaves.*

PAGE KEELEY SCIENCE PROBES

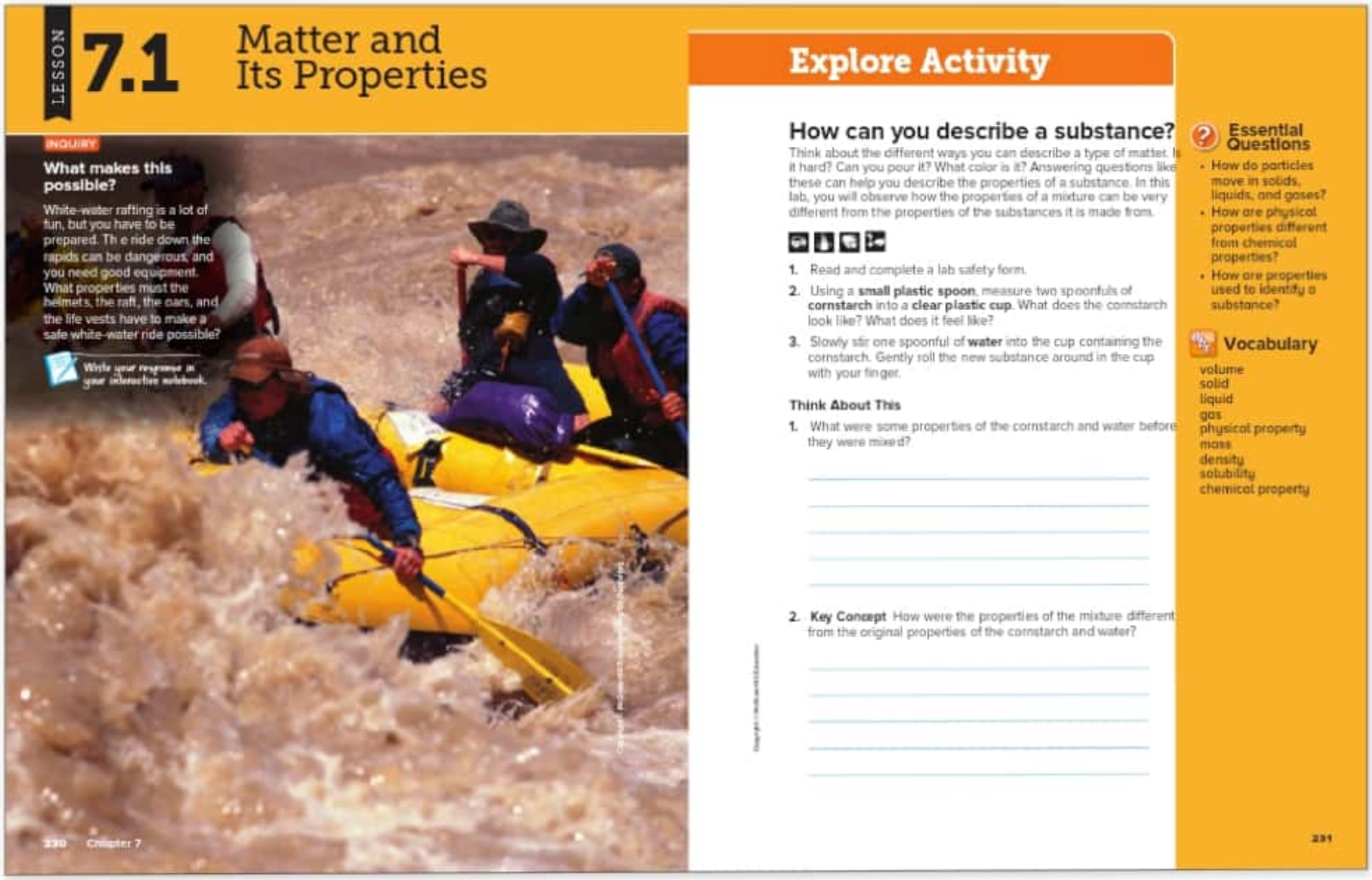
Ball of Clay

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 Match answers to questions. During the discussion, encourage students to record their own questions on separate index cards. As you teach, have students record information from the chapter that helps them answer their questions. Write each answer on a separate index card. After completing the chapter, have students play a game to match each question to its answer.

Guiding Questions

AL	What properties would be important to consider when constructing the outer shell of an airplane?	*The material for the outer shell should be strong, lightweight, moldable, and not chemically reactive to substances in air and in water.*
OL	Why is metal used for electrical wiring and plastic used for interior walls of an airplane?	*Metal is used for electrical wiring because it is ductile (capable of being drawn into a wire) and conductive (capable of carrying an electric current). Plastic is used on the interior because it is lightweight, moldable, attractive, and easily cleaned.*



LESSON 7.1

Matter and Its Properties

INQUIRY

What makes this possible?

White-water rafting is a lot of fun, but you have to be prepared. The ride down the rapids can be dangerous, and you need good equipment. What properties must the helmets, the raft, the oars, and the life vests have to make a safe white-water ride possible?

Write your response in your interactive notebook.

230 Chapter 7

Explore Activity

How can you describe a substance?

Think about the different ways you can describe a type of matter. Is it hard? Can you pour it? What color is it? Answering questions like these can help you describe the properties of a substance. In this lab, you will observe how the properties of a mixture can be very different from the properties of the substances it is made from.

1. Read and complete a lab safety form.
2. Using a **small plastic spoon**, measure two spoonfuls of **cornstarch** into a **clear plastic cup**. What does the cornstarch look like? What does it feel like?
3. Slowly stir one spoonful of **water** into the cup containing the cornstarch. Gently roll the new substance around in the cup with your finger.

Think About This

1. What were some properties of the cornstarch and water before they were mixed?

2. **Key Concept** How were the properties of the mixture different from the original properties of the cornstarch and water?

Essential Questions

- How do particles move in solids, liquids, and gases?
- How are physical properties different from chemical properties?
- How are properties used to identify a substance?

Vocabulary

volume
solid
liquid
gas
physical property
mass
density
solubility
chemical property

231

INQUIRY

About the Photo **What makes this possible?** You can use this photo to gauge students' understanding of matter and its properties. The various types of matter shown, including the water, rocks, trees, rubber raft, and plastic paddles, all have different physical and chemical properties. Use the questions below to elicit descriptions of some of these properties.

Guiding Questions

AL	Describe how the water looks in this photo. How might the water look during the winter?	*Possible answers: Water is a liquid. This water is moving very quickly. It might not freeze in the winter because it is moving so fast, or it might not get cold enough to freeze.*
OL	What do you see here that might make the rafting trip dangerous? How do you think the equipment can make the trip safer?	*Possible answers: The water has a strong current. The raft is made of material that floats on water and moves with the current. The life vests keep the rafter afloat if the boat overturns. Helmets protect the rafter's head in case of a crash.*
BL	Think of a sport that you like to watch or play. What materials are used to make the equipment for this sport?	*Possible answer: Racing bikes are made of durable but lightweight carbon fibers. Bike helmets are made of strong, lightweight plastics that protect the head in case of a crash.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

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

Defining Physical and Chemical Properties

1. Write the names of several types of food on the board. Be sure to include items from each of the main food groups. For example, you might write: *milk, potatoes, apples, kiwi, spaghetti, bread, beef, eggs, cheese, carrots,* and *cookies.*
2. Have students work with partners to determine at least two different ways to group the items. Have volunteers share their groupings with the whole class, or write them on the board. Discuss how the groupings were determined. At this point students will not realize it, but they will naturally be classifying items by physical and chemical properties.

3. After completing the lesson, return to some of the lists students created. Guide them to see that the items were grouped by their properties. Distinguish between physical properties, such as color, size, presence or absence of seeds, and so on, and chemical properties, such as the ability to spoil or turn sour.

Teacher Notes

ExploreActivity

How can you describe a substance?

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

Purpose
To demonstrate how the physical properties of a mixture can differ from those of the substances from which it is made.

Materials
Students: small plastic spoon, cornstarch, clear plastic cup

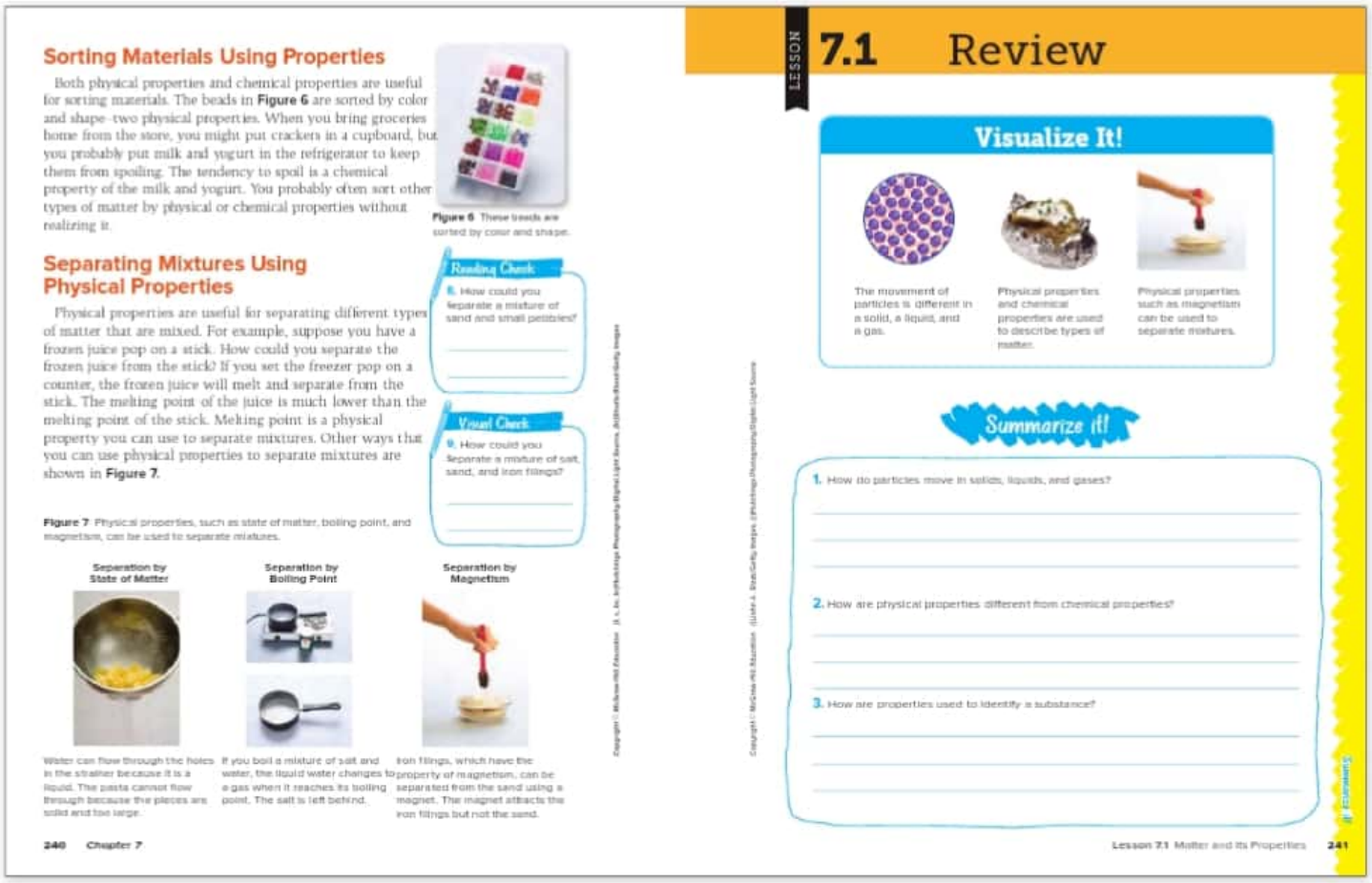
Before You Begin
You may want to line work areas with newspaper or paper towels.

Guide the Investigation

- Have students brainstorm a list of items they are familiar with that are made by mixing two or more substances together. Listed items might include ingredients for a recipe, paints, and powdered drink mixes. Discuss how the properties of the resulting mixture differ from its components.
- Warn students about adding the water too quickly. They should slowly add in the water while they continually stir. Some students may have difficulty getting the right consistency. Tell them that having less water in the mixture is better than too much.
- After students have made the mixture, ask them how the form of the mixture is different from the individual substances. Explain that the mixture is a paste that can be easily formed into various shapes.

Think About This

1. The cornstarch was a light, fluffy white powder. The water was a clear liquid.
2. The mixture is neither a powder nor a liquid. It is a paste that holds its shape when rolled into a ball.



Sorting Materials Using Properties

Both physical properties and chemical properties are useful for sorting materials. The beads in **Figure 6** are sorted by color and shape—two physical properties. When you bring groceries home from the store, you might put crackers in a cupboard, but you probably put milk and yogurt in the refrigerator to keep them from spoiling. The tendency to spoil is a chemical property of the milk and yogurt. You probably often sort other types of matter by physical or chemical properties without realizing it.

Figure 6 These beads are sorted by color and shape.

Separating Mixtures Using Physical Properties

Physical properties are useful for separating different types of matter that are mixed. For example, suppose you have a frozen juice pop on a stick. How could you separate the frozen juice from the stick? If you set the freezer pop on a counter, the frozen juice will melt and separate from the stick. The melting point of the juice is much lower than the melting point of the stick. Melting point is a physical property you can use to separate mixtures. Other ways that you can use physical properties to separate mixtures are shown in **Figure 7**.

Reading Check

8. How could you separate a mixture of sand and small pebbles?

Visual Check

9. How could you separate a mixture of salt, sand, and iron filings?

Figure 7 Physical properties, such as state of matter, boiling point, and magnetism, can be used to separate mixtures.

Separation by State of Matter

Water can flow through the holes in the strainer because it is a liquid. The pasta cannot flow through because the pieces are solid and too large.

Separation by Boiling Point

If you boil a mixture of salt and water, the liquid water changes to a gas when it reaches its boiling point. The salt is left behind.

Separation by Magnetism

Iron filings, which have the property of magnetism, can be separated from the sand using a magnet. The magnet attracts the iron filings but not the sand.

LESSON 7.1 Review

Visualize It!

The movement of particles is different in a solid, a liquid, and a gas.

Physical properties and chemical properties are used to describe types of matter.

Physical properties such as magnetism can be used to separate mixtures.

Summarize it!

1. How do particles move in solids, liquids, and gases?

2. How are physical properties different from chemical properties?

3. How are properties used to identify a substance?

Sorting Materials Using Properties

Have students look at **Figure 6** as they read the paragraph. They may not be aware of how often they unconsciously classify objects by properties or traits. Use the questions below to help raise their awareness.

Guiding Questions

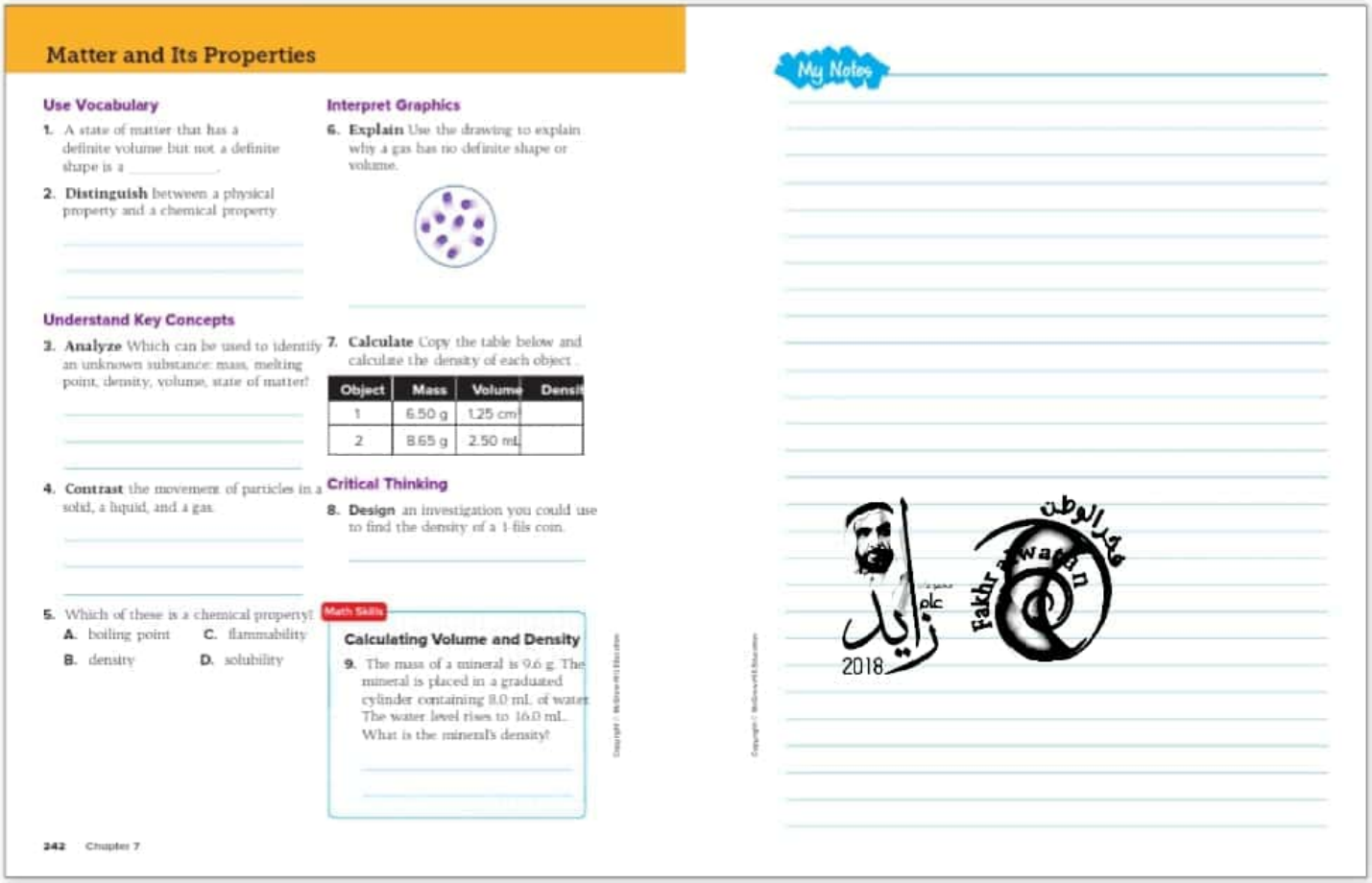
AL	What are three different properties you could use to sort the objects in this classroom?	*Possible answers: color, shape, density, magnetism, malleability, and so on*
OL	Why do you think we sort items by properties? What are the advantages to doing this?	*Possible answers: Sorting items by property helps you organize them. Sorting items by properties helps us learn about items and groups of similar items.*
BL	When deciding how to sort materials for storage, which might be more important—physical properties or chemical properties? Explain and give examples.	*Chemical properties might be more important because if the substances are stored with substances with which they react, they could change into something else or create unsafe situations. For example, some chemicals and medicines react to light. These items need to be stored in containers that do not allow light to penetrate and cause a reaction.*

Separating Mixtures Using Physical Properties

Students may believe that solids that have dissolved into liquids have become inseparable. Emphasize that the individual particles of the solids do not actually combine with those of the liquids. Rather, they blend together evenly. Have them read the paragraph, and then ask the following questions.

Guiding Questions

AL	What kinds of mixtures can be separated by magnetism? Give an example of a mixture that could be separated by magnetism.	*A mixture can be separated by magnetism if only one of the two substances in the mixture has the physical property of magnetism. For example, if you dropped metal screws containing iron into soil, you could remove the screws with a magnet.*
OL	How could you separate a mixture of sand and small pebbles?	*You could pour the sand through a strainer, leaving behind the pebbles.*
BL	Would it be possible to separate a mixture of two liquids? Explain.	*It would be possible if the liquids had different freezing or boiling points.*



Matter and Its Properties

Use Vocabulary

1. A state of matter that has a definite volume but not a definite shape is a _____.
2. **Distinguish** between a physical property and a chemical property.

Understand Key Concepts

3. **Analyze** Which can be used to identify an unknown substance: mass, melting point, density, volume, state of matter?
4. **Contrast** the movement of particles in a solid, a liquid, and a gas.
5. Which of these is a chemical property?
   A. boiling point C. flammability
   B. density D. solubility

Interpret Graphics

6. **Explain** Use the drawing to explain why a gas has no definite shape or volume.

7. **Calculate** Copy the table below and calculate the density of each object.

Object	Mass	Volume	Densit
1	6.50 g	1.25 cm³	
2	8.65 g	2.50 mL	

Critical Thinking

8. **Design** an investigation you could use to find the density of a 1-fils coin.

Math Skills

Calculating Volume and Density

9. The mass of a mineral is 9.6 g. The mineral is placed in a graduated cylinder containing 8.0 mL of water. The water level rises to 16.0 mL. What is the mineral's density?

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My Notes

Use Vocabulary

1. liquid
2. Both are characteristics of matter. You can observe physical properties without changing a substance to a new type of substance. A chemical property is the ability or inability of a substance to combine with or change into one or more new substances. Chemical properties can be only observed when a substance reacts with or changes to a different substance.

Understand Key Concepts

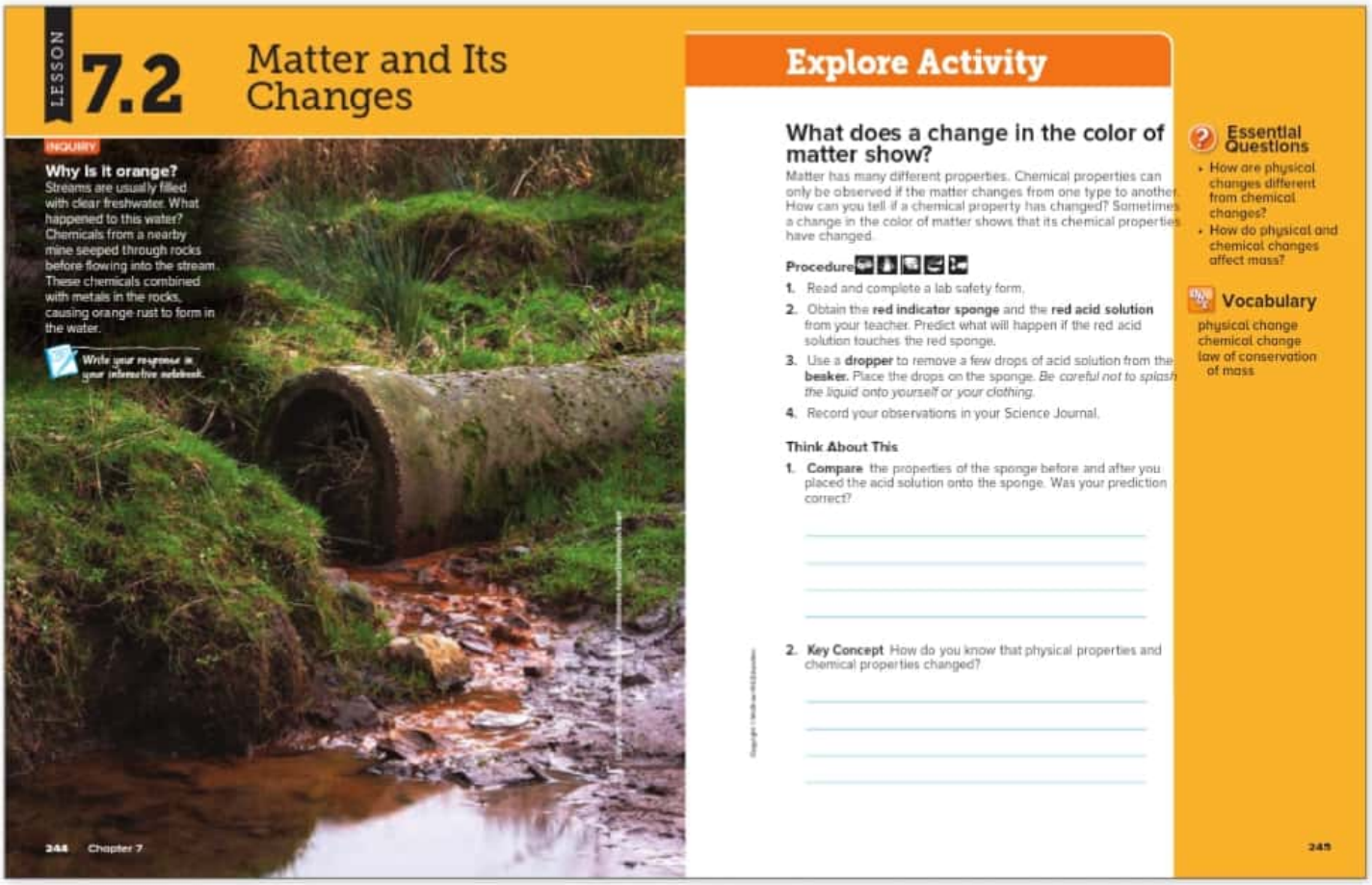
3. melting point, density
4. In solids, particles are close together and vibrate in all directions. In liquids, particles can slide past one another. In gases, particles move freely.
5. **C.** flammability Interpret Graphics
6. The particles of a gas are so far apart that they have almost no attractive forces between them. Because the particles can move freely, they have no fixed shape.They have no fixed volume because they can move to fill their container.
7. Object 1: 5.20 g/cm^3; Object 2: 3.46 g/cm^3

Critical Thinking

8. Possible answer: Measure the mass of the 1-fils coin a balance. Measure the volume of the 1-fils coin using the displacement method. Calculate the density as the mass divided by the volume of the 1-fils coin.

Math Skills

9. Volume of the sample is 16.0 mL - 8.0 mL = 8.0 mL. 9.6 g divided by 8.0 mL = 1.2 g/mL.



INQUIRY

About the Photo **Why is it orange?** Changes in color, like the one depicted here, are not uncommon. Chemicals can either react with the water or something in the water and cause a chemical change, or they can simply color the water, creating a physical change. Discuss with students common items, such as cars and bicycles, and how their metal parts can rust over time when exposed to snow, salt, and rain.

Guiding Questions

AL	What chemical property caused the stream to turn this color? What substance in the picture has this chemical property?	*The ability to rust; rocks in the water contain metals that have the ability to rust.*
OL	What caused the unusual color in this stream?	*Chemicals from a mine washed into the river and reacted with metal in the rocks. This caused rust to form in the river.*
BL	Do you think the water has changed physically or chemically? Can you justify this just by looking at the photo alone, or do you need other information?	*Possible answer: Metals in the rocks reacted chemically with chemicals from the mine. The reactions were chemical changes. The rust dissolved in the water, which is a physical change.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

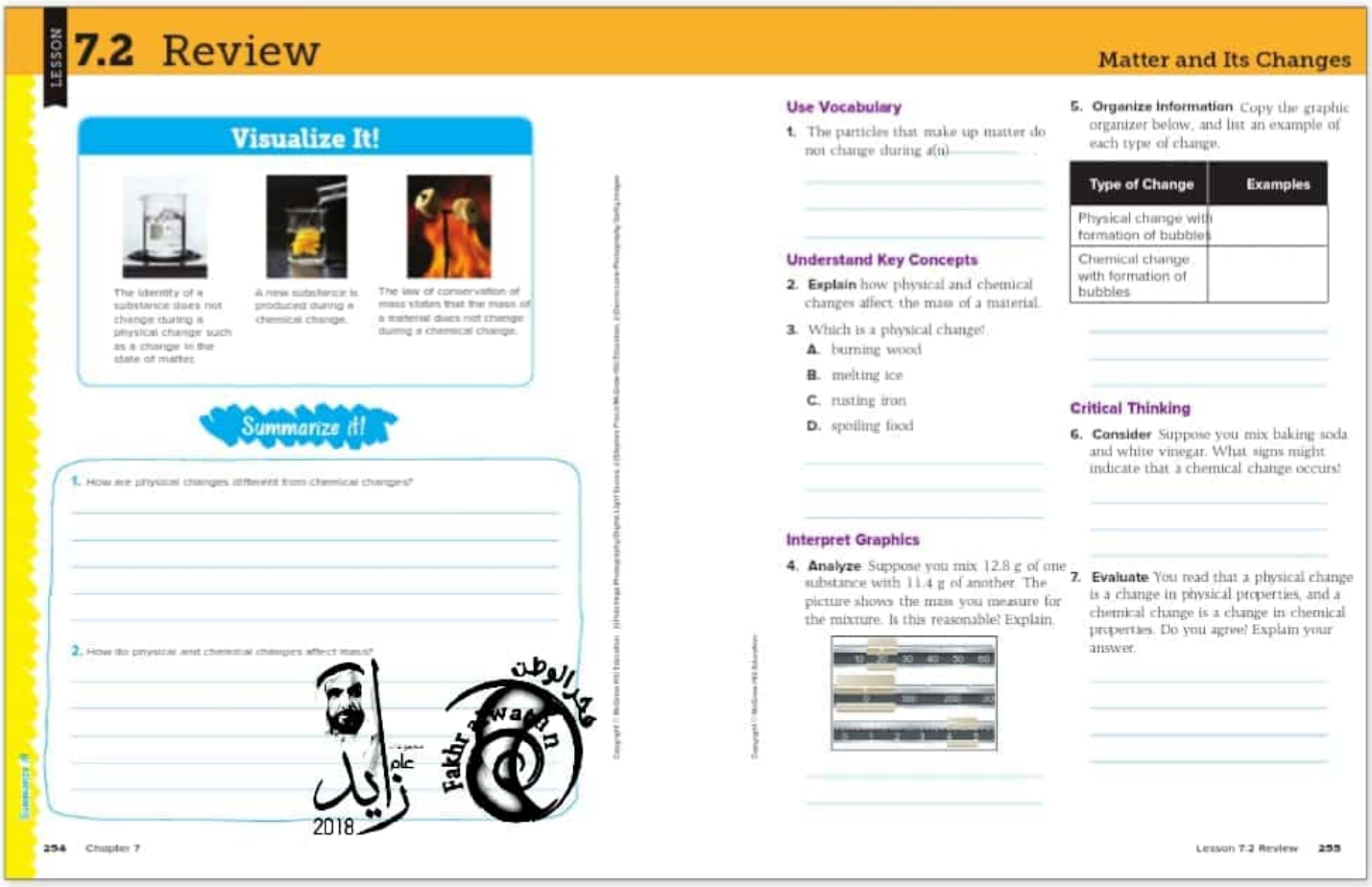
Essential Questions

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 the content.

Vocabulary

Building on Prior Knowledge

1. Write the terms *physical change* and *chemical change* on the board.
2. **Ask: Think back to the last lesson. Can you list examples of physical properties and chemical properties?** *Possible answers: color, shape, mass, and density are physical properties. Flammability and ability to rust are chemical properties.*
3. Record students' answers on the board. Remind students of any properties they do not mention.



LESSON 7.2 Review

Matter and Its Changes

Visualize It!

The identity of a substance does not change during a physical change such as a change in the state of matter.

A new substance is produced during a chemical change.

The law of conservation of mass states that the mass of a material does not change during a chemical change.

Summarize it!

1. How are physical changes different from chemical changes?

2. How do physical and chemical changes affect mass?

Use Vocabulary

1. The particles that make up matter do not change during a(n) _____.

Understand Key Concepts

2. **Explain** how physical and chemical changes affect the mass of a material.

3. Which is a physical change?
   - **A.** burning wood
   - **B.** melting ice
   - **C.** rusting iron
   - **D.** spoiling food

Interpret Graphics

4. **Analyze** Suppose you mix 12.8 g of one substance with 11.4 g of another. The picture shows the mass you measure for the mixture. Is this reasonable? Explain.

5. **Organize Information** Copy the graphic organizer below, and list an example of each type of change.

Type of Change	Examples
Physical change with formation of bubbles	
Chemical change with formation of bubbles	

Critical Thinking

6. **Consider** Suppose you mix baking soda and white vinegar. What signs might indicate that a chemical change occurs?

7. **Evaluate** You read that a physical change is a change in physical properties, and a chemical change is a change in chemical properties. Do you agree? Explain your answer.

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Lesson 7.2 Review 255

Visual Summary

Concepts and terms are easier to remember when they are associated with an image. **Ask: Exactly what types of changes are illustrated in each image? How are these changes similar or different?**

Use Vocabulary

1. physical change

Understand Key Concepts

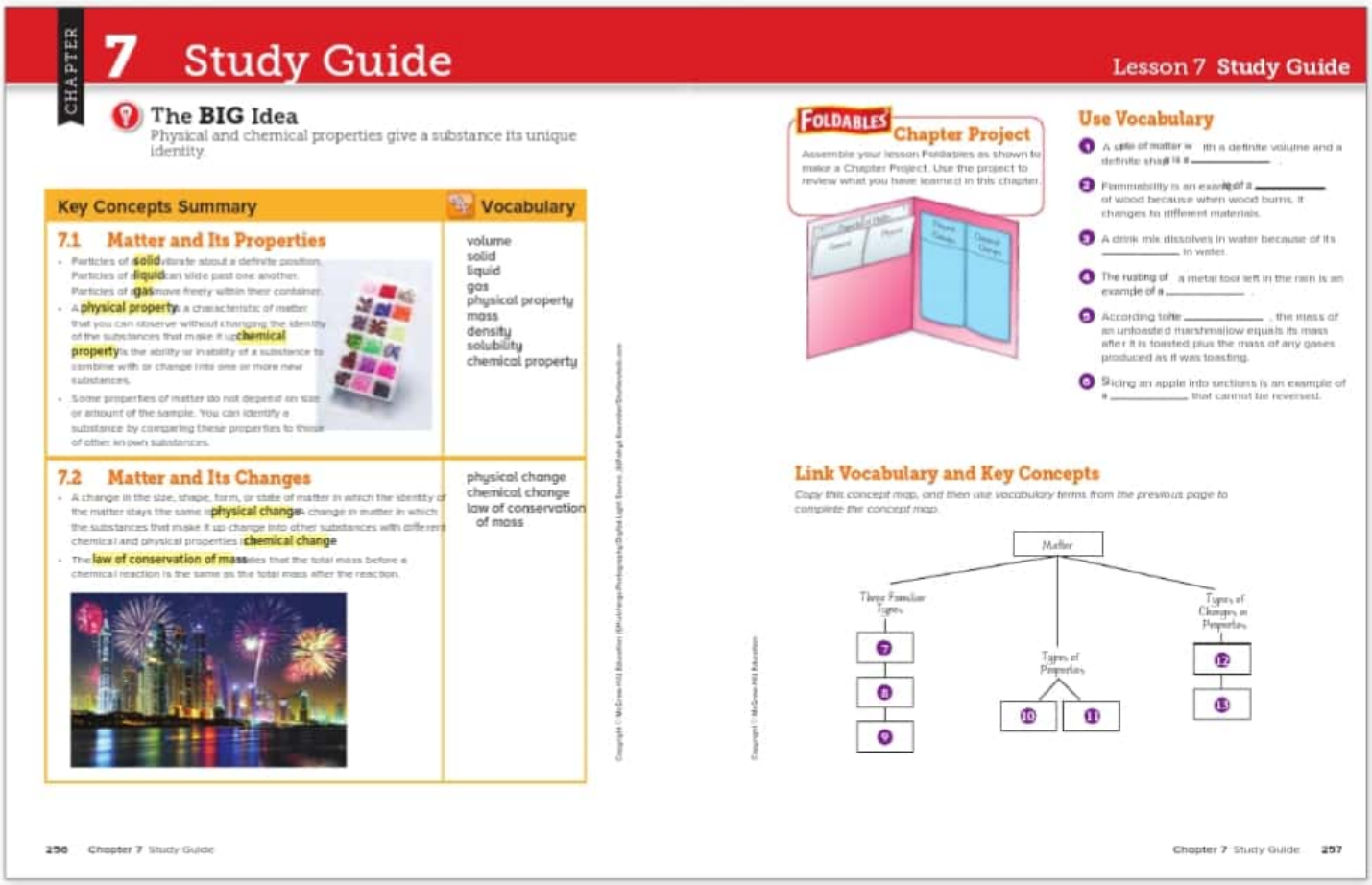
2. Mass does not change during physical or chemical changes.
3. B.melting ice

Interpret Graphics

4. Yes, it is reasonable. The total mass should be 24.2 g, but the mass shown here is 24.5 g. These numbers are close, and the difference between them could be the result of a slight measurement error.
5. Possible answers: An example of physical change with the formation of bubbles is water boiling. Two examples of a chemical change with the formation of bubbles are combining a medicine tablet with water and combining baking soda and vinegar.

Critical Thinking

6. Possible answers: the formation of bubbles, the formation of a new substance
7. Possible answers: No, physical properties do change during a physical change, but both physical and chemical properties can change in a chemical change.



CHAPTER 7 Study Guide

Lesson 7 Study Guide

The BIG Idea

Physical and chemical properties give a substance its unique identity.

Key Concepts Summary

Vocabulary

7.1 Matter and Its Properties

- Particles of solid vibrate about a definite position. Particles of liquid can slide past one another. Particles of gas move freely within their container.
- A physical property is a characteristic of matter that you can observe without changing the identity of the substances that make it up. A chemical property is the ability or inability of a substance to combine with or change into one or more new substances.
- Some properties of matter do not depend on size or amount of the sample. You can identify a substance by comparing these properties to those of other known substances.

volume
solid
liquid
gas
physical property
mass
density
solubility
chemical property

7.2 Matter and Its Changes

- A change in the size, shape, form, or state of matter in which the identity of the matter stays the same is a physical change. A change in matter in which the substances that make it up change into other substances with different chemical and physical properties is a chemical change.
- The law of conservation of mass states that the total mass before a chemical reaction is the same as the total mass after the reaction.

physical change
chemical change
law of conservation of mass

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. A type of matter is ____ if it is a definite volume and a definite shape.
2. Flammability is an example of a ____ of wood because when wood burns, it changes to different materials.
3. A drink mix dissolves in water because of its ____ in water.
4. The rusting of ____ a metal tool left in the rain is an example of a ____.
5. According to the ____, the mass of an unroasted marshmallow equals its mass after it is toasted plus the mass of any gases produced as it was toasting.
6. Slicing an apple into sections is an example of a ____ that cannot be reversed.

Link Vocabulary and Key Concepts

Copy this concept map, and then use vocabulary terms from the previous page to complete the concept map.

Key Concepts Summary

Study Strategy: Review Key Concept Questions

Teach students to review using the key icons and images in the chapter. This exercise will help them learn by linking ideas to images.

1. Ask students to make a three-column table.
2. Have students flip through the chapter for the key concept checks, then have them copy these questions in the left column.
3. Ask students to fill the middle column with the number of 1 or 2 figures in the chapter that illustrate the concept.
4. In the far right column have students explain why the image is a good illustration of the key concept.

Example:

Key Concept Questions	Related Figure	Why It Is a Good Example
How are chemical changes different from physical changes?	Figure 12	Fire burned leaves, grass, and trunks into smoke and ash.
	Figure 11	Water changed from ice to liquid to steam; changes in state are physical changes.

Vocabulary

Study Strategy: Word Connections

Asking students to make connections between two vocabulary words helps them build their understanding of the words and the interconnection between important chapter concepts.

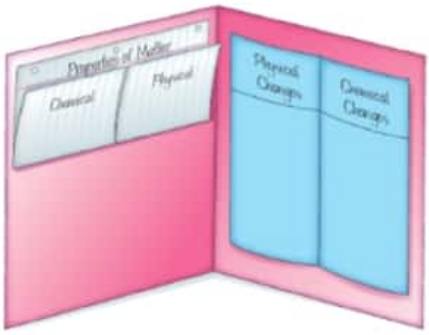
1. Have students work in pairs. Give each pair a piece of chart paper and assign them one vocabulary word to record at the top.
2. Instruct students to write sentences explaining how other vocabulary words from the chapter relate to their word. Students should use as many chapter vocabulary words as possible.
3. When all pairs have finished, compare and discuss students' responses.

Example:

Volume

The volume of solids and liquids doesn't change based on the size of their containers. The volume of gases does change based on their containers. Volume is a physical property, not a chemical property. Like mass, but unlike density, volume cannot be used to identify a substance. Volume can change during both a physical and a chemical change. A change in volume does not violate the law of conservation of mass.

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 solid
2 chemical property
3 solubility
4 chemical change
5 law of conservation of mass
6 physical change

Link Vocabulary and Key Concepts

7 solid
8 liquid
9 gas
10 physical property
11 chemical property
12 physical change
13 chemical change

CHAPTER 7 Review

Chapter Review

Understand Key Concepts

1. Which is a property of all solids?
   A. Particles are far apart.
   B. Particles vibrate in all directions.
   C. Volume and shape can easily change.
   D. Weak forces exist between particles.
2. Which characteristic is a chemical property?
   A. highly flammable
   B. mass of 15 kg
   C. woolly texture
   D. golden color
3. Which property of an object depends on its location?
   A. density
   B. mass
   C. volume
   D. weight
4. How are the particles of a gas different from the particles of a liquid shown here?

   A. They move more slowly.
   B. They are farther apart.
   C. They have less energy.
   D. They have stronger attractions.
5. Which is a physical change?
   A. burning natural gas
   B. chopping onions
   C. digesting food
   D. exploding dynamite
6. Which stays the same when a substance changes from a liquid to a gas?
   A. density
   B. mass
   C. forces between particles
   D. distance between particles
7. Which is a chemical change?
   A. boiling water
   B. copper turning green in air
   C. freezing fruit juice
   D. slicing a potato
8. Which would be most useful for identifying an unknown liquid?
   A. density
   B. mass
   C. volume
   D. weight
9. What mass is measured on this balance?

   A. 35 g
   B. 45 g
   C. 135 g
   D. 145 g
10. What causes a chemical reaction when you prepare scrambled eggs?
    A. removing the eggs from the shells
    B. mixing the egg yolks and the egg whites together
    C. heating the eggs in a pan
    D. sprinkling pepper onto the cooked eggs
11. Which describes the formation of a precipitate?
    A. A gas forms when a solid is placed in a liquid.
    B. A liquid forms when a block of metal is heated.
    C. A solid forms when one liquid is poured into another.
    D. Bubbles form when an acid is poured onto a rock.

Critical Thinking

12. **Apply** Suppose you find a gold-colored ring. Explain why you could use some physical properties but not others to determine whether the ring is actually made of gold.

13. **Reason** You make lemonade by mixing lemon juice, sugar, and water. Is this a physical change or a chemical change? Explain.

14. **Give an example** of a physical change you might observe at your school that is reversible and a physical change that is not reversible.

15. **Defend** A classmate defines a liquid as any substance that can be poured. Use the picture below to explain why this is not an acceptable definition.

16. **Suggest** a way that you could use displacement to determine the volume of a rock that is too large to fit into a graduated cylinder.

17. **Hypothesize** A scientist measures the mass of two liquids before and after combining them. The mass after combining the liquids is less than the sum of the masses before. Where is the missing mass?

Writing in Science

18. **Write** a four-sentence description of an object in your home or classroom. Be sure to identify both physical properties and chemical properties of the object.

The BIG Idea

19. What gives a substance its unique identity?
20. What are some physical and chemical properties that an airplane manufacturer must consider when choosing materials to be used in constructing the shell of an aircraft?

Math Skills

21. Use what you have learned about density to complete the table below. Then, determine the identities of the two unknown metals.

Metal	Mass (g)	Volume (cm3)	Density (g/cm3))
Iron	42.5	5.40	
Lead	28.8	2.55	
Tungsten	69.5	3.60	
Zinc	46.4	6.50	
	61.0	5.40	
	46.4	2.40	

Understand Key Concepts

1 B. Particles vibrate in all directions.
2 A. highly flammable
3 D. weight
4 B. They are farther apart.
5 B. chopping onions
6 C. mass
7 B. copper turning green in air
8 A. density
9 C. 135 g
10 C. heating the eggs in a pan
11 C. A solid forms when one liquid is poured into another.

Critical Thinking

12 Possible answer: Mass, volume, and color are not reliable for identifying a substance because they can change. Density would be a more reliable property for identifying the substance used to make the ring because it does not change. Melting point would not be a reasonable property because it would probably be too high to measure.

13 It is a physical change because the substances are combined but still have the same identity.

14 Possible answers: A reversible physical change is a classroom being painted a different color. An irreversible change is a pencil breaking.

15 Possible answer: Although liquids can be poured, substances made of small bits of solids, such as sand, can also be poured.

16 Possible answer: First, pour a known amount of liquid into a large container, place the rock into the liquid, and mark the new level of the liquid. Next, remove the rock and determine the amount of liquid you have to add to the container to reach that level.

17 Combining the liquids must have produced a gas. The mass of the gas equals the difference in mass before and after combining the liquids.

Writing in Science

18 Possible answers might include describing a pencil that has the physical properties of long, thin, and orange, and the chemical property of being flammable because it is made of wood.

The BIG Idea

19 Every substance has both physical and chemical properties. Physical properties, such as density and melting point, and chemical properties, such as flammability and ability to rust, give a substance its unique identity.

20 Possible answers: the density of the metal used on the outside of the aircraft; whether the metal will rust or react in some other way to water or oxygen; and whether the metal is malleable.

Math Skill

Math Practice

21

Metal	Mass (g)	Volume (cm^3)	Density (g/cm^3)
Iron	42.5	5.40	7.87
Lead	28.8	2.55	11.3
Tungsten	69.5	3.60	19.3
Zinc	46.4	6.50	7.14
Lead	61.0	5.40	11.3
Tungsten	46.4	2.40	19.3

Teacher Notes

Standardized Test Practice

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

Multiple Choice

1 Which describes the particles in a substance with no definite volume or shape?
- **A** Particles are close but can move freely.
- **B** Particles are close but can vibrate in all directions.
- **C** Particles are far apart and cannot move.
- **D** Particles are far apart and move freely.

2 Which diagram shows a chemical change?

A

B

C

D

3 Which is NOT true about firewood that burns completely?
- **A** Ashes and gases form from the substances in the wood.
- **B** Oxygen from the air combines with substances in the wood.
- **C** The total mass of substances in this process decreases.
- **D** The wood gives off thermal energy and light.

Use the diagram below to answer question 4.

4 What is the mass of the object on the balance scale?
- **A** 22 g
- **B** 22.5 g
- **C** 22.7 g
- **D** 30 g

5 Which is true when an ice cube melts?
- **A** Volume and mass increase.
- **B** Volume and mass do not change.
- **C** Volume decreases, but mass does not change.
- **D** Volume increases, but mass decreases.

6 What is the BEST way to separate and save the parts of a sand-and-water mixture?
- **A** Boil the mixture and collect the steam.
- **B** Pour the mixture through a filter that only the water can pass through.
- **C** Lift the sand out of the mix with a spoon.
- **D** Pour a strong acid into the mixture to dissolve the sand.

Use the table below to answer questions 7 and 8.

Action	Time	Result
Heated	30 minutes	solid
Heated	60 minutes	liquid
Not heated	30 minutes	solid
Not heated	60 minutes	solid

7 Based on the results of this experiment, what can you conclude about heating this unknown substance?
- **A** Heating melted it in 30 minutes.
- **B** Heating melted it in 60 minutes.
- **C** Heating made it solid in 60 minutes.
- **D** Heating caused no changes.

8 What can you conclude about the original state of the substance?
- **A** It is part solid and part liquid.
- **B** It is a liquid.
- **C** It is a solid.
- **D** It is part liquid and part gas.

9 Which is a sign of a physical change?
- **A** Bread gets moldy with age.
- **B** Ice forms on a puddle in winter.
- **C** The metal on a car starts to rust.
- **D** Yeast causes bread dough to rise.

Constructed Response

Use the table below to answer questions 10–13.

Properties	Substance 1	Substance 2	Substance 3
Color	yellow	yellow	yellow
State	solid	solid	solid
Mass	217 g	217 g	75 g
Melting point	505°C	230°C	505°C
Density	3.78 g/cm3	2.76 g/cm3	3.78 g/cm3
Flammable	yes	yes	yes

10 Identify each property of the unknown substances as either chemical or physical. Explain your reasoning.

11 Of the three unknown substances tested, two are the same substance and one is different. Which two substances do you think are the same? Explain your reasoning.

12 Which properties in the table helped you determine your answer in number 11? Which properties were not helpful? Explain your reasoning.

13 What additional physical and chemical properties of substances might the table have included?

Need Extra Help?

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

Multiple Choice

1 D—Correct. A, B, C—The question describes a gas, which has no definite volume or shape. Its particles are far apart, moving freely within a container, because no attractive forces hold them together.

2 C—Correct. A, B, D—When a substance undergoes a chemical change, it becomes a different substance with different physical and chemical properties. For example, when a wooden match burns, the wood changes into other substances, including carbon dioxide and ash. The physical properties of the paper, balloon, and fruit do not change when they undergo cutting, emptying, and peeling respectively.

3 C—Correct. A, B, D—When wood burns, it changes into other substances, including carbon dioxide, water vapor, and ash. However, total mass in this, or any chemical change, does not change; that is, the combined mass of the new substances is equal to that of the wood. This is known as the law of conservation of mass.

4 C—Correct. A, B, D—The scale has three measurement indicators (ones units—bottom, tens units—top, hundreds units—middle). The mass of the object on the scale can be calculated by adding the unit measurements. Mass = the ones units (2.7) + the tens units (20) and the hundreds units (0). 2.7 + 20 + 0 = 22.7 g.

5 C—Correct. A, B, D—When water changes state from solid to liquid, its volume decreases; that is, the ice cube occupies a greater space than the liquid water. Because matter is always conserved, however, mass does not change. Therefore, the mass of the ice cube is equal to that of the liquid water.

6 B—Correct. A, C, D—Physical properties are useful in separating materials in a mixture. Because water can be separated from sand by going through filter paper, the mixture can be filtered for separation.

7 B—Correct. A, C, D—The table shows that the substance, a solid, melted, or changed to a liquid, in 60 minutes when heat was applied.

8 C—Correct. A, B, D—According to the table, in its original state—that is, when no change agent such as heat is applied—the substance is a solid.

9 B—Correct. A, C, D—In a physical change, only the state of matter is affected. Of the answers, the only physical change is the formation of ice on a puddle of water. (Water changes from a liquid to a solid—ice.) The other answer choices reflect chemical changes because both the physical and chemical properties of th e original substances change.

Constructed Response

10 Color, state, mass, melting point, and density are all physical properties that can be observed without interaction with another substance. Flammability is a chemical property because it is observable when the substance reacts with or changes to a different substance.

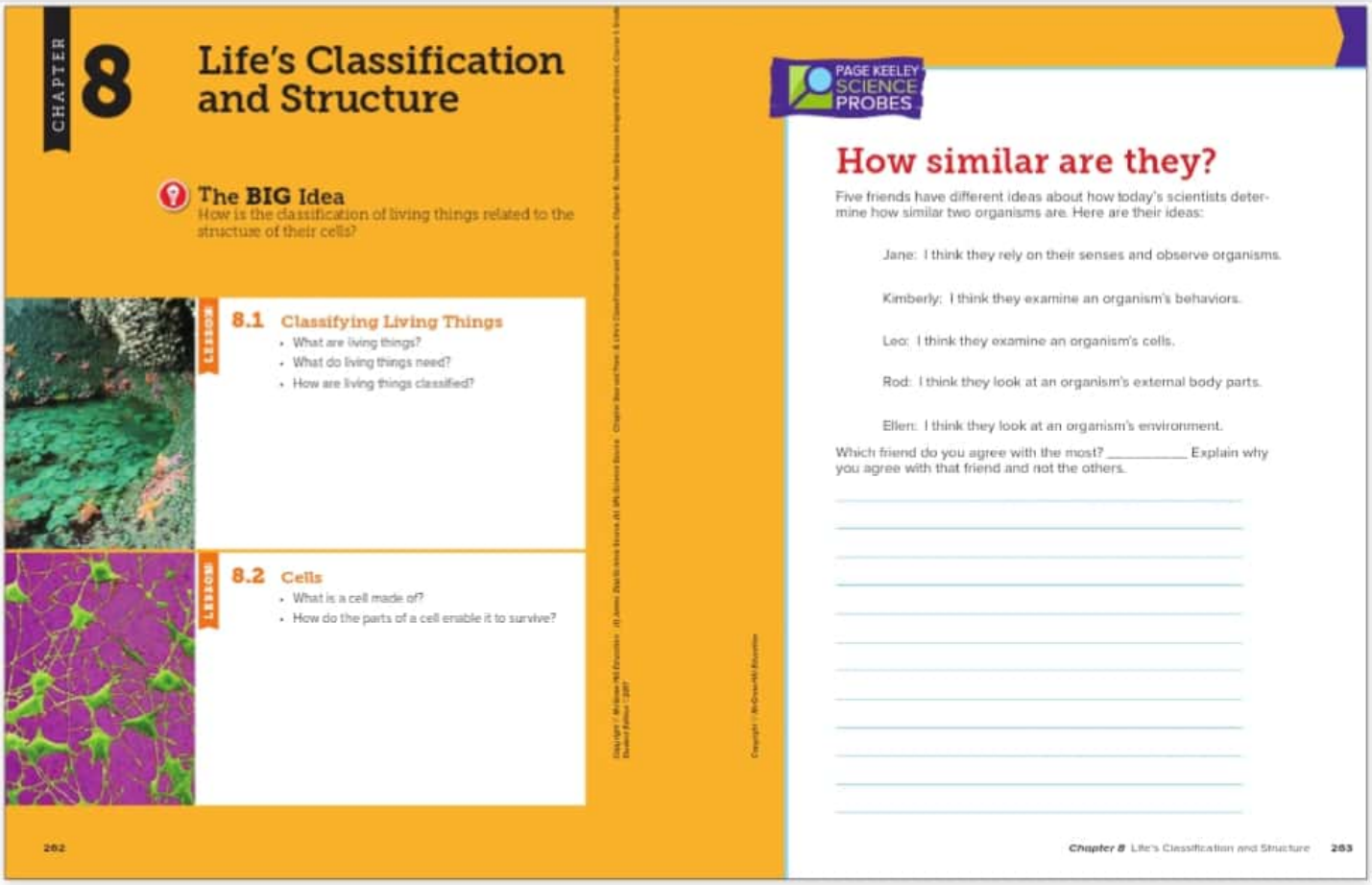
11 Samples 1 and 3 could be the same substance because they have the same melting point and density. Color, state, mass, and flammability are not useful for determining the identity.

12 Melting point and density were useful for comparing the substances because they do not depend on the sample size or amount. The color, state, flammability, and mass were not useful for comparing the substances. Color and flammability were not useful because all three substances have the same color, state, and flammability. Mass was not useful, because mass depends on the amount of a substance present.

13 Additional physical properties of substances include malleability, electrical conductivity, magnetism, solubility, volume, and boiling point. Malleability is the ability of the substance to be rolled or hammered into thin sheets. Electrical conductivity is a substance's ability to transmit an electric charge. Magnetism allows a substance to attract certain metals. Solubility is the ability of one material to dissolve in another. The volume of a liquid can be measured with a graduated cylinder and reading the volume mark. The boiling point of a substance is the temperature at which a liquid changes to a gas. An additional chemical property of a substance includes the ability to rust.

Answer Key

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



CHAPTER 8

Life's Classification and Structure

The BIG Idea

How is the classification of living things related to the structure of their cells?

LESSON 8.1

8.1 Classifying Living Things

- What are living things?
- What do living things need?
- How are living things classified?

LESSON 8.2

8.2 Cells

- What is a cell made of?
- How do the parts of a cell enable it to survive?

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PAGE KEELEY SCIENCE PROBES

How similar are they?

Five friends have different ideas about how today's scientists determine how similar two organisms are. Here are their ideas:

Jane: I think they rely on their senses and observe organisms.

Kimberly: I think they examine an organism's behaviors.

Leo: I think they examine an organism's cells.

Rod: I think they look at an organism's external body parts.

Ellen: I think they look at an organism's environment.

Which friend do you agree with the most? _____ Explain why you agree with that friend and not the others.

Chapter 8 Life's Classification and Structure 263

Life's Classification and Structure

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.

PAGE KEELEY SCIENCE PROBES

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

Guiding Questions

AL	What are different groups of living things?	*Students may suggest different kinds of animals, plants and animals, or other groups. Use this question to initiate students' thinking about the classification of living things.*
OL	How do scientists classify living things into groups?	*Use this question to prompt students to think about the ways living things in a group are similar to each other but different from other groups.*
BL	What are some ways the cells in bacteria, plants, and animals differ?	*Use this question to begin a discussion of the differences between eukaryotic and prokaryotic cells and between plant and animal cells.*

LESSON

8.1 Classifying Living Things

Explore Activity

How can you tell whether it is alive?

Living things share several basic characteristics. Think about what you have in common with other living things such as a bug or a tree. Do other things have some of those same characteristics?

Procedure

1. Read and complete a lab safety form.
2. Observe **lit candle** for 1–2 min. Pay attention to both the candle and the flame.
3. Write what you observe in your Science Journal.
4. Write what you think you would observe if you were to observe the candle for several hours.

Think About This

1. What characteristics does the flame have that would lead some people to think the flame is alive?
2. What qualities did you think of earlier (that you share with other living things) that the candle does not possess?
3. **Key Concept** What characteristics do you think something must have to be considered alive?

Essential Questions

- What are living things?
- What do living things need?
- How are living things classified?

Vocabulary

autotroph
heterotroph
habitat
binomial nomenclature
taxon

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INQUIRY

About the Photo **Living or Not?** You can tell that some animals are alive because they move around. But the sea anemones, barnacles, and sea stars in the photo are stationary, so how can you tell that they are living things? All living things share six characteristics, which will be explored in this lesson.
Start the lesson with questions about the characteristics of living things

Guiding Questions

OL How can you tell if something is alive?	*Tell students that a thing needs to have all the characteristics of living things in order to be alive. The characteristics are listed on the next page.*
BL Do all living things move from place to place?	*Have the class brainstorm a list of living things that do not use their own energy to change locations, such as plants, anemones, barnacles, and sea stars.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

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

Bringing a Big Term Down to Size

1. Write the term *binomial nomenclature* on chart paper or the board..
2. Explain that big terms often have simple meanings. *Binomial* means "having a two-word name." *Nomenclature* means "naming system." Thus, *binomial nomenclature* means "a naming system in which things are given a two-part name."
3. Binomial nomenclature is used by scientists to classify organisms. Every living thing has a two-part name in which the first word is the organism's genus and the second word is its species.

4. Explain that the term binomial is also used in algebra to mean "two terms" or numbers. A binomial expression is a quantity given as the sum or difference of two terms, such as 10x + 5.

ExploreActivity

How can you tell whether it is alive?

Prep: *2 min* **Class:** *10 min*

Purpose
To compare and contrast characteristics of living and nonliving things.

Materials
tapered candle with a secure base per team of 2–4 students (or for the class), lighter
Alternate: Any kind of candle can be used, however the narrower the candle, the more quickly it can be observed to become shorter.

Before You Begin
Use the introduction to create a student-generated list of characteristics that all living things have in common. It may be useful to keep this list visible somewhere or have students copy it into their Science Journals. Make sure it is labeled so they know it was the student-generated list and not necessarily a list agreed upon by scientists.

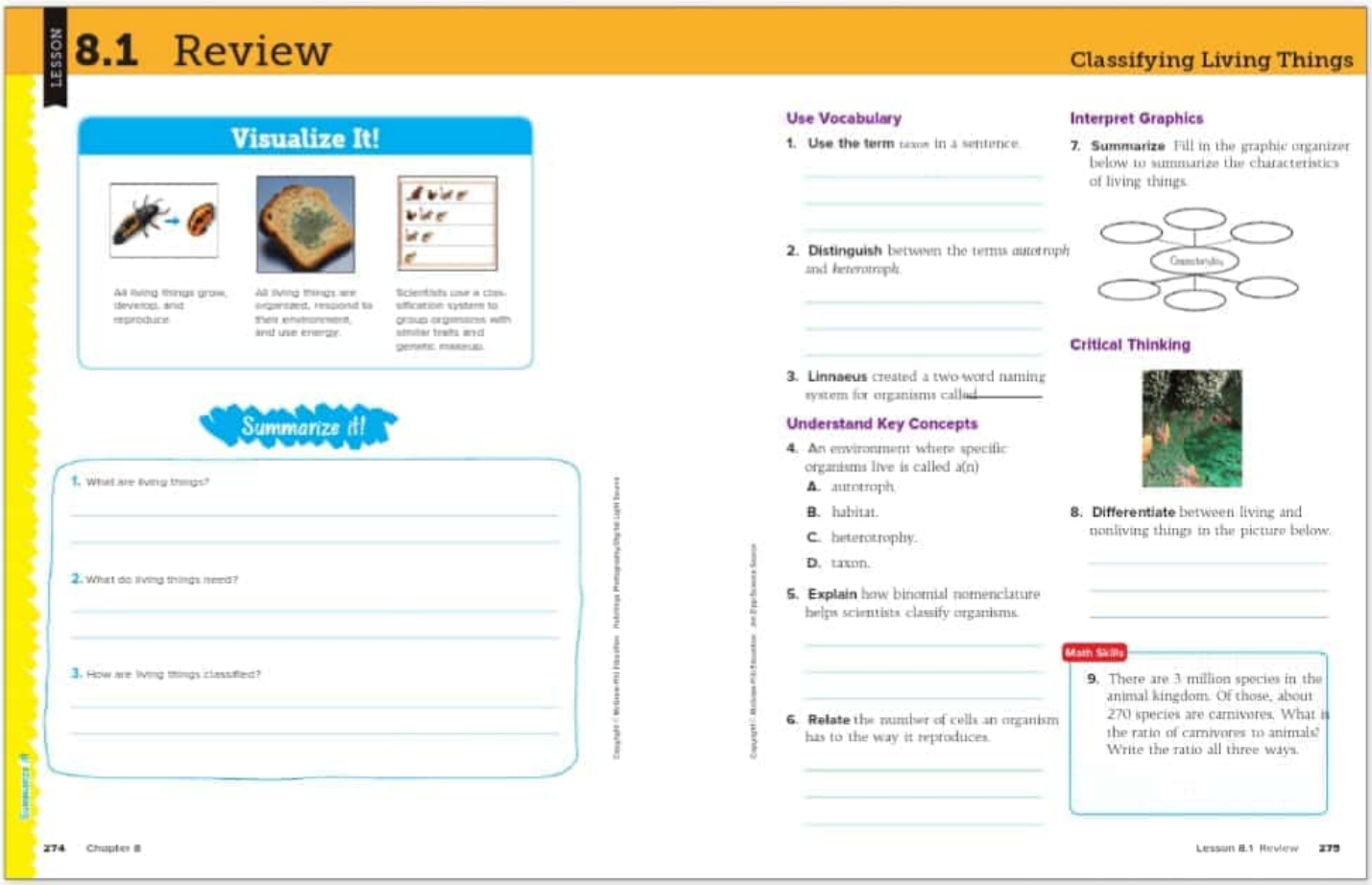
Guide the Investigation

- Read and check students' lab safety forms.
- ⚠ Make sure the candles are in a secure base. You may wish to light the candles yourself. Reinforce the instruction that students focus on both the flame and candle.
- Remind students to think of the characteristics of living things.
- ⚠ Make sure students understand they are not to play with the candle, flame, or wax. Have a fire blanket and a fire extinguisher easily accessible in case of emergency.

Think About This

1. Answers will vary, but will likely include the ideas that the flame moves, grows, and consumes (the wax and air). Students may even respond that the flame can reproduce by starting new fires, though that was not directly observed.
2. If students originally came up with the idea that living things are made of cells, it would be the characteristic indicated for this question.
3. Students should arrive at a list similar to the one presented in the text: Living things are made of cells, reproduce, respond to their environment, grow and develop, use energy, and have organization.

Teacher Notes



LESSON 8.1 Review

Classifying Living Things

Visualize It!

All living things grow, develop, and reproduce.

All living things are organized, respond to their environment, and use energy.

Scientists use a classification system to group organisms with similar traits and genetic makeup.

Summarize it!

1. What are living things?
2. What do living things need?
3. How are living things classified?

Use Vocabulary

1. **Use the term** taxon in a sentence.
2. **Distinguish** between the terms *autotroph* and *heterotroph*.
3. **Linnaeus** created a two-word naming system for organisms called _____.

Understand Key Concepts

4. An environment where specific organisms live is called a(n)
   - A. autotroph.
   - B. habitat.
   - C. heterotrophy.
   - D. taxon.
5. **Explain** how binomial nomenclature helps scientists classify organisms.
6. **Relate** the number of cells an organism has to the way it reproduces.

Interpret Graphics

7. **Summarize** Fill in the graphic organizer below to summarize the characteristics of living things.

Critical Thinking

8. **Differentiate** between living and nonliving things in the picture below.

Math Skills

9. There are 3 million species in the animal kingdom. Of those, about 270 species are carnivores. What is the ratio of carnivores to animals? Write the ratio all three ways.

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Lesson 8.1 Review 275

Summarize it!

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

- Classifying Living Things

Use Vocabulary

1. Possible answers include "A genus is a type of taxon" **DOK 1**
2. Autotrophs produce their own food using light energy, whereas heterotrophs obtain energy by eating autotrophs or other heterotrophs. **DOK 1**
3. binomial nomenclature **DOK 1**

Understand Key Concepts

4. B. habitat **DOK 1**
5. Binomial nomenclature assigns every species a two-word name consisting of the organism's genus and species. **DOK 2**
6. Most unicellular organisms reproduce asexually, whereas most multicellular organisms reproduce sexually. DOK 2

Interpret Graphics

7. Central oval: Characteristics; Outer ovals: Made of cells, organized, grow and develop, use energy, respond to environment, reproduce **DOK 2**

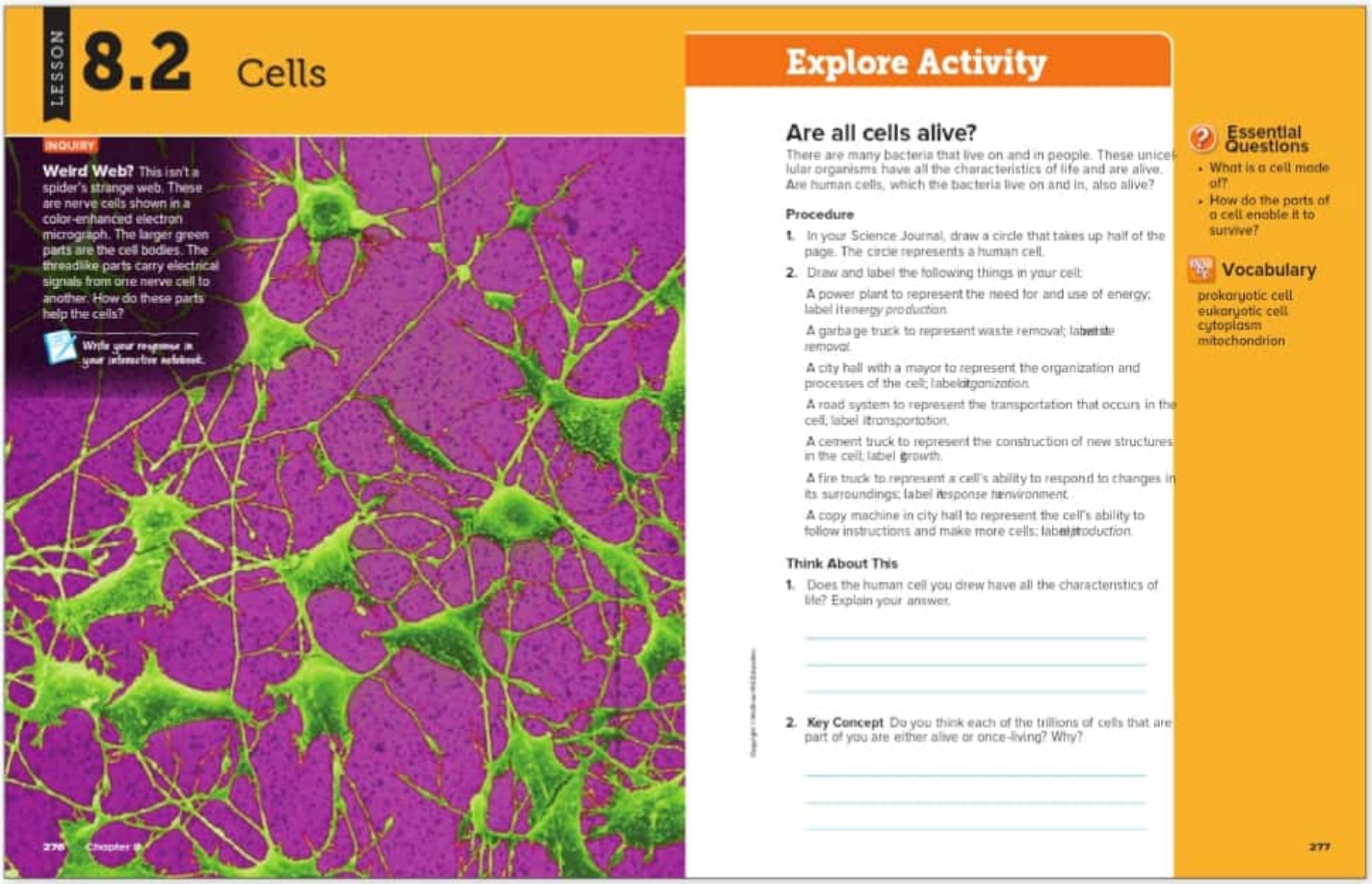
Critical Thinking

8. Rocks and water are not alive, but the algae, shellfish, and other organisms are. **DOK 3**

Math Skills

9. $\frac{270}{3{,}000{,}000} = \frac{27}{300{,}000} = \frac{9}{100{,}000}$ or 9:100,000 or 9 to 100,000. **DOK 3**

Teacher Notes


LESSON 8.2 Cells

INQUIRY

Weird Web? This isn't a spider's strange web. These are nerve cells shown in a color-enhanced electron micrograph. The larger green parts are the cell bodies. The threadlike parts carry electrical signals from one nerve cell to another. How do these parts help the cells?

Write your response in your interactive notebook.

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Explore Activity

Are all cells alive?

There are many bacteria that live on and in people. These unicellular organisms have all the characteristics of life and are alive. Are human cells, which the bacteria live on and in, also alive?

Procedure

1. In your Science Journal, draw a circle that takes up half of the page. The circle represents a human cell.
2. Draw and label the following things in your cell:

A power plant to represent the need for and use of energy; label it *energy production*.

A garbage truck to represent waste removal; label it *waste removal*.

A city hall with a mayor to represent the organization and processes of the cell; label it *organization*.

A road system to represent the transportation that occurs in the cell; label it *transportation*.

A cement truck to represent the construction of new structures in the cell; label it *growth*.

A fire truck to represent a cell's ability to respond to changes in its surroundings; label it *response to environment*.

A copy machine in city hall to represent the cell's ability to follow instructions and make more cells; label it *reproduction*.

Think About This

1. Does the human cell you drew have all the characteristics of life? Explain your answer.

2. **Key Concept** Do you think each of the trillions of cells that are part of you are either alive or once-living? Why?

Essential Questions
- What is a cell made of?
- How do the parts of a cell enable it to survive?

Vocabulary

prokaryotic cell
eukaryotic cell
cytoplasm
mitochondrion

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INQUIRY

About the Photo **Weird Web?** Explain that cells are a basic part of a living organism and that while some organisms have only one cell, humans have about 100 trillion. Guide students in understanding that cell parts interact with one another and depend on one another.

Guiding Questions

AL How many cells are shown in the photo?	*Students may have trouble counting the cells because of the intricate network they form. If they count cell bodies, they may be able to estimate the number of cells.*
OL Why are cells important?	*They are a necessary part of living organisms.*
BL Why do you think some organisms have only one cell, but humans have about 100 trillion?	*Use this question to launch a discussion about the complexity of the human body.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

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

Use Word Parts to Understand Word Meaning

1. Write *prokaryotic* and *eukaryotic* on the board. Tell students these terms refer to two different types of cells. Circle the root *kary*. Then write *karyon*.
2. Explain that the root *kary* comes from the Greek *karyon*, which means "nut" and references the nucleus of a cell.
3. Circle *pro* in *prokaryotic*. **Ask: What do you know about the meaning of the prefix pro–?** *It can mean "before."*
4. Guide students in recognizing that *prokaryotic* references the idea of "before having a nucleus," as a prokaryotic cell does not have a membrane-bound nucleus.
5. Circle *eu* in *eukaryotic*. Guide students in recognizing that the prefix *eu–* means "true," and in the word *eukaryotic*, it refers to a true membrane-bound nucleus. So, a prokaryotic cell does not have a membrane-bound nucleus, and a eukaryotic cell does.

ExploreActivity

Are all cells alive?

Purpose
To illustrate that individual cells within larger organisms are alive.

Materials
science textbook for each individual or group of two

Before You Begin
Review the characteristics that all living things possess.

Guide the Investigation

- Read and check students' lab safety forms.
- Make sure all students draw their cells large enough to house all components.
- During classroom discussion, it is important to relate each of the functions represented to the characteristics of life.
- At the end of the activity, discuss with students that even though the cells are alive, they cannot live on their own.

Think About This

1. It should have all the characteristics of life. Some students might point out that as a drawing, their cells are not alive but have representatives of all of the characteristics of life.
2. The trillions of cells that make me are indeed alive, as they have all the characteristics of living things. Each is organized, grows and develops, responds to its environment, reproduces, and uses energy.

Teacher Notes

LESSON

8.2 Review

Cells

Visualize It!

Prokaryotic cells are surrounded by a cell membrane but have no internal organelles with membranes.

Eukaryotic cells contain a nucleus and many other organelles.

Plant cells have cell walls, chloroplasts, and a large vacuole.

Summarize it!

1. What is a cell made of?

2. How do the parts of a cell enable it to survive?

Use Vocabulary

1. **Distinguish** between prokaryotic cells and eukaryotic cells.

2. Water, proteins, and other substances are found in the _____ of a cell.

3. **Define** *mitochondrion* in your own words.

Understand Key Concepts

4. Which organelles store water, carbohydrates, and wastes in plants?
   - **A.** chloroplasts
   - **B.** mitochondria
   - **C.** nuclei
   - **D.** vacuoles

5. **Compare** how energy is processed in animal and plant cells.

6. **Distinguish** between a cell membrane and a cell wall.

Interpret Graphics

7. **Summarize** Use the table below to identify organelles and their functions.

Organelle	Function
Nucleus	
	energy processing
Vacuole	

8. **Compare and contrast** the structures of the two cells shown below.

Critical Thinking

9. **Assess** the role of water in cell function.

10. **Relate** the cell wall to protection in bacteria.

Summarize it!

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

- Cells

Use Vocabulary

1. Prokaryotic cells lack organelles, including a nucleus, whereas eukaryotic cells contain a nucleus and other membrane-bound organelles. **DOK 1**
2. cytoplasm **DOK 1**
3. Sample answer: The mitochondrion is an organelle found in animal and plant cells; it is used to process energy. **DOK 1**

Understand Key Concepts

4. D. vacuoles **DOK 1**
5. Plant cells contain chloroplasts that convert the energy from sunlight into ATP and carbohydrates, whereas animal cells use mitochondria to convert nutrients into ATP. **DOK 3**
6. The cell membrane surrounds all cell types. However, cell walls are found in plants and some bacteria on the outside of the cell membrane. Both structures provide protection, but the cell wall is more rigid than the cell membrane. DOK 3

Interpret Graphics

7.

Organelle	Function
Nucleus	controlling cell activities
Mitochondria Chloroplasts	energy processing
Vacuole	storage

DOK 2

8. The prokaryotic cell has no organelles. The eukaryotic cell has a nucleus and several other membrane-bound organelles. **DOK 3**

Critical Thinking

9. Water dissolves ions and other substances and helps substances and organelles move around in cells. **DOK 3**

10. Cell walls are rigid structures that prevent toxins and other substances from being taken up by cell membranes. **DOK 3**

Teacher Notes

CHAPTER 8

Study Guide

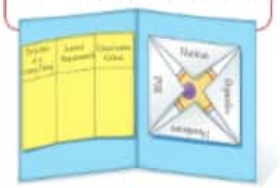
The BIG Idea

Organisms are classified based on similar characteristics, including cell structure and function.

Key Concepts Summary	Vocabulary
8.1 Classifying Living Things • Living things are organized, process energy, grow, reproduce, respond to stimuli, and contain cells. • Living things need food, water, and habitat. • Organisms are classified based on similar characteristics. 	autotroph heterotroph habitat binomial nomenclature taxon
8.2 Cells • Cells are made of water and macromolecules. • Different parts of a cell enable it to perform special functions. 	prokaryotic cell eukaryotic cell cytoplasm mitochondrion

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.

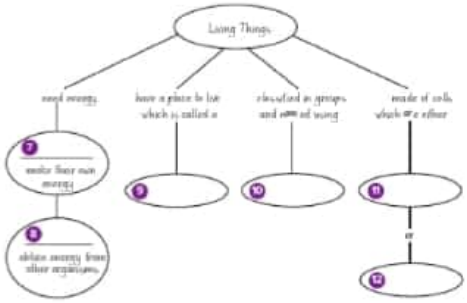


Use Vocabulary

1. The Latin term *Homo sapiens* is an example of _____
2. Organisms that obtain energy by eating other organisms are called _____
3. Use the term habitat in a sentence.
4. Define the term cytoplasm in your own words.
5. Animal cells obtain energy by breaking down food in _____
6. Use the term prokaryotic cell in a sentence.

Link Vocabulary and Key Concepts

Use vocabulary terms from the previous page to complete the concept map.



Key Concepts Summary

Study Strategy: Questions and Answers

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.
3. Prompt students to write their own answer for each Key Concept question in the second column.
4. Then have them read the Key Concept Summary and write their self-assessment in the third column. Example:

Lesson KC Questions	My Answers	My Self-Assessment
What are living things?	Living things have six characteristics. They are made of cells, are organized, grow and develop, respond to their environment, and use energy.	My answer means the same thing as the Key Concept Summary.

Vocabulary

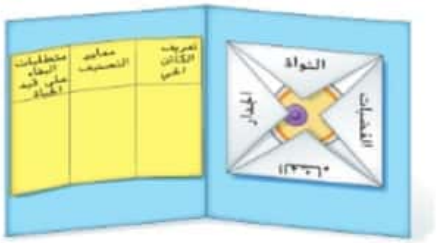
Study Strategy: In Your Own Words

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. 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
autotroph	An autotroph is a living thing that can change light energy into energy it can use. Plants and algae are autotrophs. Some autotrophs use chemicals instead of light for energy and are chemoautotrophs.

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. binomial nomenclature
2. heterotrophs
3. Answers will vary. Sample answer: All organisms need food, water, and a habitat in which they live.
4. Answers will vary. Sample answer: Cytoplasm is the liquid part of a cell that is inside the cell membrane.
5. mitochondria
6. Answers will vary. Sample answer: Bacterial cells are prokaryotic cells because they lack a nucleus and other organelles.

Link Vocabulary and Key Concepts

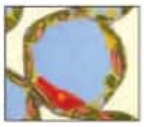
7. autotrophs
8. heterotrophs
9. habitat
10. binomial nomenclature
11. 12 prokaryotic cells, eukaryotic cells

Teacher Notes

CHAPTER 8 Review

Understand Key Concepts

1. What is a rigid structure that provides support and protection to plants and some types of bacteria?
   A. chloroplast
   B. nucleus
   C. cell membrane
   D. cell wall
2. What type of reproduction occurs when a cell divides to form two new cells?
   A. autotrophic
   B. heterotrophic
   C. asexual reproduction
   D. sexual reproduction
3. Which is the binomial nomenclature for humans?
   A. *Canis lupos*
   B. *Felis catus*
   C. *Homo sapiens*
   D. *Tamias striatus*
4. What is a group of organisms called?
   A. taxon
   B. tissue
   C. dichotomous key
   D. organ system
5. Which organelle is the arrow pointing to in the picture below?



   A. chloroplast
   B. cytoplasm
   C. mitochondrion
   D. vacuole
6. Which is NOT a characteristic of all living things?
   A. grow
   B. reproduce
   C. have organelles
   D. use energy
7. Which organelle is the arrow pointing to in the picture below?

   A. chloroplast
   B. cytoplasm
   C. mitochondrion
   D. nucleus
8. What is the name used to describe the specific place where an organism lives?
   A. autotroph
   B. habitat
   C. heterotroph
   D. taxon
9. What is the smallest unit of all living things?
   A. cell
   B. organ
   C. organelle
   D. tissue
10. What are cells mostly made of?
    A. DNA
    B. lipids
    C. proteins
    D. water

Critical Thinking

11. **Summarize** the characteristics of all living things.
12. **Describe** how the organization of a multicellular organism helps it function. Diagram the relationships.
13. **Assess** how taxonomy relates to the diversity of species.
14. **Explain** why different organisms live in different habitats.
15. **Assess** the role of organelles in the functions of eukaryotic cells.
16. **Summarize** the role of nucleic acids in controlling cell functions.
17. **Discuss** how heterotrophs process energy.

Writing in Science

18. On another sheet of paper, **write** a five-sentence paragraph that describes the characteristics that all living things share.

The BIG Idea

19. **Assess** how the classification of prokaryotes and eukaryotes relates to the structure of their cells.

Math Skills

Use Ratios

20. There are about 300,000 species of plants. Of those, 12,000 are mosses. What is the ratio of mosses to plants? Express the answer all three ways.

Understand Key Concepts

1 D. cell wall
2 C. asexual reproduction
3 C. *Homo sapiens*
4 A. taxon
5 D. vacuole
6 C. have organelles
7 D. nucleus
8 B. habitat
9 A. cell
10 D. water

Critical Thinking

11 Living things are made of cells, are organized, grow, develop, reproduce, respond to their environment, and use energy.

12 Cells that perform specific functions are grouped into tissues, and these tissues are grouped into organs. Organs that work together form organ systems to carry out a specific function.

13 Taxonomy is the classification of organisms based on shared traits, which lets scientists determine how many different types of species are on Earth.

14 Living things have different types of cells that are adapted for survival in different habitats.

15 Organelles allow specific cellular processes to occur in distinct parts of a cell.

16 DNA stores information needed for cells to function, and RNA transmits information that is used to make proteins.

17 Heterotrophs use mitochondria to convert nutrients into ATP.

Writing in Science

18 Paragraph should include the characteristics that all living things share: Living things are made of cells, are organized, grow, develop, reproduce, respond to their environment, and use energy.

The BIG Idea

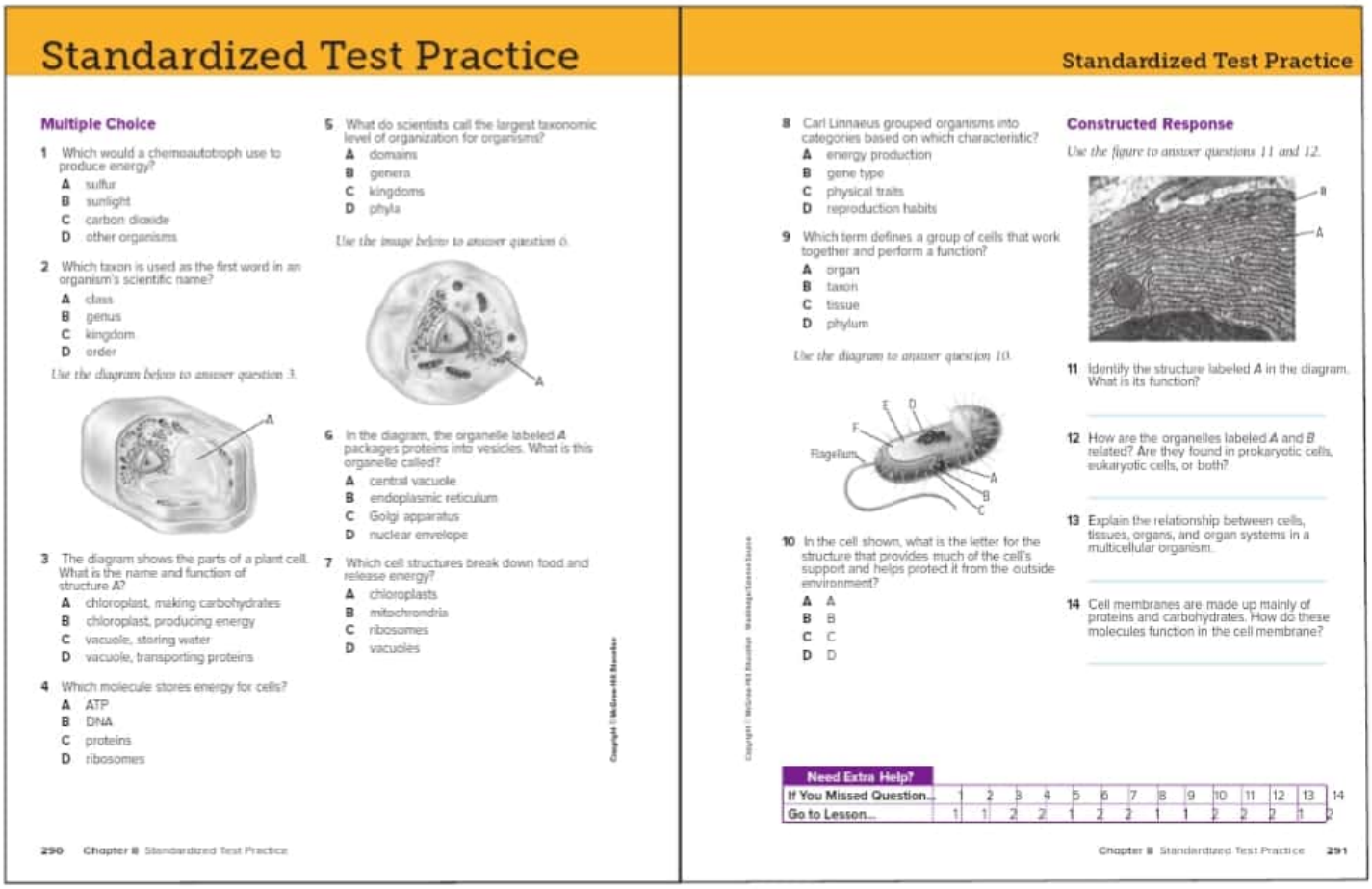
19 Prokaryotes are organisms that do not have organelles, whereas all eukaryotes have a nucleus and other organelles.

Math Skills

Use Volume

20 $\frac{12{,}000}{333{,}600} : \frac{120}{3336} = \frac{1}{278}$ or 1:278 or 1 to 278

Teacher Notes



Standardized Test Practice

Multiple Choice

1 Which would a chemoautotroph use to produce energy?
- A sulfur
- B sunlight
- C carbon dioxide
- D other organisms

2 Which taxon is used as the first word in an organism's scientific name?
- A class
- B genus
- C kingdom
- D order

Use the diagram below to answer question 3.

3 The diagram shows the parts of a plant cell. What is the name and function of structure A?
- A chloroplast, making carbohydrates
- B chloroplast, producing energy
- C vacuole, storing water
- D vacuole, transporting proteins

4 Which molecule stores energy for cells?
- A ATP
- B DNA
- C proteins
- D ribosomes

5 What do scientists call the largest taxonomic level of organization for organisms?
- A domains
- B genera
- C kingdoms
- D phyla

Use the image below to answer question 6.

6 In the diagram, the organelle labeled *A* packages proteins into vesicles. What is this organelle called?
- A central vacuole
- B endoplasmic reticulum
- C Golgi apparatus
- D nuclear envelope

7 Which cell structures break down food and release energy?
- A chloroplasts
- B mitochrondria
- C ribosomes
- D vacuoles

8 Carl Linnaeus grouped organisms into categories based on which characteristic?
- A energy production
- B gene type
- C physical traits
- D reproduction habits

9 Which term defines a group of cells that work together and perform a function?
- A organ
- B taxon
- C tissue
- D phylum

Use the diagram to answer question 10.

10 In the cell shown, what is the letter for the structure that provides much of the cell's support and helps protect it from the outside environment?
- A A
- B B
- C C
- D D

Constructed Response

Use the figure to answer questions 11 and 12.

11 Identify the structure labeled *A* in the diagram. What is its function?

12 How are the organelles labeled *A* and *B* related? Are they found in prokaryotic cells, eukaryotic cells, or both?

13 Explain the relationship between cells, tissues, organs, and organ systems in a multicellular organism.

14 Cell membranes are made up mainly of proteins and carbohydrates. How do these molecules function in the cell membrane?

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	2	2	1	2	2	1	1	2	2	2	1	2

Multiple Choice

1 **A—Correct.** B and C are used by autotrophs to produce energy in processes such as photosynthesis. D is used by heterotrophs for energy (when other organisms are eaten). **DOK 1**

2 **B—Correct.** A and C are not parts of a scientific name. The species designation (D) is the second part of an organism's scientific name. **DOK 2**

3 **C—Correct.** Chloroplasts (A and B) are located elsewhere and process energy. Vacuoles do not transport proteins. **DOK 2**

4 **A—Correct.** DNA contains genetic material, and proteins are made on the surface of ribosomes and have many uses, but they are not used for storing energy. **DOK 1**

5 **A—Correct.** B, C, and D are taxa at lower levels. **DOK 1**

6 **C—Correct.** The central vacuole is used for storage. The endoplasmic reticulum is where ribosomes are attached, and the nuclear envelope surrounds the nucleus. **DOK 2**

7 **B—Correct.** Chloroplasts process energy, ribosomes produce proteins, and vacuoles are used for storage. **DOK 1**

8 **C—Correct.** A, B, and D are characteristics used more recently to classify organisms. **DOK 1**

9 **C—Correct.** A is composed of a group of tissues, B is a group of organisms, and D is a level of taxonomic classification. **DOK 2**

10 **B—Correct.** A is the cell membrane, C is the capsule, and D is the DNA. **DOK 1**

Constructed Response

11 The structure labeled A is a ribosome. Proteins are made by the ribosomes. In eukaryotes, the proteins are moved inside the cell through the ER. **DOK 2**

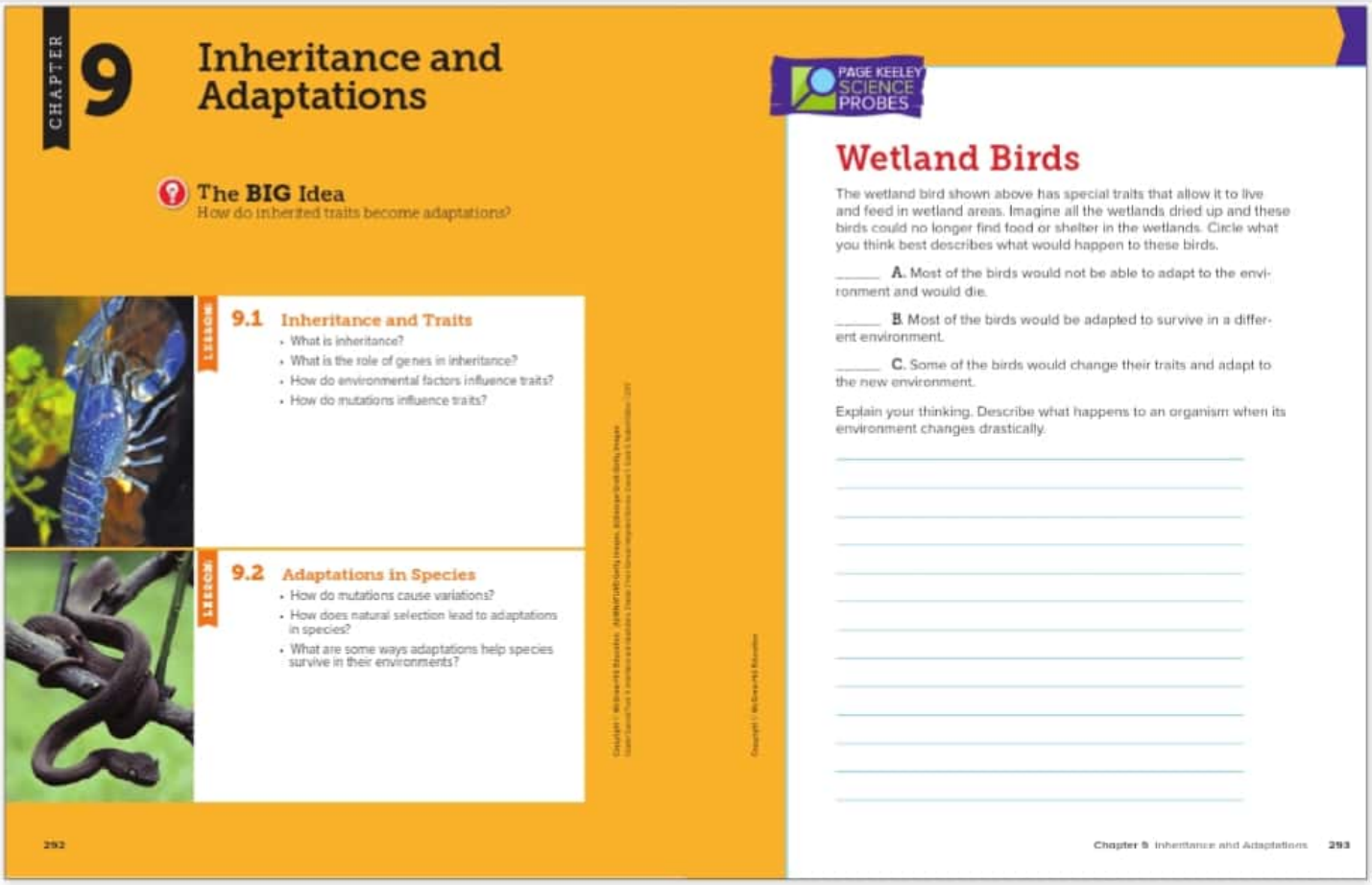
12 Label B shows endoplasmic reticulum, which functions to transport proteins produced by ribosomes. Ribosomes are found in both prokaryotes and eukaryotes. The ER is not found in prokaryotes. **DOK 2**

13 Tissues are groups of cells that work together to carry out a task. Organs are structures made up of different tissues that work together to carry out a specific function. Organ systems are groups of organs that work together to execute all of the functions that an organism needs to survive. **DOK 2**

14 Lipids in the cell membrane help protect the interior cell from the environment. Membrane proteins transport materials between the inside and outside of the cell. Membrane proteins also communicate with other cells and sense changes in the cell's environment. **DOK 2**

Answer Key

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



How do inherited traits become adaptations?

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 some characteristics that animals are born with and get from their parents?	*Students may suggest characteristics such as feathers, fur, or scales; wings, legs, or fins; and types of internal organs. Point out that these are inherited traits.*
OL	What is an adaptation?	*Use this question to initiate discussion of inherited traits that help organisms survive in their environment.*
BL	Is an inherited trait always an adaptation? Explain your answer.	*No. Students might propose that an inherited trait might have no effect on survival or be harmful for survival. Even if it is helpful, it might be a variation of an individual and not an adaptation of the species.*

Get Ready to Read

What do you think?

Use this anticipation guide to gauge students' background knowledge and preconceptions about inheritance and adaptations. At the end of each lesson, ask students to read and evaluate their earlier responses. Students should be encouraged to change any of their responses.

Anticipation Set for Lesson 1

1. **Genes are made of chromosomes.**

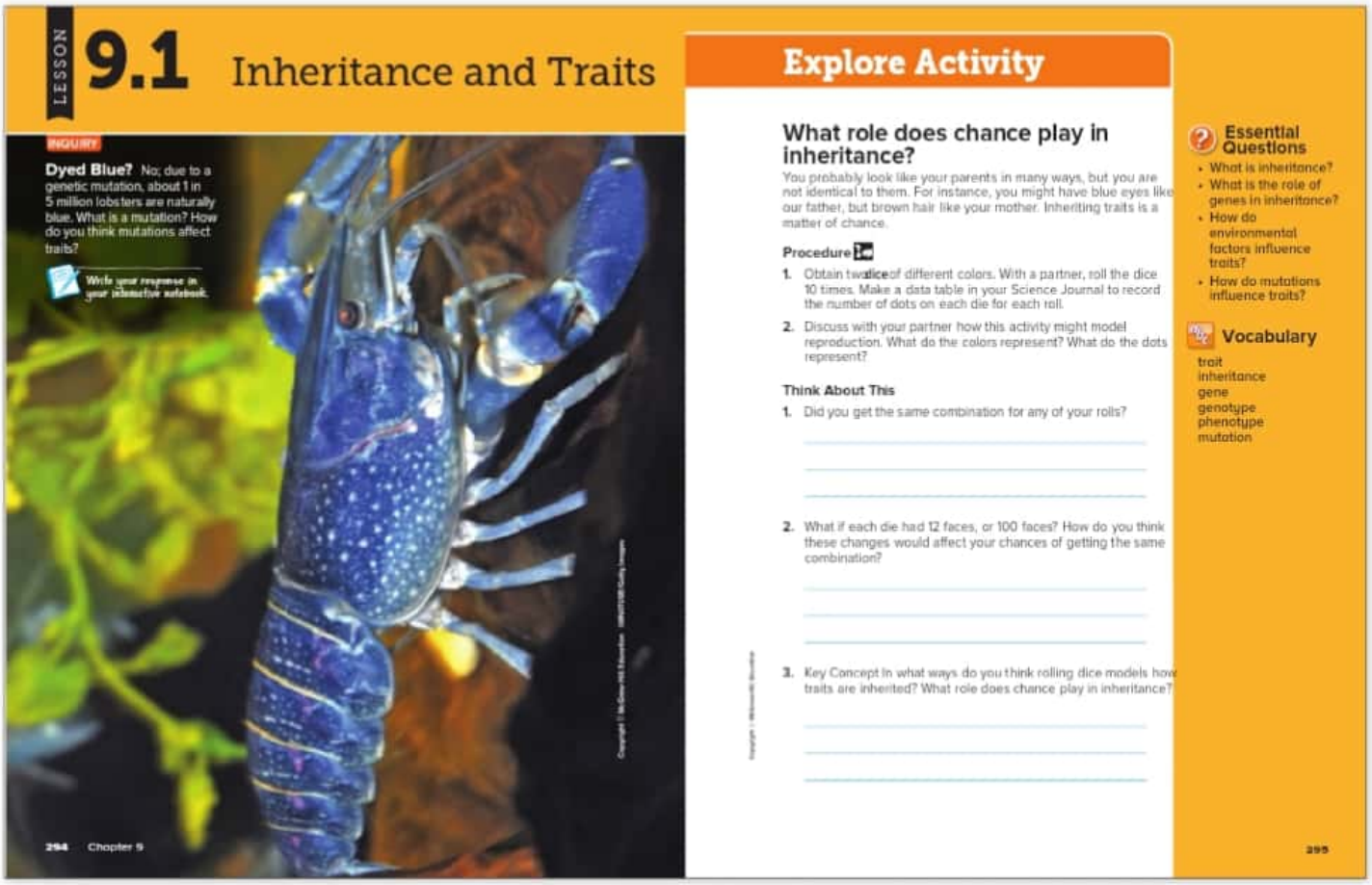
   Disagree. Genes are distinct segments of DNA on a chromosome.

2. **A mutation is a permanent change in a gene.**

   Agree. A mutation is a permanent change in the sequence of DNA in a gene.

3. **The environment cannot affect an inherited trait.**

   Disagree. While the environment cannot affect an organism's genotype, it can affect the expression of a trait controlled by a gene.


LESSON 9.1 Inheritance and Traits

INQUIRY

Dyed Blue? No; due to a genetic mutation, about 1 in 5 million lobsters are naturally blue. What is a mutation? How do you think mutations affect traits?

Write your response in your interactive notebook.

294 Chapter 9

Explore Activity

What role does chance play in inheritance?

You probably look like your parents in many ways, but you are not identical to them. For instance, you might have blue eyes like our father, but brown hair like your mother. Inheriting traits is a matter of chance.

Procedure

1. Obtain two dice of different colors. With a partner, roll the dice 10 times. Make a data table in your Science Journal to record the number of dots on each die for each roll.
2. Discuss with your partner how this activity might model reproduction. What do the colors represent? What do the dots represent?

Think About This

1. Did you get the same combination for any of your rolls?
2. What if each die had 12 faces, or 100 faces? How do you think these changes would affect your chances of getting the same combination?
3. Key Concept In what ways do you think rolling dice models how traits are inherited? What role does chance play in inheritance?

Essential Questions

- What is inheritance?
- What is the role of genes in inheritance?
- How do environmental factors influence traits?
- How do mutations influence traits?

Vocabulary

trait
inheritance
gene
genotype
phenotype
mutation

295

INQUIRY

About the Photo **Dyed Blue?** Lobsters live in saltwater environments and come in many colors, including yellow, greenish-brown, and orange. Very rarely, a genetic mutation produces the blue color. All lobsters turn red when placed into hot water for cooking. This is because the red pigment in the lobster's shell is stable at high temperatures, unlike the other color pigments that are present.

Guiding Questions

AL If a lobster's parents are brown, do you think the lobster is more likely to be brown or another color?	*Use this question to initiate a discussion about inherited traits. Students may have prior knowledge that offspring inherit some traits, such as color, from their parents.*
OL What is a mutation, and how might a mutation affect traits?	*Use this question to begin a discussion about mutations as permanent changes in genes that can change traits in organisms.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

Essential Questions

After this lesson, students should understand the Essential questions 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 *genotype* and *phenotype* on the board or chart paper. Circle *geno* and *pheno*. Write *genea* next to *genotype* and *phainein* next to *phenotype*.
2. **Ask: Which part of these two words is the same?** *type* **Ask: What can we use to remember the difference between these two scientific terms?** *the meaning of the first part of each word; the word origin*
3. Explain that *genea* is Greek for *generation*, while *phainein* comes from the German language and means "to show." An organism's genotype is the entire set of genes—what has

been inherited from other generations but is particular to the organism. An organism's phenotype describes how inherited traits are shown. So, for example, a plant's genotype may include a gene for tallness, but because of growing conditions, its phenotype could be expressed as short.

ExploreActivity

What role does chance play in inheritance?

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

Purpose
To observe the role of chance in combining traits.

Materials
pair of dice, each die a different color

Before You Begin
Ask students how they know, by appearance, when people are related. Students may mention eye color, hair color, shape of face, nose, height, and so on. Encourage students to think about why members of the same family have similar, but not identical, characteristics.

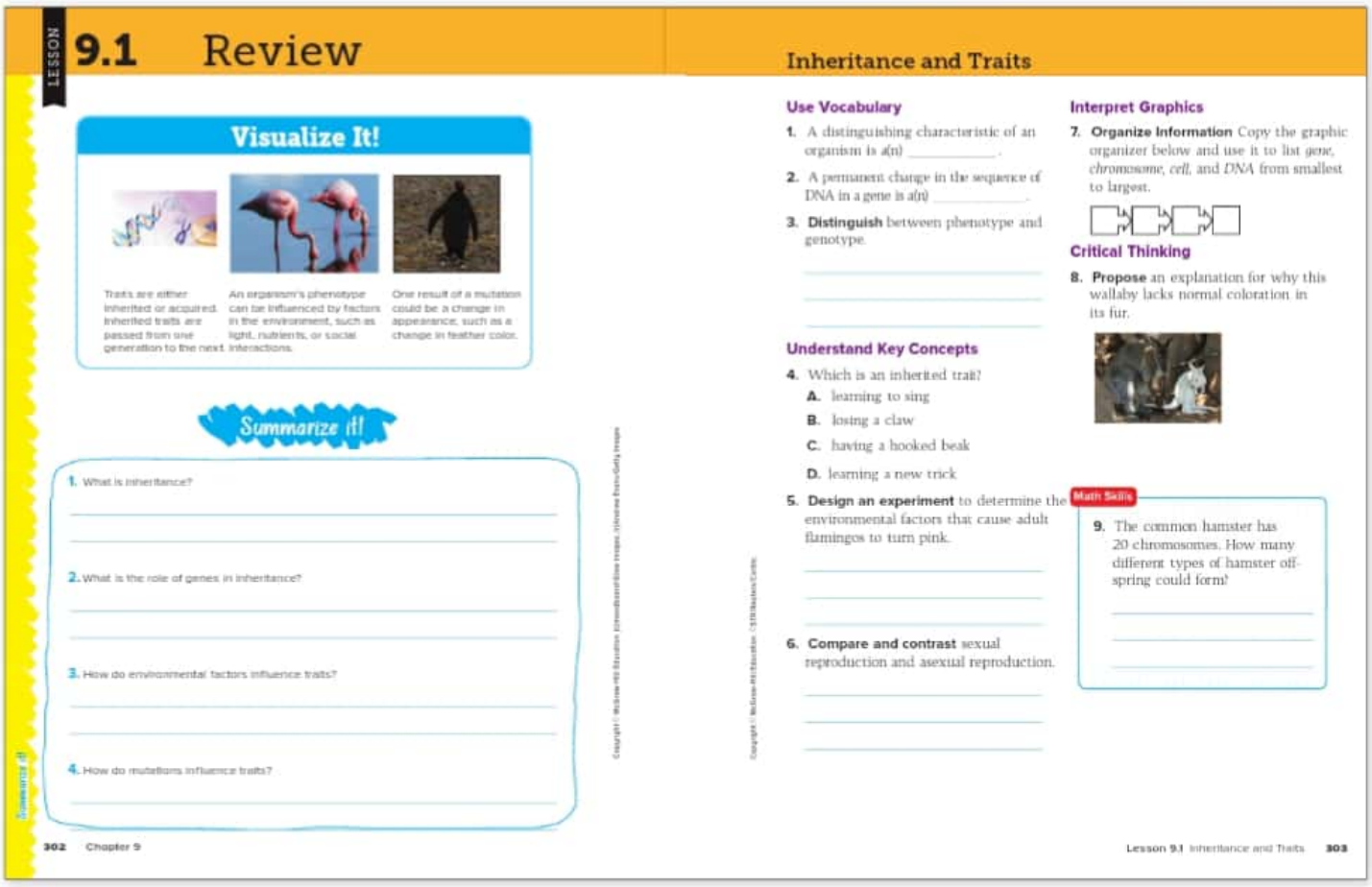
Guide the Investigation

- Have students make a table in their Science Journals to record the data. The table should have three columns. The first column is labeled *Toss Number*. The second column is labeled *Die 1 (Color of die)* and the second column *Die 2 (Color of die)*.
- Point out that the same set of numbers may represent different characteristics. For example, a 2 on the red die and a 5 on the blue die are different than a 5 on the red die and a 2 on the blue die.
- Ask students to discuss the meaning of the colors and numbers. Circulate to help them understand that the colors represent the two parents. Each numbered face represents a certain characteristic that the offspring might inherit from that parent.

Think About This
Do not expect students to determine the correct answers. Students should be encouraged to speculate. Use the answer set to guide students' reasoning.

1. Students may or may not have gotten the same result on two throws. This would represent two offspring inheriting the same characteristics from the parents.
2. The greater the number of possible characteristics, the less chance two offspring have of inheriting exactly the same characteristics.
3. The dice model the randomness of inherited characteristics. Because there are so many different possible combinations, chance plays a big part in determining which characteristics any particular offspring will inherit.

Teacher Notes



LESSON 9.1 Review

Visualize It!

Traits are either inherited or acquired. Inherited traits are passed from one generation to the next.

An organism's phenotype can be influenced by factors in the environment, such as light, nutrients, or social interactions.

One result of a mutation could be a change in appearance, such as a change in feather color.

Summarize it!

1. What is inheritance?
2. What is the role of genes in inheritance?
3. How do environmental factors influence traits?
4. How do mutations influence traits?

302 Chapter 9

Inheritance and Traits

Use Vocabulary

1. A distinguishing characteristic of an organism is a(n) _____.
2. A permanent change in the sequence of DNA in a gene is a(n) _____.
3. **Distinguish** between phenotype and genotype.

Understand Key Concepts

4. Which is an inherited trait?
   - A. learning to sing
   - B. losing a claw
   - C. having a hooked beak
   - D. learning a new trick
5. **Design an experiment** to determine the environmental factors that cause adult flamingos to turn pink.
6. **Compare and contrast** sexual reproduction and asexual reproduction.

Interpret Graphics

7. **Organize Information** Copy the graphic organizer below and use it to list *gene*, *chromosome*, *cell*, and *DNA* from smallest to largest.

Critical Thinking

8. **Propose** an explanation for why this wallaby lacks normal coloration in its fur.

Math Skills

9. The common hamster has 20 chromosomes. How many different types of hamster offspring could form?

Lesson 9.1 Inheritance and Traits 303

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. trait **DOK 1**
2. mutation **DOK 1**
3. Phenotype is the collection of observable traits in an organism that results from the interaction of genes and the environment. Genotype is the entire collection of genes in an organism's cells. **DOK 2**

Understand Key Concepts

4. C. having a hooked beak **DOK 2**
5. Answers will vary. Students could vary the diet of the birds or choose other variables to test, such as temperature or nutrients in the water. **DOK 4**
6. In asexual reproduction, the offspring are identical to a parent. In sexual reproduction, the offspring are all different from their parents because each receives a slightly different set of genes from each parent. **DOK 3**

Interpret Graphics

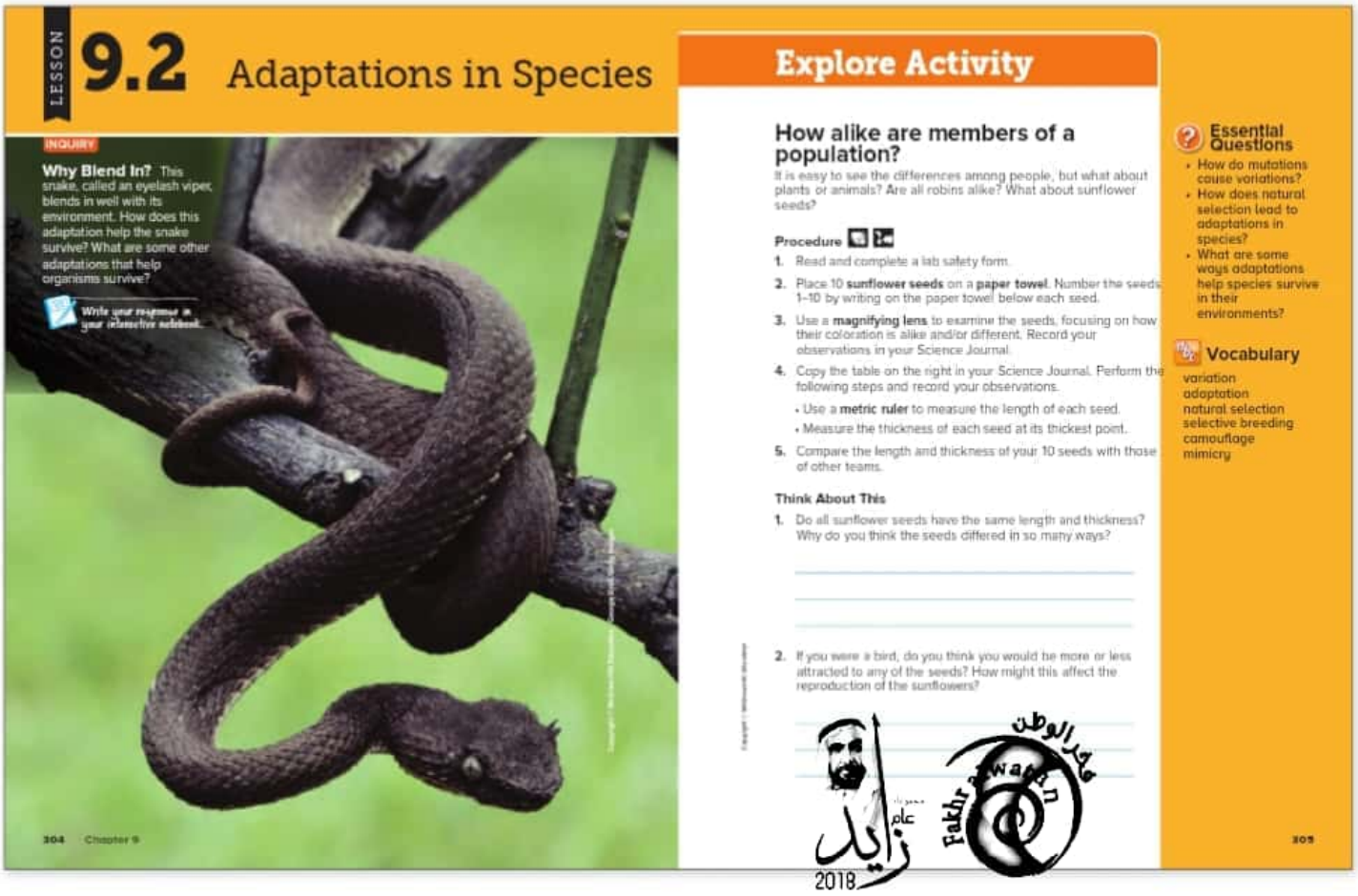
7. DNA → genes → chromosome → cell **DOK 2**

Critical Thinking

8. There is a mutation in one of the genes. **DOK 3**

Math Skills

9. $\frac{20}{2} = 10$; $2^{10} = 1024$ **DOK 1**



INQUIRY

About the Photo **Why Blend In?** Eyelash vipers vary in color, depending on where they live. These snakes can be yellow, green, red, brown, or gray. Eyelash vipers' habitats range from the southwestern United States through the northernmost parts of South America. In addition to their coloring, the eyelash vipers have scales above each eye. These "eyelashes" may help them blend in with their environments, making their eyes less noticeable. Ask students to closely note the details of the photo as you discuss adaptations.

Guiding Questions

AL	Why might you not notice the snake when you first glance at the photo?	*It blends in with the branch because it is a similar color.*
OL	How does the snake's adaptation help it survive?	*Use this question to launch a discussion of the importance of blending in for the purpose of hiding from predators—and hiding to await prey.*
BL	What are some other adaptations that help organisms survive?	*Answers will vary. Students may cite other ways animals camouflage with color or patterns, how some animals hunt at night or migrate, how some animals spray venom or shed their coats. All are adaptations for survival.*

LAB Manager

Labs can be found in *Activity Lab Workbook*.

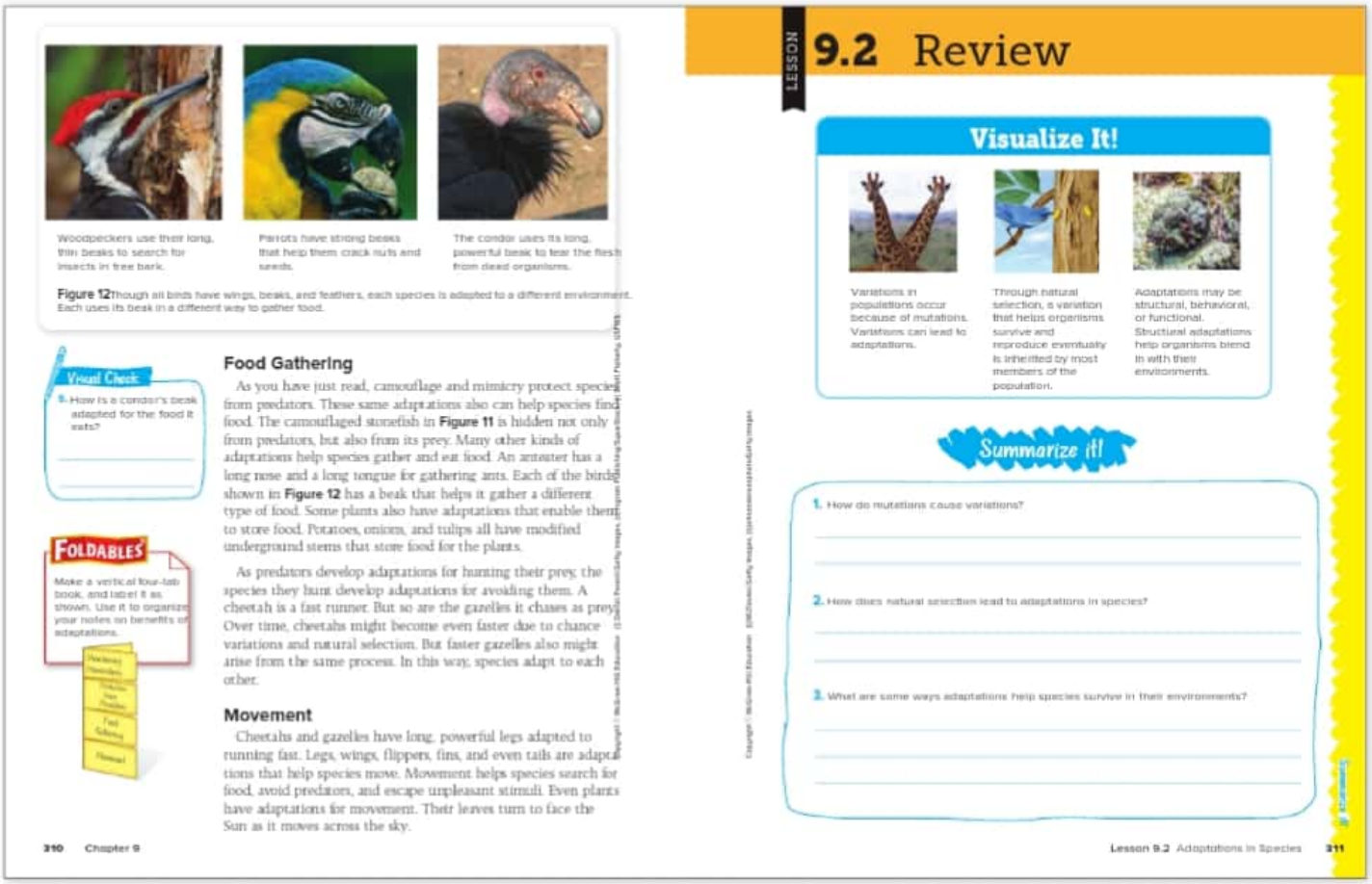
Essential Questions

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

Using Prior Knowledge to Understand Vocabulary

Ask students to talk about when they have used mimicry to imitate a singer, a dancer, or someone else. Write *mimic* on the board, making sure students understand that to *mimic* is to "imitate." Point out that the meaning of *mimicry* is a bit different in the natural world; it is an adaptation in which one species looks like another. Explain that in this lesson, students will learn more about mimicry in nature and about the difference between camouflage and mimicry.



Woodpeckers use their long, thin beaks to search for insects in tree bark.

Parrots have strong beaks that help them crack nuts and seeds.

The condor uses its long, powerful beak to tear the flesh from dead organisms.

Figure 12 Though all birds have wings, beaks, and feathers, each species is adapted to a different environment. Each uses its beak in a different way to gather food.

Visual Check

1. How is a condor's beak adapted for the food it eats?

FOLDABLES

Make a vertical four-tab book, and label it as shown. Use it to organize your notes on benefits of adaptations.

Food Gathering

As you have just read, camouflage and mimicry protect species from predators. These same adaptations also can help species find food. The camouflaged stonefish in **Figure 11** is hidden not only from predators, but also from its prey. Many other kinds of adaptations help species gather and eat food. An anteater has a long nose and a long tongue for gathering ants. Each of the birds shown in **Figure 12** has a beak that helps it gather a different type of food. Some plants also have adaptations that enable them to store food. Potatoes, onions, and tulips all have modified underground stems that store food for the plants.

As predators develop adaptations for hunting their prey, the species they hunt develop adaptations for avoiding them. A cheetah is a fast runner. But so are the gazelles it chases as prey. Over time, cheetahs might become even faster due to chance variations and natural selection. But faster gazelles also might arise from the same process. In this way, species adapt to each other.

Movement

Cheetahs and gazelles have long, powerful legs adapted to running fast. Legs, wings, flippers, fins, and even tails are adaptations that help species move. Movement helps species search for food, avoid predators, and escape unpleasant stimuli. Even plants have adaptations for movement. Their leaves turn to face the Sun as it moves across the sky.

LESSON 9.2 Review

Visualize It!

Variations in populations occur because of mutations. Variations can lead to adaptations.

Through natural selection, a variation that helps organisms survive and reproduce eventually is inherited by most members of the population.

Adaptations may be structural, behavioral, or functional. Structural adaptations help organisms blend in with their environments.

Summarize it!

1. How do mutations cause variations?
2. How does natural selection lead to adaptations in species?
3. What are some ways adaptations help species survive in their environments?

Food Gathering

While students recognize the need of food for survival, they might not have carefully considered adaptations related to acquiring food. Use the **Visual Literacy** below and **Figure 12** to guide their understanding.

Visual Literacy: Figure 12

Students should study the photographs in **Figure 12** and then answer the following questions.

Ask: How is a condor's beak adapted to the food it eats? *Its long, powerful beak is used to tear the flesh of the carcasses.*

Ask: How is a woodpecker's beak adapted to the food it eats? *Its long, thin beak helps it hammer into tree bark to find insects.*

Ask: How is a parrot's beak adapted to the food it eats? *Its strong beak is shaped for cracking open nuts and seeds.*

Movement

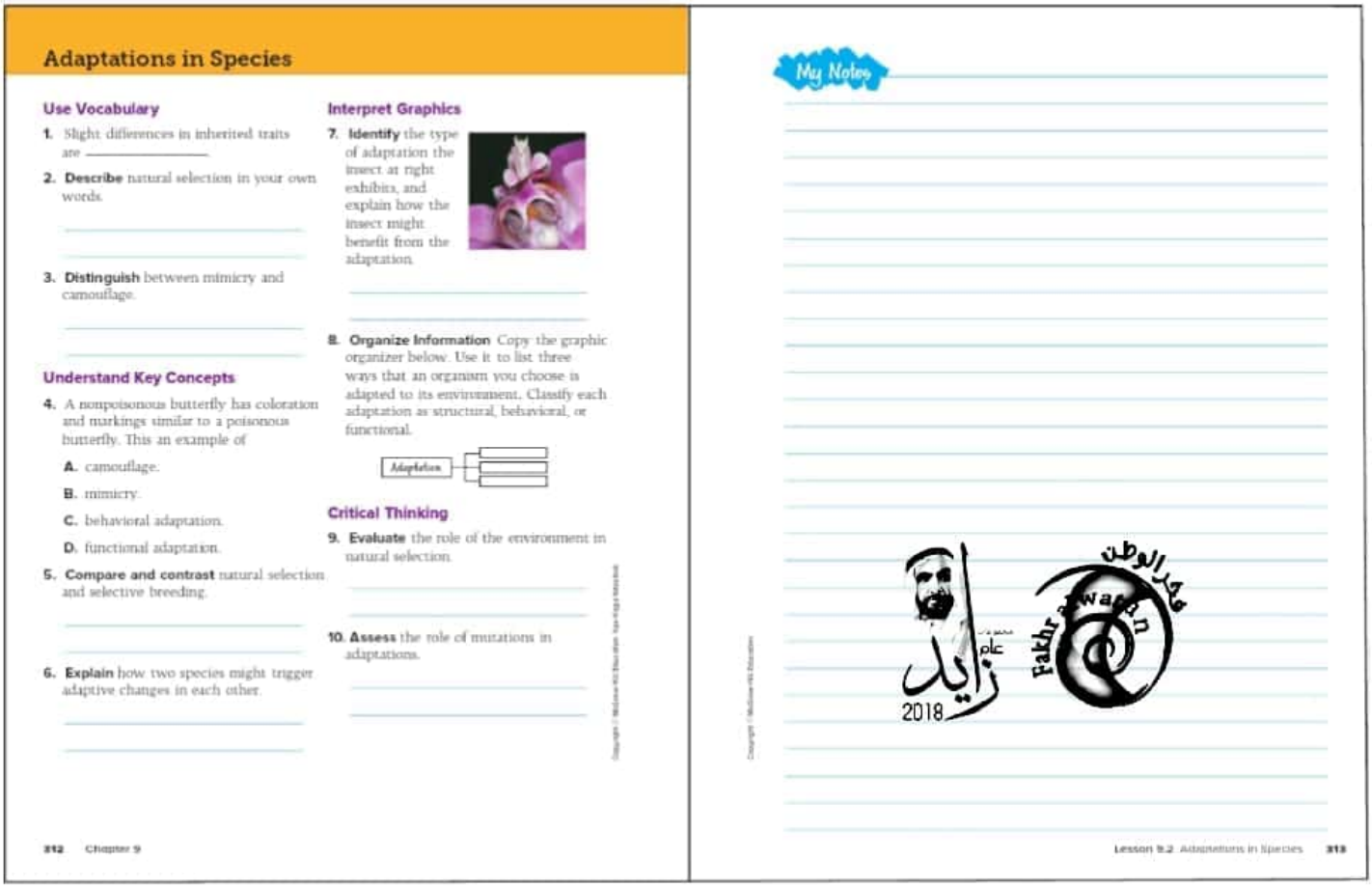
Use the Guiding Questions to help students understand adaptations that help species move.

Guiding Questions

AL	What are five adaptations that help species move?	*legs, wings, flippers, fins, and tails*
OL	How are adaptations related to movement alike for animals and plants?	*These adaptations enable animals and plants to obtain what they need for survival.*
BL	Suppose a fish's fins were damaged during an attack by a predator. What would be the effect on movement for the fish?	*Use this question to launch a discussion regarding the importance of movement to a fish. Students should discuss survival issues as they recognize that if the fins are badly damaged, the fish will not be able to move—or will not be able to control direction of movement.*

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?**



Adaptations in Species

Use Vocabulary

1. Slight differences in inherited traits are _____.
2. **Describe** natural selection in your own words.
3. **Distinguish** between mimicry and camouflage.

Understand Key Concepts

4. A nonpoisonous butterfly has coloration and markings similar to a poisonous butterfly. This an example of
   - A. camouflage.
   - B. mimicry.
   - C. behavioral adaptation.
   - D. functional adaptation.
5. **Compare and contrast** natural selection and selective breeding.
6. **Explain** how two species might trigger adaptive changes in each other.

Interpret Graphics

7. **Identify** the type of adaptation the insect at right exhibits, and explain how the insect might benefit from the adaptation.
8. **Organize Information** Copy the graphic organizer below. Use it to list three ways that an organism you choose is adapted to its environment. Classify each adaptation as structural, behavioral, or functional.

Adaptation

Critical Thinking

9. **Evaluate** the role of the environment in natural selection.
10. **Assess** the role of mutations in adaptations.

312 Chapter 9

My Notes

Lesson 9.2 Adaptations in Species 313

Summarize it!

Use Vocabulary

1. variations. variations **DOK 1**
2. Answers will vary but should convey that natural selection is the process by which variations that help organisms survive and reproduce more become common in a population. **DOK 2**
3. In camouflage, a species looks like something in its environment, usually nonliving. In mimicry, one species resembles another species. Usually this calls attention to the species. **DOK 2**

Understand Key Concepts

4. **B** mimicry **DOK 1**
5. Natural selection is a naturally-occurring process in which variations that help an organism survive are passed to offspring. Selective breeding is similar except people—not nature or the environment—select variations that are passed to offspring. **DOK 2**
6. Answers will vary but might include two species that are known to be predator and prey, such as a fox and a rabbit. As the environment selects variations that make the fox faster, similar variations in the rabbit are selected to make the rabbit faster. If the predator didn't get faster, the environment would not be as likely to select variations to make the prey faster. There is more chance that a variation will be passed to offspring if it increases survival. **DOK 3**

Interpret Graphics

7. This is an example of camouflage. Because the insect is hard to see against its background, it avoids being eaten and survives longer in its environment. **DOK 1**
8. Answers will vary but should be traits common to a species, not an individual. **DOK 2**

Critical Thinking

9. The environment plays a critical role in natural selection. Only the variations that help an organism survive in its environment will be selected. These variations will then be passed to offspring. **DOK 3**
10. Without mutations, there would be no variations in individuals. If there were no variations, the environment would have nothing to "select." Therefore, mutations help organisms—and their offspring and the offspring's offspring, and so on—adapt to changes in their environments. **DOK 4**

CHAPTER 9

Study Guide

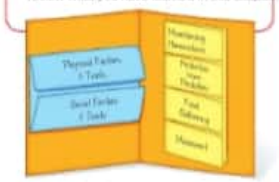
The BIG Idea

Inherited mutations can lead to variations, which can become adaptations through natural selection over many generations.

Key Concepts Summary	Vocabulary
9.1 Inheritance and Traits - The passing of traits from generation to generation is inheritance. - Information about traits is passed from parents to offspring in genes. - An organism's phenotype can be influenced by environmental factors, such as temperature, nutrients, and social interaction. - Only traits affected by mutation can be passed to offspring. 	trait inheritance gene genotype phenotype mutation
9.2 Adaptations in Species - Variations arise when mutations cause changes in the sequence of an organism's DNA. - Natural selection explains how variations that help organisms survive are passed to offspring and eventually become adaptations. - Adaptations help species maintain homeostasis, protect themselves from predators, gather food, and move. 	variation adaptation natural selection selective breeding camouflage mimicry

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.



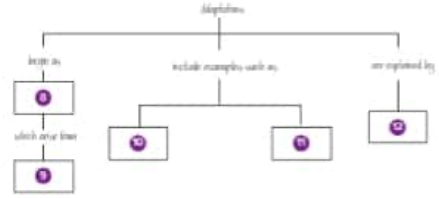
Use Vocabulary

Choose the vocabulary term that best matches the descriptions below.

1. slight differences in inherited traits
2. a distinguishing characteristic of an organism
3. all of an organism's genes
4. how a trait appears, or is expressed
5. adaptation that helps an organism blend in with its surroundings
6. the human practice of breeding organisms with desired characteristics
7. resembling another species

Link Vocabulary and Key Concepts

Copy this concept map, and then use vocabulary terms from the previous page to complete the concept map.



Key Concepts Summary

Study Strategy: Questions and Answers

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 in the first column, their answer in the second column, and their self-assessment in the third column. **Example:**

Lesson KC Questions	My Answers	My Self-Assessment
What is inheritance?	Inheritance is the passing of inherited traits from parents to offspring.	I left out the part about passing the traits from generation to generation, but it means the same thing as passing the traits from parents to offspring. I understand the concept.

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. 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
trait	A trait is a characteristic that an organism has. Inherited traits are passed on from parents to offspring. Acquired traits are not passed on to offspring.

Use Vocabulary

1 variations
2 trait
3 genotype
4 phenotype
5 camouflage
6 selective breeding
7 mimicry

Link Vocabulary and Key Concepts

8 variations
9 mutations
10 camouflage
11 mimicry
12 natural selection

Teacher Notes

CHAPTER 9 Review

Chapter Review

Understand Key Concepts

1. In which way does asexual reproduction differ from sexual reproduction?
   - A. Genes are not involved in asexual reproduction.
   - B. No traits are passed to offspring in asexual reproduction.
   - C. Offspring are identical to the parent in asexual reproduction.
   - D. There are no mutations in asexual reproduction.
2. Which is a source of variations?
   - A. adaptations
   - B. mutations
   - C. phenotype
   - D. traits
3. Which is the sequence by which natural selection works?
   - A. selection → adaptation → variation
   - B. selection → variation → adaptation
   - C. variation → adaptation → selection
   - D. variation → selection → adaptation
4. Which adaptation is functional?
   - A. a lizard playing dead
   - B. a monkey swinging by its tail
   - C. a skunk spraying a predator
   - D. a wolf hunting in a pack
5. Which process is illustrated below?

   - A. meiosis
   - B. mutation
   - C. asexual reproduction
   - D. natural selection
6. Which trait cannot be inherited?
   - A. scars
   - B. shyness
   - C. big feet
   - D. red hair
7. The photo below is a leaf butterfly. Which explains how the butterfly came to resemble a leaf?

   - A. The butterfly's shape is the result of an exchange of genes with plants over many generations.
   - B. The butterfly's shape is the result of the environment causing mutations over many generations.
   - C. The butterfly's shape is the result of the environment influencing its phenotype over many generations.
   - D. The butterfly's shape is the result of the environment selecting variations over many generations.
8. Giraffes range in color from orange to yellow. Which explains these color differences?
   - A. adaptations
   - B. variations
   - C. natural selection
   - D. selective breeding

Critical Thinking

9. **Design** an organism adapted to a murky lake with many plants. The organism's major predator is a large fish that swims slowly.
10. **Assess** how mutations can be beneficial.
11. **Differentiate** among mutation, variation, and adaptation, and explain how they are related to one another.
12. **Classify** the following adaptations as structural, behavioral, or functional: robins migrating, llamas spitting, bats hibernating, a beetle's color, wolves hunting in packs.
13. **Predict** what might happen to a species of ground plants over many generations when leaf-eating tortoises move into its range.
14. **Design an experiment** to test whether a trait in an animal is inherited or the result of an environmental factor.
15. **Interpret Graphics** The seal on the right has normal coloration. The seal on the left does not. What could explain why the seal on the left has abnormal coloration?

Writing in Science

16. **Write** Scientists have determined that all dogs were bred from wolves. Think about how wolves might have become tame enough to be pets. Then write a paragraph explaining how dogs became so different over time. Include a main idea, supporting details, and a concluding sentence.

The BIG Idea

17. Adaptations help species survive in their environments. Choose two species that live near you, and list at least three ways—one structural, one behavioral, and one functional—that each is adapted to its environment. Explain how each adaptation helps the species survive.
18. In what ways does the juvenile mountain goat look like its mother? In what ways might the offspring be different from its mother? Explain how differences in individual mountain goats could help the species survive if its environment suddenly changed.

Math Skills

Use Probability

19. A dandelion has 24 chromosomes. How many possible combinations of chromosomes can form in the offspring?
20. A human has 46 chromosomes. How many different combinations of chromosomes can be produced during reproduction?
21. A radish has 18 chromosomes. How many possible combinations can the chromosomes make during reproduction?

Understand Key Concepts

1 **C.** Offspring are identical to the parent in asexual reproduction.

2 **B.** mutations

3 **D.** variation → selection → adaptation

4 **C.** a skunk spraying a predator

5 **A.** meiosis

6 **A.** scars

7 **D.** The butterfly's shape is the result of the environment selecting variations over many generations.

8 **B.** variations

Critical Thinking

9 Answers will vary but should reflect the conditions of the lake. The organism may have dark coloration, move quickly, and feed on plants.

10 Mutations can lead to variations in individuals within a population. Some variations might give an organism an advantage in a particular environment.

11 A mutation is a permanent change to a gene. A variation is a difference in inherited traits among individual members of a species. An adaptation is a trait that helps a species survive in its environment. Variation within a species occurs because of mutations in genes. Variations can lead to adaptations if the variation enables individuals to survive and reproduce.

12 behavioral; functional; behavioral; structural; behavioral

13 The plants might be eaten to extinction. If some plants have a variation that enables them to grow taller, they might survive and reproduce. Eventually, most or all of the surviving plants would be taller.

14 Answers will vary but should describe a hypothesis and the variables being tested in the experiment. Sample answer: Change the environmental variable (number of hours of daylight) and see if the trait (biorhythm) responds.

15 The seal on the left has a mutation in which pigment is not produced so its fur is white.

Writing in Science

16 Answers will vary. Students might include the idea that dogs that were tame received food or shelter from humans that enabled them to survive and reproduce more successfully than those that were not. Differences in types of dogs might have been selectively bred into many dogs. Others would have adapted, over time, to the type of environment that they were living in.

The BIG Idea

17 Answers will vary depending on the organisms students choose.

18 The juvenile goat has white fur, strong legs, and hooves for climbing like its mother. It might be larger or smaller than its mother, once it is fully grown. It might have more fur or stronger legs. Variations in individuals might help them survive and reproduce more successfully than those that do not have the variations. Since variations are caused by mutations in genes, they are inherited, or passed from one generation to the next. As more individuals in a population inherit the variation, it becomes an adaptation. An adaptation is a trait that helps a species survive in its environment.

Math Skills

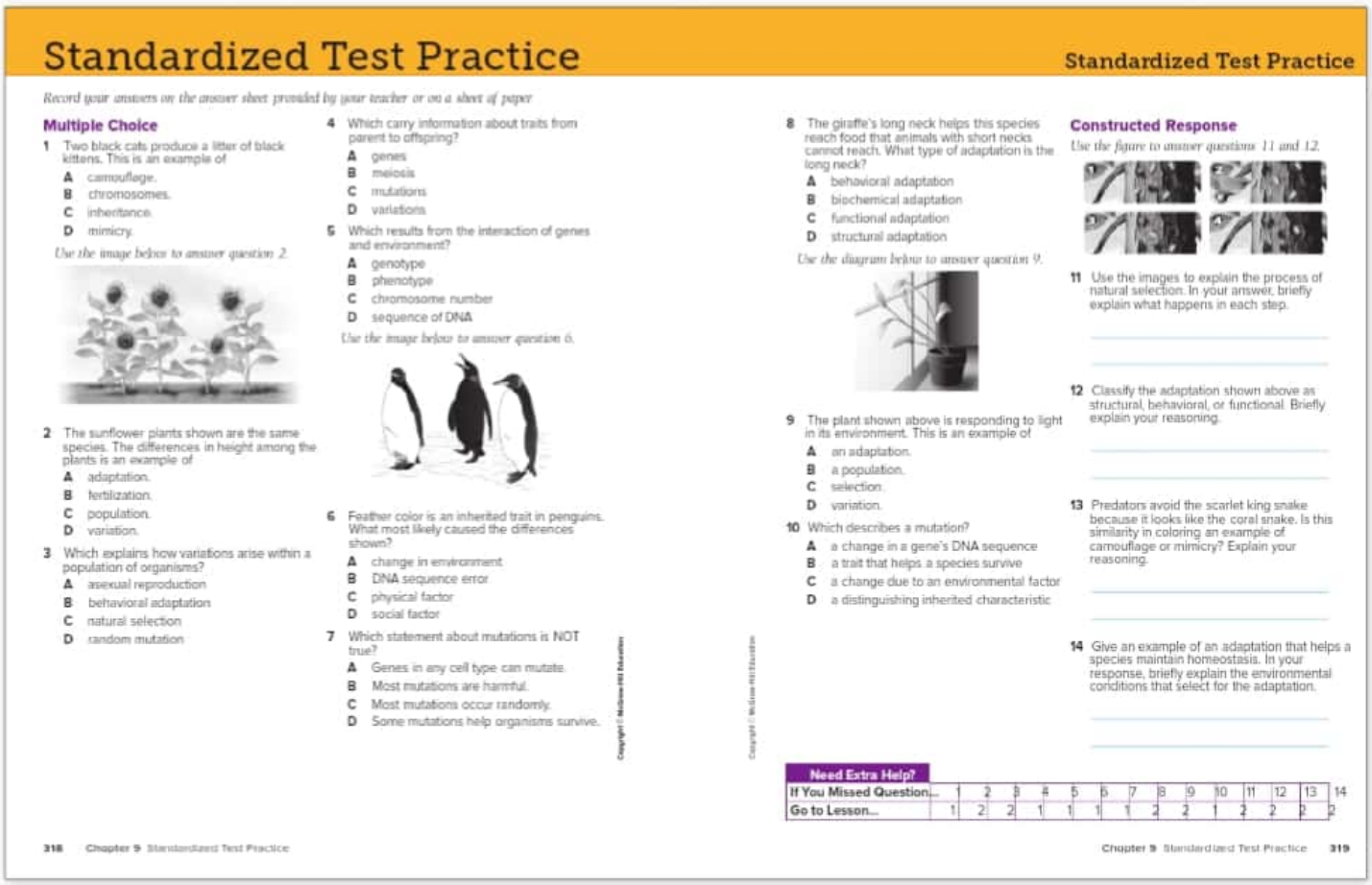
Use Probability

19 4096

20 8,400,000

21 512

Teacher Notes



Standardized Test Practice

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

Multiple Choice

1 Two black cats produce a litter of black kittens. This is an example of
A camouflage.
B chromosomes.
C inheritance.
D mimicry.

Use the image below to answer question 2.

2 The sunflower plants shown are the same species. The differences in height among the plants is an example of
A adaptation.
B fertilization.
C population.
D variation.

3 Which explains how variations arise within a population of organisms?
A asexual reproduction
B behavioral adaptation
C natural selection
D random mutation

4 Which carry information about traits from parent to offspring?
A genes
B meiosis
C mutations
D variations

5 Which results from the interaction of genes and environment?
A genotype
B phenotype
C chromosome number
D sequence of DNA

Use the image below to answer question 6.

6 Feather color is an inherited trait in penguins. What most likely caused the differences shown?
A change in environment
B DNA sequence error
C physical factor
D social factor

7 Which statement about mutations is NOT true?
A Genes in any cell type can mutate.
B Most mutations are harmful.
C Most mutations occur randomly.
D Some mutations help organisms survive.

8 The giraffe's long neck helps this species reach food that animals with short necks cannot reach. What type of adaptation is the long neck?
A behavioral adaptation
B biochemical adaptation
C functional adaptation
D structural adaptation

Use the diagram below to answer question 9.

9 The plant shown above is responding to light in its environment. This is an example of
A an adaptation.
B a population.
C selection.
D variation.

10 Which describes a mutation?
A a change in a gene's DNA sequence
B a trait that helps a species survive
C a change due to an environmental factor
D a distinguishing inherited characteristic

Constructed Response

Use the figure to answer questions 11 and 12.

11 Use the images to explain the process of natural selection. In your answer, briefly explain what happens in each step.

12 Classify the adaptation shown above as structural, behavioral, or functional. Briefly explain your reasoning.

13 Predators avoid the scarlet king snake because it looks like the coral snake. Is this similarity in coloring an example of camouflage or mimicry? Explain your reasoning.

14 Give an example of an adaptation that helps a species maintain homeostasis. In your response, briefly explain the environmental conditions that select for the adaptation.

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	2	2	1	1	1	1	2	2	1	2	2	2	2

Multiple Choice

1 C—Correct. A, B, D—The passing of traits from generation to generation is inheritance. Camouflage and mimicry are types of adaptations. A chromosome is a structure in a cell that contains DNA. **DOK 1**

2 D—Correct. A, B, C—The difference in the height of the sunflowers is due to a variation. The difference is not an adaptation because there is no indication that it is beneficial. Fertilization is a step in sexual reproduction. A population refers to a group of individuals, not a difference among individuals. **DOK 2**

3 D—Correct. A, B, C—Variations occur through random mutations. In asexual reproduction, the offspring is identical to the parent. A behavioral adaptation and natural selection do not explain how a genetic variation arises. **DOK 2**

4 A—Correct. B, C, D—Genes carry information about traits. Meiosis is a process involved in passing along genetic information. Mutations and variations do not carry genetic information. **DOK 1**

5 B—Correct. A, C, D—An organism's phenotype is the result of its genotype and its environment. Genotype, chromosome number, and the sequence of DNA are not affected by environment. **DOK 1**

6 B—Correct. A, C, D—The difference in the penguin's feather color was most likely caused by an error in the sequence of its DNA. A, C, and D do not cause changes in inherited traits. **DOK 2**

7 B—Correct. A, C, D—Some mutations are harmful, but many have no effect on the organism or are beneficial. **DOK 1**

8 D—Correct. A, B, C—A physical trait, such as the giraffe's long neck, is a structural adaptation. **DOK 1**

9 A—Correct. B, C, D—The plant responding to light is an adaptation which helps the plant survive in its environment. **DOK 1**

10 A—Correct. B, C, D—A mutation is a permanent change in the DNA sequence of a gene. A trait that helps a species survive is an adaptation. An organism's phenotype can be affected by an environmental factor. A distinguishing inherited characteristic is a trait. **DOK 1**

Constructed Response

11 Step 1 shows variation in body color in a population of beetles. In step 2, the environment changes when a new predator arrives. The predator sees lightcolored beetles more easily, so more light-colored beetles are eaten than dark ones. Step 3: Fewer light-colored beetles survive to reproduce. Because body color is inherited, the next generation will include fewer light-colored beetles. There are now more dark-colored beetles compared to light-colored beetles. Step 4: With each generation, more and more offspring display dark color. Dark color becomes a camouflage adaptation. **DOK 3**

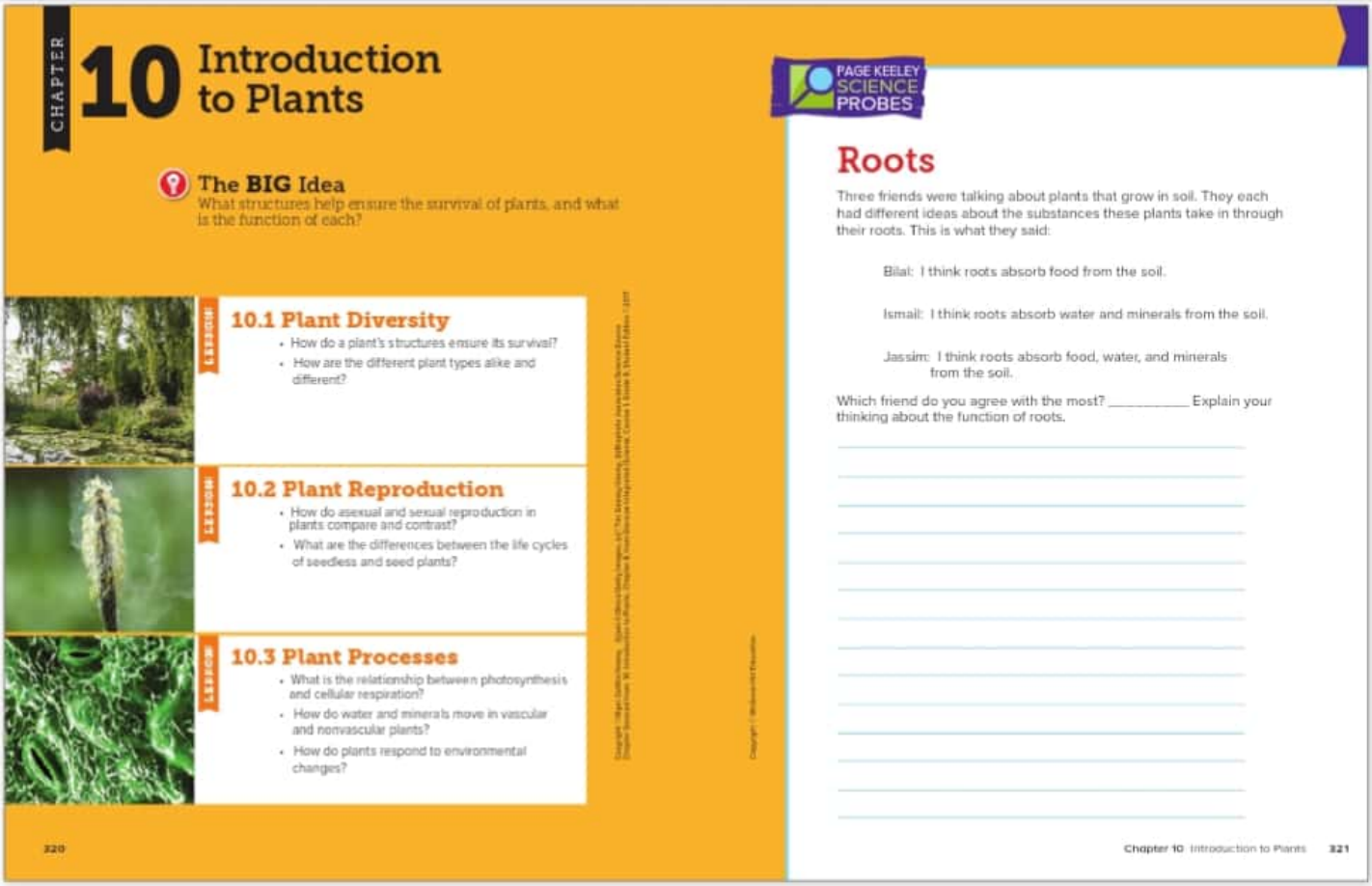
12 Body color is a structural adaptation because it is a physical trait that increases the beetles' chances of survival. **DOK 2**

13 The similarity in coloring between the scarlet king snake and the coral snake is an example of mimicry. Mimicry is an adaptation in which one species looks like another species. Camouflage is an adaptation in which an organism blends in with its surroundings. **DOK 2**

14 Student answers will vary but should note both the adaptation and the environmental conditions and should demonstrate an understanding of homeostasis. Sample answer: Sweating in humans maintains homeostasis when environmental temperature increases. **DOK 3**

Answer Key

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



CHAPTER 10 Introduction to Plants

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

LESSON 10.1 Plant Diversity
- How do a plant's structures ensure its survival?
- How are the different plant types alike and different?

LESSON 10.2 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?

LESSON 10.3 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?

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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:

Bilal: I think roots absorb food from the soil.

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

Jassim: 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 10 Introduction to Plants 321

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*.

Get Ready to Read

What do you think?

Use this anticipation guide to gauge students' background knowledge and preconceptions about plants. At the end of each lesson, ask students to read and evaluate their earlier responses. Students should be encouraged to change any of their responses.

Anticipation Set for Lesson 1

1. **Humans could survive without plants.**

   Disagree. Humans depend on plants for food, oxygen, building materials, and other things.

2. **Plant cells contain the same organelles as animal cells.**

   Disagree. Plant cells have some organelles that animals cells do not have.

LESSON

10.1 Plant Diversity

INQUIRY

Why Such Diversity?

There are a wide variety of plant species shown in this photo. Some of the plants are growing directly in the pond, while other plants are growing outside the pond. What similarities do all of these plants share? What differences do you observe?

Write your response in your interactive notebook.

Explore Activity

What does a plant need to grow?

Plants grow in many different environments. What sorts of things do plants need to survive?

Procedure

1. Read and complete a lab safety form.
2. Brainstorm things a plant needs to survive. List the items on a large sheet of **poster board** and **tape** it to a wall of your classroom.
3. Obtain several **radish seeds**. Select the materials you will need to grow the seeds from the materials provided.
4. Plant the radish seeds in a **petri dish**. Place the petri dish in an appropriate environment.
5. Write a brief plan in your Science Journal describing how to grow and care for your radish plants. Include information about what your seeds need and how you will meet these needs. Follow this plan for the next several days.

Think About This

1. What things do plants require to survive? Which of these requirements are similar to the things humans need to survive?
2. What did you use to grow your radish seeds? Explain your reasoning for each.
3. **Key Concept** What types of structures do you think plants have in order to obtain the things they need to survive?

Essential Questions

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

Vocabulary

rhizoids
stomata
nonvascular plant
vascular plant
gymnosperm
angiosperm

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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.

LAB Manager

All the labs for this lesson can be found in the *Student Resource Handbook* and the *Activity Lab Workbook*.

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

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.

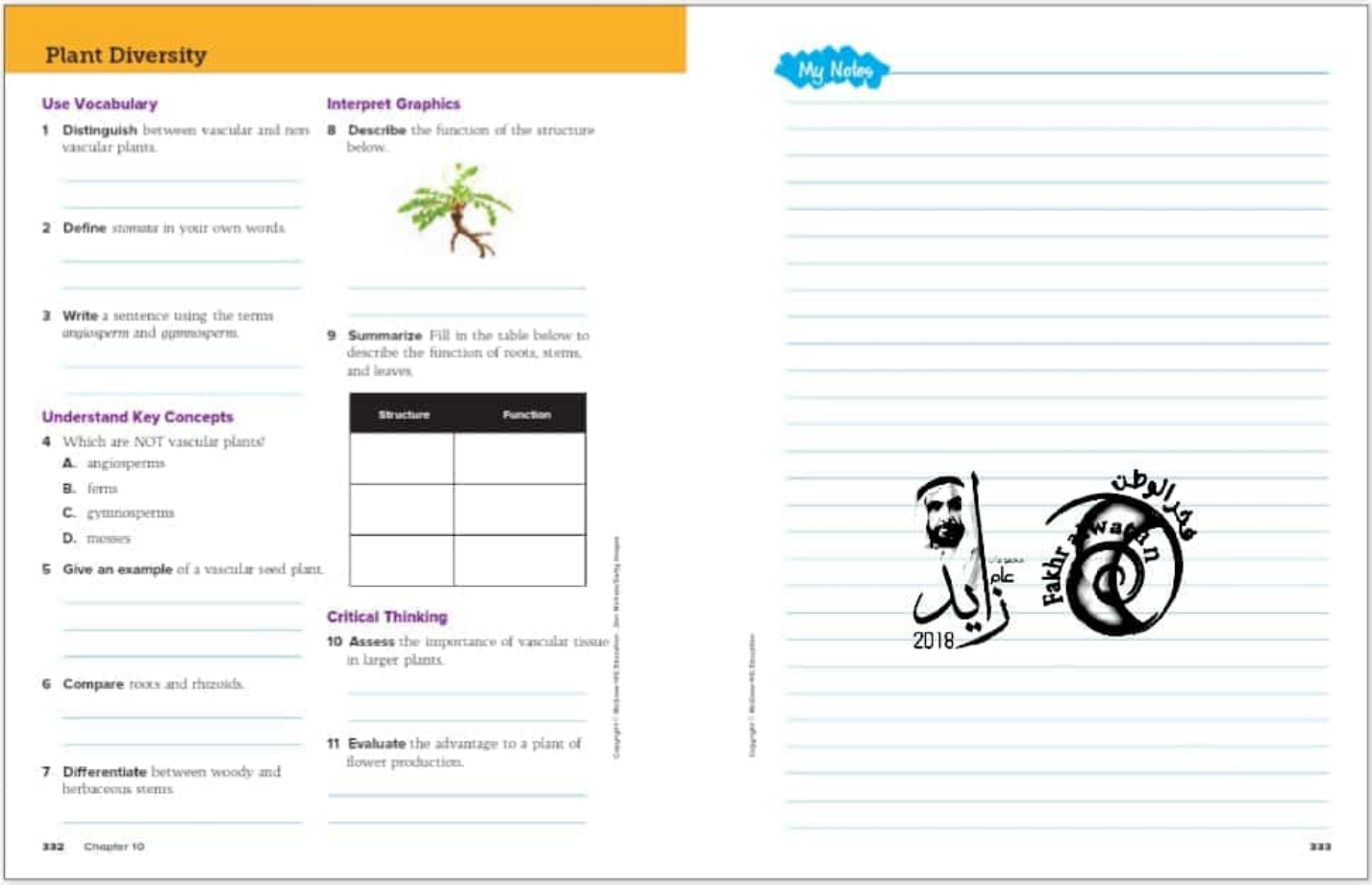
Guide the Investigation

- 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



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.

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

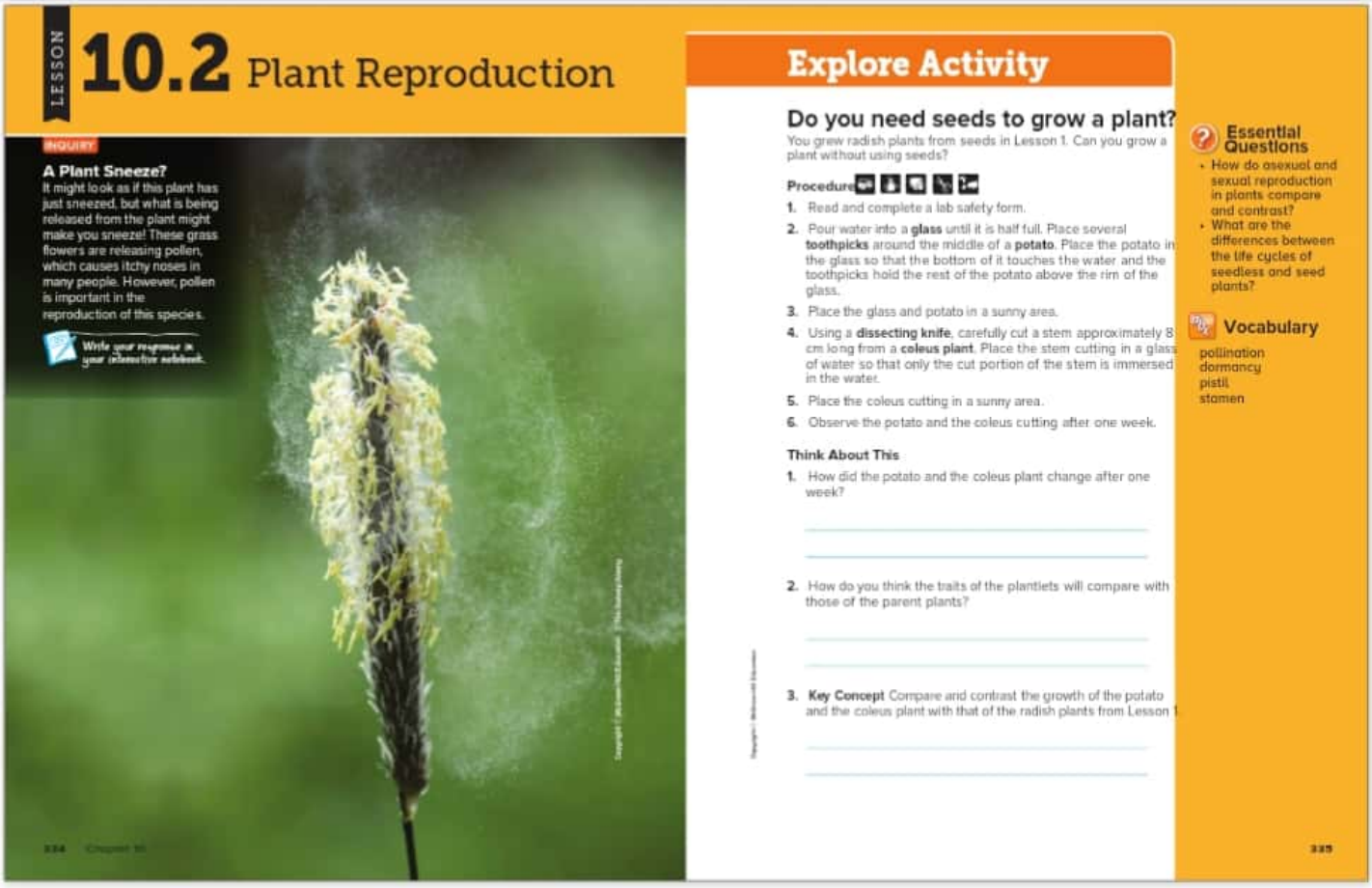
8. It is a taproot. It anchors the plant in the soil, absorbs water and nutrients, and can store food for the plant. **DOK 2**

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

10.2 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

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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.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

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

10.2 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?

Summarize it!

Use Vocabulary

1. A period of no growth is called _____.

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

3. **Write** a sentence using the terms *pistil* 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

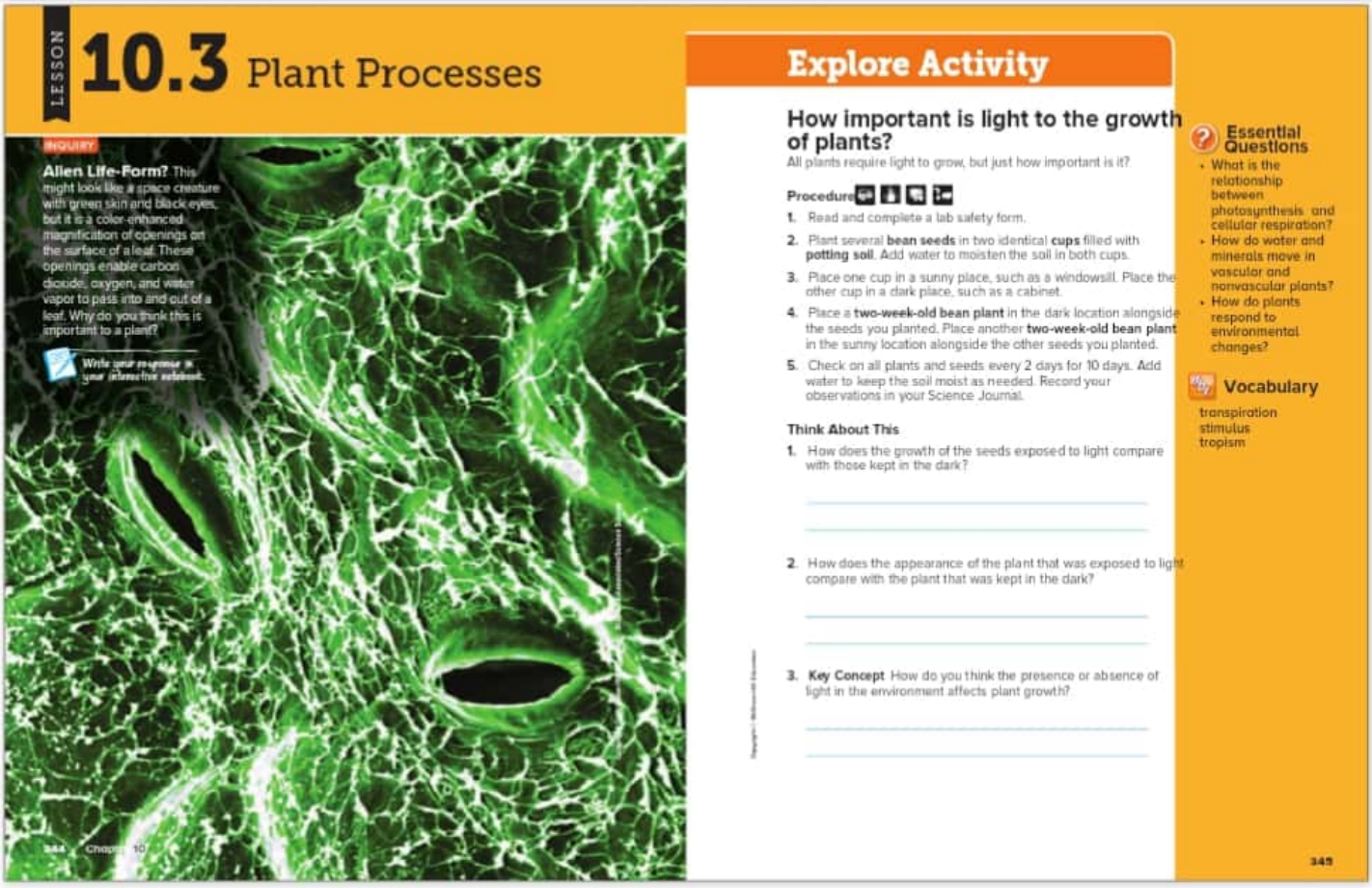
8. The traits are identical because the plant reproduces asexually. **DOK 2**
9.

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 10.3 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.

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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.*

LAB Manager

All the labs for this lesson can be found in the *Activity Lab Workbook*.

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 light 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 10.3 Review

Plant Processes

Plants make sugar through the process of photosynthesis. Plants break down sugar into usable energy through the process of cellular respiration.

All plants must be able to transport water and nutrients in order to survive.

Plants respond to internal and external stimuli.

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 10.3 Review 353

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**

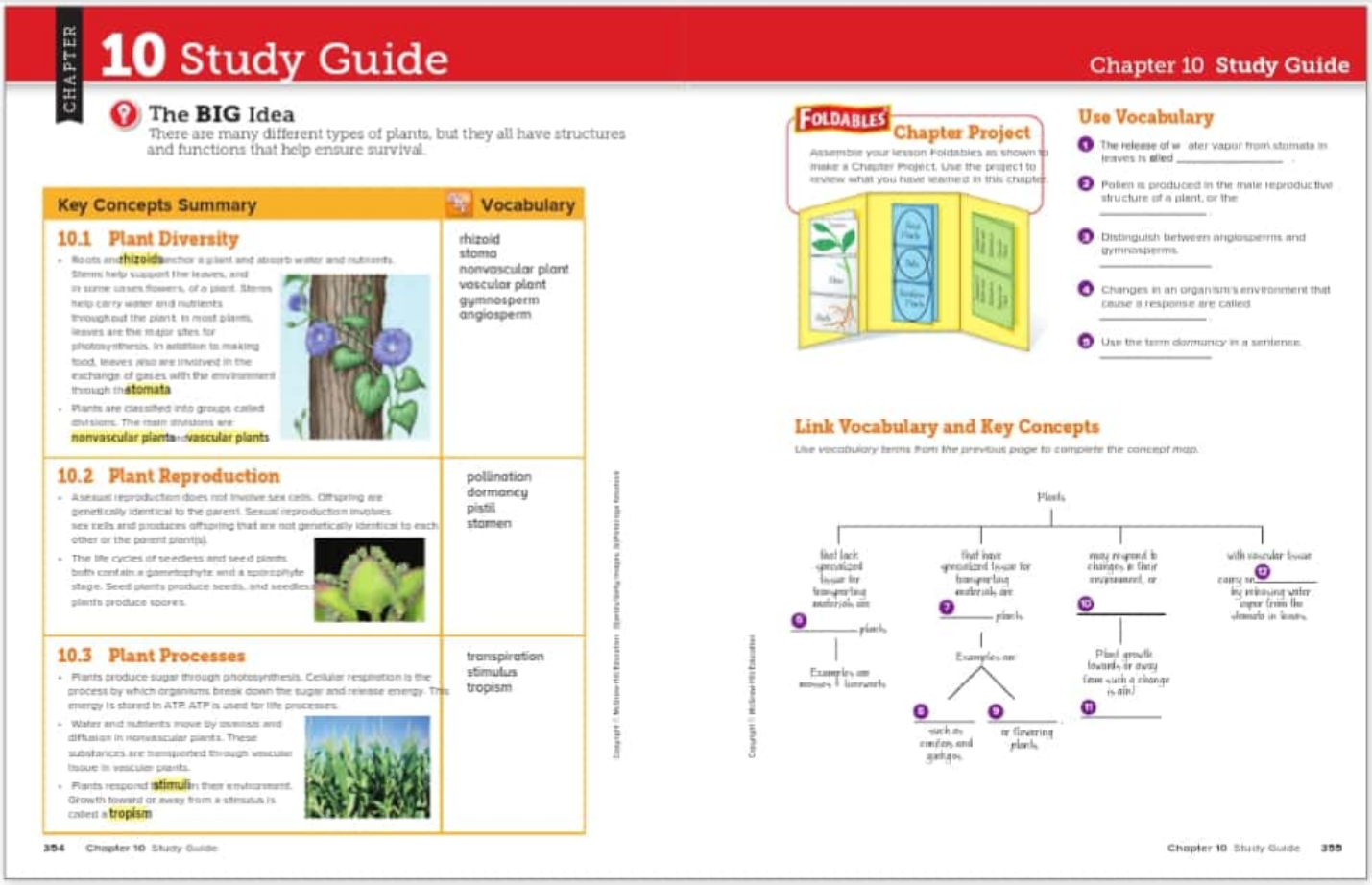
Critical Thinking

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**



CHAPTER 10 Study Guide

Chapter 10 Study Guide

The BIG Idea

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

Key Concepts Summary

10.1 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 help 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 the stomata.
- Plants are classified into groups called divisions. The main divisions are nonvascular plants and vascular plants.

10.2 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 plant(s).
- 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.

10.3 Plant Processes

- Plants produce sugar through photosynthesis. Cellular respiration is the process by which organisms break down the 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.

Vocabulary

rhizoid
stoma
nonvascular plant
vascular plant
gymnosperm
angiosperm
pollination
dormancy
pistil
stamen
transpiration
stimulus
tropism

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. _____

Link Vocabulary and Key Concepts

Use vocabulary terms from the previous page to complete the concept map.

Plants

that lack specialized tissue for transporting materials are 6 _____ plants.

Examples are mosses and liverworts.

that have specialized tissue for transporting materials are 7 _____ plants.

Examples are 8 _____ such as conifers and ginkgos, and 9 _____ or flowering plants.

may respond to changes in their environment, or 10 _____

Plant growth toward or away from such a change is a(n) 11 _____.

with vascular tissue 12 _____ carry water by releasing water vapor from the stomata in leaves.

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Chapter 10 Study Guide 355

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.

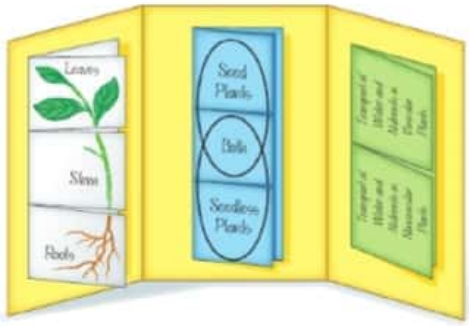
Vocabulary

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

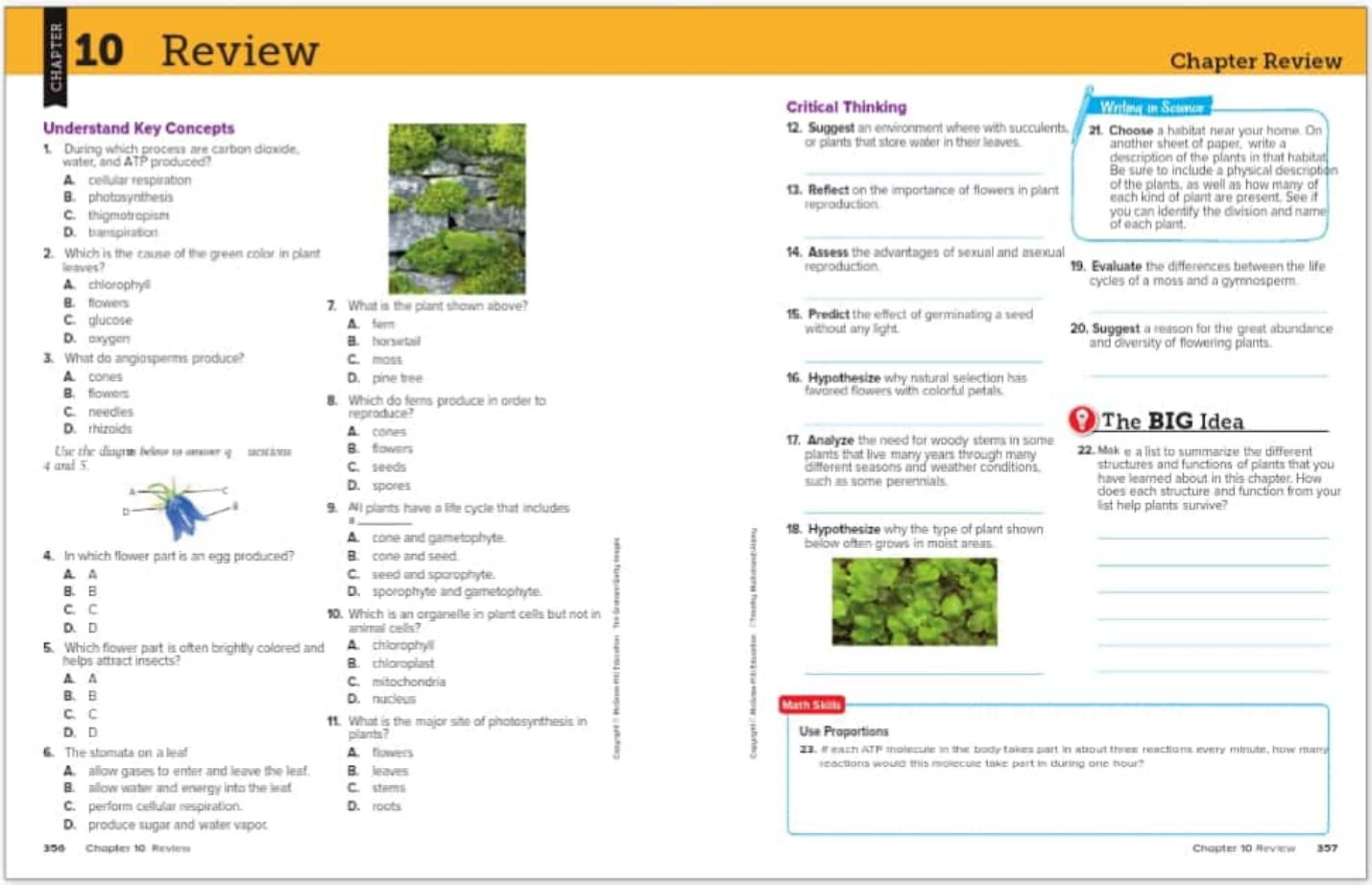
9 angiosperms

10 stimuli

11 tropism

12 transpiration

Teacher Notes



CHAPTER 10 Review

Chapter Review

Understand Key Concepts

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.

Write 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

Use Proportions

23. If each ATP molecule in the body takes part in about three reactions every minute, how many reactions would this molecule take part in during one hour?

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Chapter 10 Review 357

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

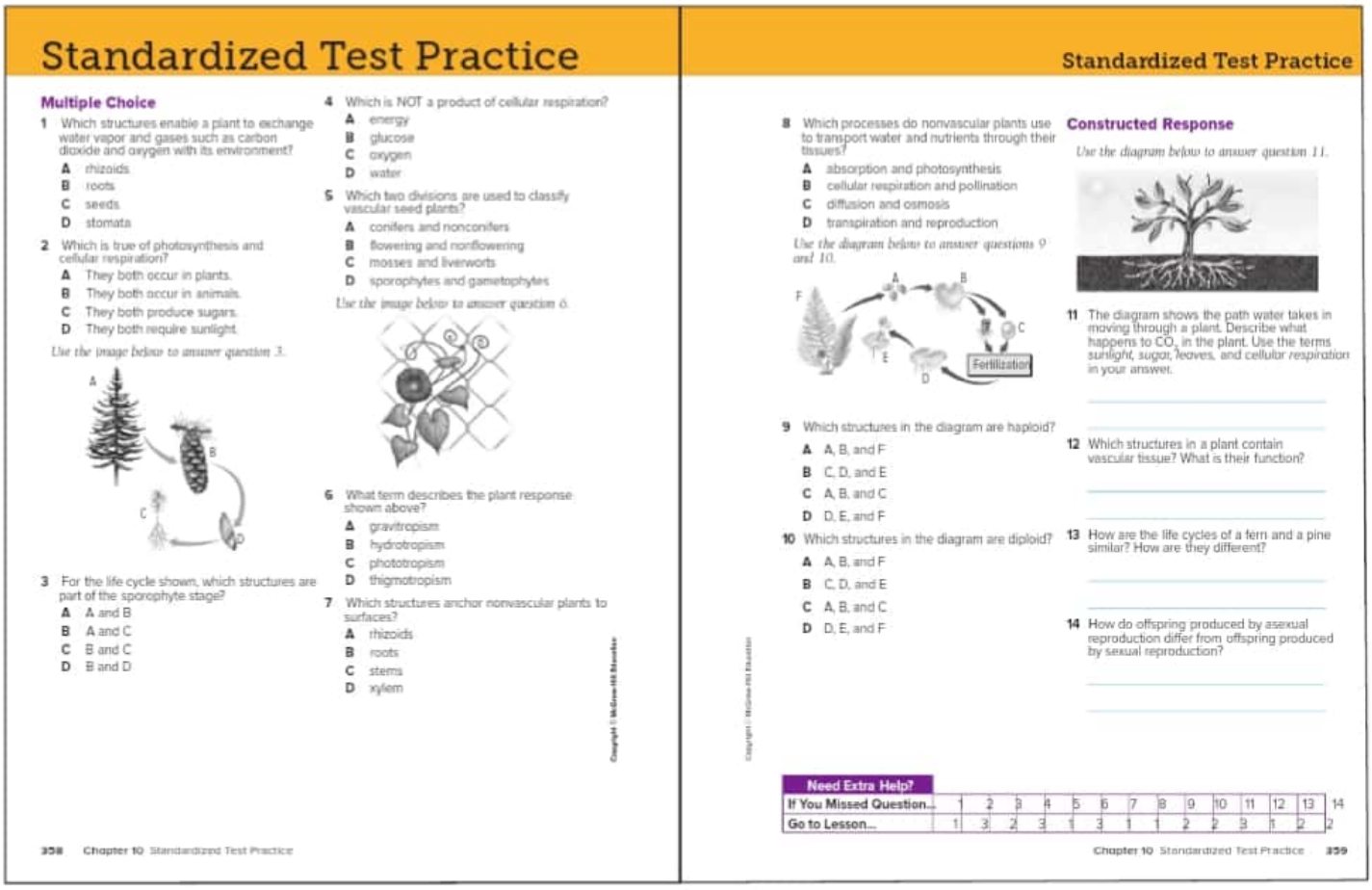
22. Students should list structures such as roots, leaves, vascular tissue, and so on, and describe their function. Students should explain that these structures are adaptations that help plants survive the different conditions of their environments.

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

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

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

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

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**

Constructed Response

11 Carbon dioxide is taken into the plant through the leaves. Together with water, sunlight, and chlorophyll, it is converted into sugar and oxygen through photosynthesis. The sugar and oxygen from photosynthesis is used during cellular respiration to produce carbon dioxide, water, and ATP (energy). **DOK 3**

12 Vascular tissue is located in the roots, stems, and leaves. It is specialized to carry water and nutrients from the soil up to the leaves. **DOK 2**

13 Both types of plants have a gametophyte stage and a sporophyte stage. Ferns are seedless plants and produce spores; pines are seed plants and produce seeds. **DOK 3**

14 Offspring produced by asexual reproduction are genetically identical to each other and to the parent. Offspring produced by sexual reproduction are not genetically identical to each other or to the parent plant(s). **DOK 2**

Answer Key

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