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SCIENCE EXPLORER

Grade 8

Guided Reading and Study Workbook

- Promotes active reading and enhances students' study skills using innovative questioning strategies and exercises linked to the student text
- Builds a record of students' work to use as a study aid for quizzes and tests
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Pearson Education

Science Explorer Guided Reading and Study Workbook Grade 8

Prentice Hall

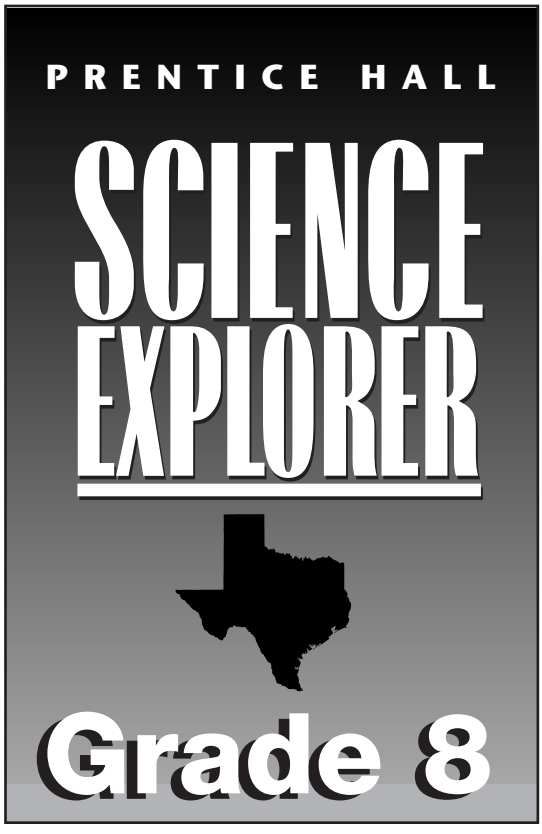

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Table of Contents

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What Is Science?
(pages 10–19)

This section describes the skills that scientists use in their work. It also explains how scientists test possible explanations for what they have observed.

▶ Introduction (page 10)

1. What is science? Science is a way of learning about the natural world and the knowledge gained in that process

2. A term for the many ways in which scientists study the world around them is scientific inquiry.

▶ Thinking Like A Scientist (pages 10–15)

3. What are four skills used by scientists?
   a. posing questions
   b. making observations and inferences
   c. developing hypotheses
   d. designing experiments
   e. collecting data and making measurements
   f. interpreting data
   g. drawing conclusions

4. Circle the letter of the term that involves using one or more of the five senses to gather information.
   a. experimentation **b.** scientific inquiry
   c. observation **d.** manipulation

5. Observations usually lead to inferences.

Name _____ Date _____ Class _____

What Is Science? *(continued)*

6. What is a hypothesis? A hypothesis is a possible explanation for observations that relate to a scientific question.

7. Complete the table about variables.

Variables		
Type	**Alternative Name**	**Definition**
Manipulated variable	Independent variable	The variable that a scientist changes
Responding variable	Dependent variable	The variable that is expected to change because of the manipulated variable

8. What do scientists do to make sure that changes in the manipulated variable are causing the changes in the responding variable? They test, or change, only one variable at a time.

9. An investigation in which all variables except one remain constant is called a(n) controlled experiment.

10. What are data? Data are the facts, figures, and other evidence that you learn through observation.

11. Why do scientists take measurements in a standard way? Doing so makes it easier to share data.

12. The system of measurement scientists use is called the International System of Units (SI).

13. At the end of an experiment, what does the conclusion state? The conclusion states whether or not the data supported the hypothesis.

14. A model that imitates a real-world situation is called a(n) simulation.

Name _____ Date _____ Class _____

15. What are two ways that scientists communicate with one another?

a. Writing articles in scientific journals and speaking at meetings

▶ Developing Scientific Laws and Theories (page 16)

16. What is a scientific law? A scientific law is a statement that describes what scientists expect to happen every time under a particular set of conditions.

17. A well-tested idea that explains and connects a wide range of observations is a(n) scientific theory.

18. What happens when a scientific theory is contradicted by new evidence?

Scientists change the theory or abandon it.

▶ Laboratory Safety (page 16)

19. What are two reasons that following safe laboratory practices is a good idea? Following them will protect you and your classmates from injury and it will make your investigations run more smoohtly.

▶ Branches of Science (page 18)

20. What are the four main branches of science? physical science, Earth science, life science, and environmental science

21. A person who studies the chemicals found in air, soil, and water is a(n) environmental chemist.

▶ Technology and the Internet (page 19)

22. Most modern scientific equipment is connected to computers, which allow scientists to record, store, and analyze data.

Name _____ Date _____ Class _____

WordWise

Complete the sentences by using one of the scrambled terms below.

Word Bank

noitvarsebo	eeiccns	ecnerefni
sisthepoyh	eicnstfiic rthoey	aadt
gniondpsre lebaaivr	eicnstfiic wal	aiuaedtlpnm lebaaivr

1. The variable that a scientist changes during an experiment is the manipulated variable.
2. A logical interpretation based on observations or prior knowledge is a(n) inference.
3. A way of learning about the natural world through observations and logical reasoning is science.
4. A well-tested idea that explains and connects a wide range of observations is a(n) scientific theory.
5. A possible explanation for observations that relate to a scientific question is a(n) hypothesis.
6. Using all five senses to gather information is called observation.
7. The variable that is expected to change during an experiment is the responding variable.
8. A statement that describes what scientists expect to happen every time under a particular set of conditions is a(n) scientific law.
9. The facts, figures, and other evidence learned through observation are data.

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CHAPTER 1

CHEMICAL INTERACTIONS

SECTION 1–1 Inside an Atom (pages 24–28)

This section describes the structure of an atom and explains the role that certain electrons play in forming chemical bonds.

▶ Introduction (page 24)

1. A substance that cannot be broken down into other substances by chemical or physical means is a(n) element.
2. The smallest particle of an element is a(n) atom.

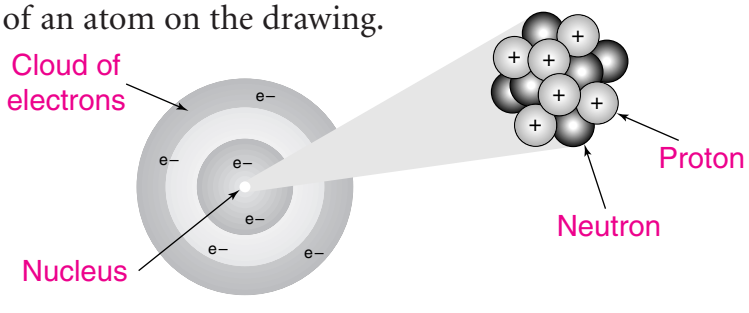
▶ Properties of an Atom (pages 24–25)

3. What does an atom consist of? An atom consists of a nucleus (containing protons and neutrons) surrounded by one or more electrons.

Match the particle with its charge.

Particle	Charge
c 4. neutron	a. positive
a 5. proton	b. negative
b 6. electron	c. neutral

7. Label the parts of an atom on the drawing.



8. Why is an atom neutral? An atom is neutral because the number of protons and the number of electrons are equal.

9. The number of protons in the nucleus of an atom is called the atomic number.

10. What is a unit of measurement for the mass of particles in atoms? atomic mass unit (amu)

11. Most of an atom's mass is in its nucleus.

12. Circle the letter of each sentence that is true about atoms.
   a. Atoms of a particular element can have different numbers of neutrons.
   b. Atoms of a particular element always have the same number of protons.
   c. The mass of atoms of a particular element can vary.
   d. Neutrons play an important role in chemical reactions.

▶ The Role of Electrons (pages 25–28)

13. The space in which the electrons move is huge compared to the space occupied by the nucleus.

14. The electrons farthest from the nucleus or most loosely held are called valence electrons.

15. Is the following sentence true or false? Many properties of the atom are determined by the size of the valence electrons. false

16. When chemical bonds form, valence electrons are either transferred or shared between atoms.

17. A way to show the number of valence electrons an atom has, using dots around the symbol of an element, is a(n) electron dot diagram.

Name _____ Date _____ Class _____

18. According to the dot diagram in Figure 3 on page 28, how many valence electrons does Neon (Ne) have? Neon has eight valence electrons.

19. What are two things that can happen when an atom forms a chemical bond?

a. The number of valence electrons increases to a total of eight.

b. All the valence electrons are given up.

20. When atoms end up with eight or zero valence electrons, how are they different than they were before? They are more stable, or less reactive, than they were before.

SECTION 1–2 The Periodic Table (pages 29-37)

This section explains how the elements are organized in a chart called the periodic table. It also explains what information the periodic table contains.

▶ Introduction (page 29)

1. A property that can be observed without changing the substance into something else is a(n) physical property.

2. A property that is observed when a substance interacts with another substance is a(n) chemical property.

▶ Using Properties to Group Elements (pages 29–30)

3. What is the atomic mass of an element? The atomic mass of an element is the average mass of one atom of the element.

4. What are the two especially important properties that Dmitri Mendeleev noted about the elements? The two are atomic mass and the number of chemical bonds an element can form.

▶ The Periodic Table (pages 30–33)

5. Mendeleev noticed that patterns appeared when he arranged the elements in what way? Patterns appeared when he arranged the elements in order of increasing atomic mass.

6. A chart of the elements showing the repeating pattern of their properties is called the periodic table.

7. What does the word *periodic* mean? Having a regular, repeated pattern

8. In the modern periodic table, the elements are arranged according to their atomic numbers.

9. Look at *Exploring the Periodic Table* on pages 32–33. Where does the periodic table become wider? It becomes wider at periods 2, 4, and 6.

10. What is the highest atomic number shown on the periodic table? 118.

▶ Reading the Periodic Table (pages 34–35)

11. What does each square of the periodic table usually include? It usually includes the element's atomic number, symbol, name, and atomic mass.

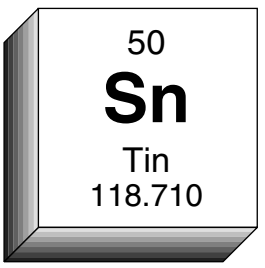
12. Use the square from the periodic table to fill in the blanks below.

Name of element: Tin

Symbol: Sn

Atomic mass: 118.710

Atomic number: 50



Name _____ Date _____ Class _____

13. The atomic number for the element calcium (Ca) is 20. How many protons and electrons does each calcium atom have? Each calcium atom has 20 protons and 20 electrons.

14. Circle the letter of each term that refers to the elements in a column of the periodic table.

a. period **b.** family **c.** group **d.** symbol

15. Group 15 of the periodic table is the nitrogen family.

16. Each horizontal row across the periodic table is called a(n) period.

17. Circle the letter of the sentence that is true about a period of elements.

a. It contains elements that all have the same atomic mass.

b. It contains a series of different elements from different families.

c. It contains elements that all have similar atomic numbers.

d. It contains elements that all have the same chemical symbol.

18. Is the following sentence true or false? Every period contains the same number of elements. false

▶Properties of Elements in the Periodic Table (pages 35–36)

19. How can an element's properties be predicted? An element's properties can be predicted from its location on the periodic table.

20. Is the following sentence true or false? Most of the elements in the periodic table are nonmetals. false

21. Most metals are good conductors of heat and electricity.

22. The elements that usually gain or share valence electrons in a chemical reaction are nonmetals.

23. Between the metals and nonmetals are elements known as metalloids.

24. Density of elements usually increases as you move down a group.

▶ Why the Periodic Table Works (page 37)

25. Why does the periodic table work? It works because it's based on the structure of atoms, especially the valence electrons.

26. The number of valence electrons in a row of eight elements increases from one to eight.

27. Why do elements in a family have similar properties? They have similar properties because they have the same number of valence electrons.

28. Circle the letter of each sentence that is true about elements.

a. All elements have the same number of valence electrons.

b. The number of valence electrons of an atom increases from left to right across a period of elements.

c. The properties across a period change in a regular way.

d. All elements in a family have the same number of valence electrons.

Reading Skill Practice

Writing a summary can help you remember the information you have read. When you write a summary, write only the most important points. Write a summary of the information under the heading *Reading the Periodic Table,* pages 34–35. Your summary should be shorter than the text on which it is based. Do your work on a separate sheet of paper.

Students' summaries should include definitions of the highlighted terms—group, family, and period—as well as the main points under each subheading.

Name _____ Date _____ Class _____

SECTION 1–3

Observing Chemical Reactions

(pages 38–43)

This section explains how you can tell when a chemical reaction has occurred. It also describes how chemical bonds are changed in reactions.

▶ Evidence for Chemical Reactions (pages 38–41)

1. What is a chemical reaction? A chemical reaction is a change in matter that produces one or more new substances.

2. Is the following sentence true or false? You can never detect a chemical reaction just by observing changes in properties of matter.

false

3. A solid that forms from solution during a chemical reaction is a(n) precipitate.

4. What are two observable characteristics of a chemical reaction?

a. One is the production of new materials with properties that are different from those of the starting materials.

b. A second is a change in energy. Some reactions absorb energy, while others release energy.

5. Complete the table about chemical reactions.

Chemical Reactions		
Type of Reaction	**Description**	**Example**
Endothermic reaction	A chemical reaction that absorbs energy in the form of heat	Baking soda reacts with vinegar
Exothermic reaction	A chemical reaction that releases energy in the form of heat	Charcoal reacts with oxygen in a barbecue grill

6. Use *Exploring Evidence for Chemical Reactions* on page 40 to complete the table.

Evidence for Chemical Reactions	
Type of Evidence	**Observed Evidence**
Color change	The color change of leaves in the fall
Precipitation	A precipitate forms when solutions are mixed
Gas production	Oxygen bubbles form on the leaves of an underwater plant
Changes in temperature	Water boils when placed on a natural-gas burner
Changes in properties	Soft dough changes into flaky bread in a hot oven

7. What is a common indication that energy has been absorbed or released in a chemical reaction? One indication is a change in temperature.

8. When a cold pack is squeezed, as shown in Figure 13 on page 41, why does it feel cool to the touch? It feels cool because a chemical reaction between water and another compound absorbs energy.

▶ Chemical Reactions on a Small Scale (page 42)

9. Circle the letter of the sentence that is true about chemical reactions.

a. Most chemical reactions do not produce new substances.

b. A chemical reaction is a physical change.

c. Chemical reactions don't affect the atoms of substances.

d. A chemical reaction is the result of countless small changes involving atoms.

Name _____ Date _____ Class _____

10. What are two ways that chemical bonds are affected during chemical reactions?

a. Chemical bonds break.

b. New chemical bonds form.

11. A particle made of two or more atoms bonded together is a(n) molecule.

▶ Elements Forming Compounds (pages 42–43)

12. A compound is a substance made of two or more elements that have been chemically combined.

13. Water, table salt, and baking soda are examples of compounds.

14. Circle the letter of each sentence that is true about a reaction between magnesium and oxygen.

a. The properties of the product are different from the properties of either magnesium or oxygen.

b. When magnesium burns, its atoms receive electrons from oxygen atoms.

c. The properties of magnesium oxide are the same as those of magnesium.

d. Magnesium oxide melts at a higher temperature than magnesium does.

SECTION 1–4 Writing Chemical Equations (pages 46–53)

This section explains how to show chemical reactions with symbols. It also identifies three categories of chemical reactions.

▶ Introduction (page 46)

1. What is a chemical equation? A chemical equation is a shorter, easier way to show chemical reactions, using symbols instead of words.

▶ The Importance of Chemical Equations (pages 47–49)

2. Why can all chemists read a chemical equation in the same way? Chemical equations follow a common structure that all chemists understand.

3. What is a chemical formula? A formula is a combination of symbols that represent the elements in a compound.

4. Use the table in Figure 18 on page 47 to write the chemical formula for each of the compounds below.

a. Ammonia NH_3

b. Baking soda $NaHCO_3$

c. Water H_2O

d. Carbon dioxide CO_2

e. Sodium chloride NaCl

g. Sugar $C_{12}H_{22}O_{11}$

5. What are subscripts in a chemical formula? Subscripts are small lowered numbers that show the ratio of atoms of different elements in a compound.

6. If a symbol in a chemical formula doesn't have a subscript, what is understood about that symbol? The number 1 is understood to be there.

7. How many atoms of each kind of element are there in a molecule of carbon dioxide (CO_2)? A molecule of carbon dioxide has one carbon atom and two oxygen atoms.

8. In a molecule of propane, the ratio of carbon atoms (C) to hydrogen atoms (H) is 3 to 8. Write the formual for propane. C_3H_8

Name _____ Date _____ Class _____

9. The substances you have at the beginning of a chemical reaction are called reactants.

10. The substances you have when a chemical reaction is complete are called products.

11. Is the following sentence true or false? A chemical equation uses symbols and formulas to show the reactants and the products of a reaction. true

12. What is the meaning of the arrow in a chemical equation? yields

13. Label each formula in the chemical equation below as either a reactant or a product.

Fe	+	S	→	FeS
reactant		reactant		product

14. At the end of a chemical reaction, what is the total mass of the reactants compared to the total mass of the products? The total mass of the reactants must equal the total mass of the products.

15. What is the principle of conservation of mass? During a chemical reaction, matter is not created or destroyed.

▶ Balancing Chemical Equations (pages 49–50)

16. A number in front of a chemical formula in a chemical equation is called a(n) coefficient.

17. What does a coefficient tell you? It tells you how many molecules or atoms of each reactant or product take part in the reaction.

18. Tell why this chemical equation is not balanced: $H_2 + O_2 \rightarrow H_2O$.

There are two oxygen atoms on the left side, but only one oxygen atom on the right side.

19. Write the balanced equation for this reaction: Oxygen reacts with hydrogen to form water. $2\ H_2 + O_2 \rightarrow 2\ H_2O$

▶ Classifying Chemical Reactions (pages 51–53)

20. On what basis can chemical reactions be classified? Many chemical reactions can be classified by what happens to the reactants and products.

21. Complete the table about the three categories of chemical reactions.

Categories of Chemical Reactions

Category	Description	Example Chemical Equation
Synthesis	Two or more substances combine to make a more complex compound.	$2\ SO_2 + O_2 + 2H_2O \rightarrow 2\ H_2SO_4$
Decomposition	Compounds are broken down into simpler products.	$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$
Replacement	One element replaces another in a compound, or two elements in different compounds trade places.	$2\ CuO + C \rightarrow 2\ Cu + CO_2$

22. Classify each of the following equations as synthesis, decomposition, or replacement.

a. $CaCO_3 \rightarrow CaO + CO_2$ decomposition

b. $2\ Na + Cl_2 \rightarrow 2\ NaCl$ synthesis

c. $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$ replacement

Name _____ Date _____ Class _____

SECTION 1–5 Controlling Chemical Reactions
(pages 54–59)

This section explains how energy is related to chemical reactions. It also describes how the rate of a chemical reaction can be controlled.

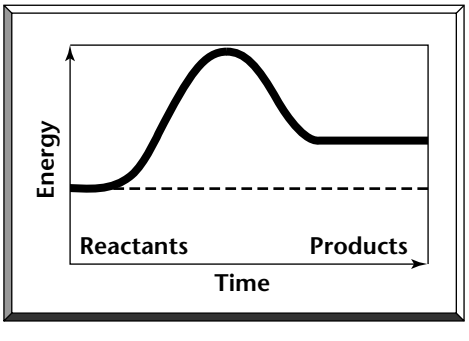
▶ Getting Reactions Started (pages 55–56)

1. What is one reason why chemical reactions need a certain amount of energy to get started? Energy is needed to break existing chemical bonds.

2. What is the activation energy of a chemical reaction? It is the minimum amount of energy that has to be added to start a reaction.

3. In a reaction that makes water from hydrogen and oxygen, where can the activation energy come from? An electric spark can be the source of the activation energy. Then, the large amount of energy released by the reaction of the first few molecules provides the activation energy for more molecules to react.

4. On the graph below, how does the energy of the products compare with the energy of the reactants? The energy of the products is higher than the energy of the reactants.



Endothermic reaction

5. Label the graph above as either an exothermic or endothermic reaction.

6. Why do endothermic reactions need additional energy to keep going, while exothermic reactions do not? Endothermic reactions need additional energy because the materials absorb energy as the products are formed. Exothermic reactions don't need additional energy because energy is given off as the reaction takes place.

▶ Rates of Chemical Reactions (pages 56–59)

7. What are three factors that can be changed to affect the rate of a chemical reaction? concentration, surface area, and temperature

8. The amount of one material in a given amount of another material is called concentration.

9. To increase the rate of a reaction, why would you increase the concentration of the reactants? Increasing the concentration of the reactants makes more particles available to react.

10. Circle the letter of each of the following that would increase the rate of a reaction.

(a.) Add heat. **b.** Decrease the surface area.

(c.) Increase the surface area. **d.** Reduce heat.

11. What is a catalyst? A catalyst is a material that increases the rate of a reaction by lowering the activation energy.

12. Is the following sentence true or false? Catalysts are always permanently changed in a reaction. false

13. A biological catalyst is called a(n) enzyme.

14. What is an inhibitor? An inhibitor is a material used to decrease the rate of a reaction.

Name _____ Date _____ Class _____

WordWise

Complete the sentences by using one of the scrambled terms below.

Word Bank

mocpsoinoited	dcsutrop	eaeeplcmnrt	idllaotmes	ysisehtns
lmheiaccl notiuqea	ntreactonionc	etaptiicrpe	reenltco	ctatsnaer
eoeicmhrtz trienaoc	moat	ffeeiiccont		

1. A particle that moves rapidly in all directions in the space outside the nucleus is called a(n) electron.
2. A chemical reaction that breaks down compounds into simpler products is called a(n) decomposition reaction.
3. A solid that forms from solution during a chemical reaction is called a(n) precipitate.
4. The substances you have at the beginning of a chemical reaction are called reactants.
5. A chemical reaction in which two or more substances combine to make a more complex compound is called a(n) synthesis reaction.
6. The amount of one material in a given amount of another material is called concentration.
7. The smallest particle of an element is called a(n) atom.
8. Energy is given off in the form of heat during a(n) exothermic reaction.
9. Between the metals and the nonmetals in the periodic table are the metalloids.
10. A chemical reaction in which one element replaces another in a compound, or in which two elements in different compounds trade places, is called a(n) replacement reaction.
11. The substances formed as a result of a chemical reaction are called products.
12. A way to show chemical reactions, using symbols instead of words, is a(n) chemical equation.
13. A number placed in front of a formula in an equation is called a(n) coefficient.

MathWise

Balance the chemical equations below by adding coefficients. Write the balanced equations on the lines provided. If an equation is already balanced, copy the equation as it is written.

▶ Balancing Chemical Equations (pages 49–50)

1. $H_2O \rightarrow H_2 + O_2$ $2\ H_2O \rightarrow 2\ H_2 + O_2$
2. $N_2 + H_2 \rightarrow NH_3$ $N_2 + 3\ H_2 \rightarrow 2\ NH_3$
3. $H_2CO_3 \rightarrow H_2O + CO_2$ $H_2CO_3 \rightarrow H_2O + CO_2$ (already balanced)
4. $K + H_2O \rightarrow H_2 + KOH$ $2\ K + 2\ H_2O \rightarrow H_2 + 2\ KOH$
5. $Li + O_2 \rightarrow Li_2O$ $4\ Li + O_2 \rightarrow 2\ Li_2O$
6. $Fe + O_2 \rightarrow Fe_2O_3$ $4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$
7. $Ag + N_2 \rightarrow Ag_3N$ $6\ Ag + N_2 \rightarrow 2\ Ag_3N$
8. $C_2H_5OH + O_2 \rightarrow CO_2 + H_2O$ $C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$

Name _____ Date _____ Class _____

CHAPTER 2

Exploring Properties of Materials

SECTION 2–1 Polymers and Composites (pages 68–75)

This section explains how large, complex molecules form. It also describes properties of materials made of two or more substances.

▶ Carbon's Strings, Rings, and Other Things (page 69)

1. What do plastics and cells in your body have in common? They are made of organic compounds.

2. Circle the letter of the number of chemical bonds that a carbon atom can form.

   a. 2 **b.** 3 **c.** 4 **d.** 5

▶ Carbon Compounds Form Polymers (page 69)

3. A large, complex molecule built from smaller molecules joined together is a(n) polymer.

4. Describe three repeating patterns found in different polymers.

   a. A single kind of monomer repeats over and over again.

   b. Two or three monomers join in an alternating pattern.

   c. Links between monomer chains occur, forming large webs or netlike molecules.

5. The smaller molecules from which polymers are built are called monomers.

▶ Natural Polymers (page 70)

6. Is the following sentence true or false? Living things produce the polymers they need from materials in the environment. true

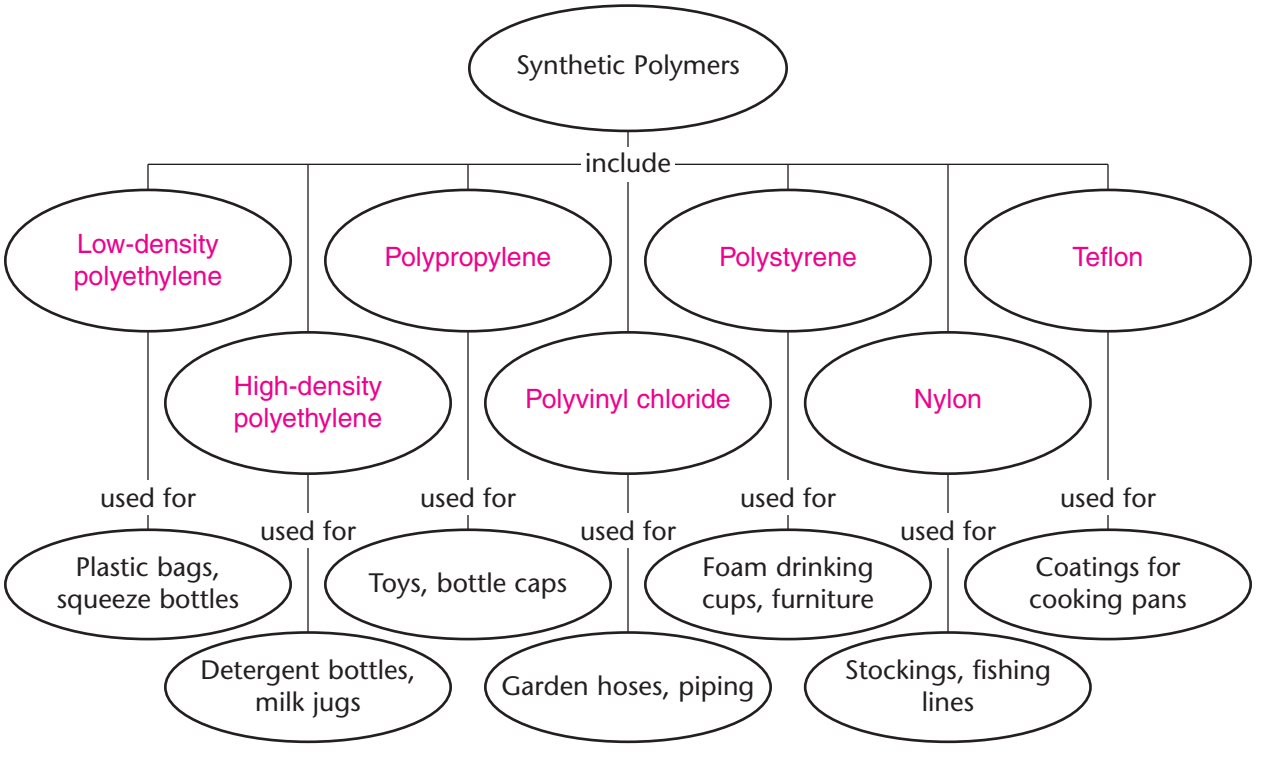
7. What is cellulose? Cellulose is a flexible but strong natural polymer that gives shape to plant cells.

8. Is the following sentence true or false? A wool sweater is made from natural polymers. true

9. In your body, proteins are polymers made from monomers called amino acids.

▶ Synthetic Polymers (page 71)

10. Complete the concept map about synthetic polymers.



Name _____ Date _____ Class _____

11. The starting materials for most synthetic polymers come from coal or oil.

12. What are plastics? Plastics are synthetic polymers that can be molded or shaped.

13. Why are synthetic polymers often used in place of some natural materials? The natural materials are too expensive or wear out too quickly.

▶ Composites (pages 72–74)

14. What are composites? Composites combine two or more substances as a new material with different properties.

15. What is an advantage of composite materials? Composites combine the useful properties of two or more substances into one new material that works better than either one alone.

16. What are fiberglass composites composed of? They are composed of strands of glass fiber that are woven together and strengthened with a liquid plastic that sets like glue.

▶ Too Many Polymers? (pages 74–75)

17. What are two disadvantages of using plastics? It is often cheaper to throw away plastic materials and make new ones than it is to reuse them. As a result, the volume of trash increases. Plastics don't break down into simpler materials in the environment.

18. What is one solution to the problem of waste plastics? One solution is to use waste plastics as raw material for making new plastic products.

Reading Skill Practice

Outlining can help you remember the information you have read. On a separate sheet of paper, write an outline of Section 2–1.

Outlines should be organized under the headings shown on pages 68–75 and include the main points under each heading.

SECTION 2–2

Metals and Alloys

(pages 79-83)

This section describes the properties of metals and substances made of two or more elements that are like metals.

▶ Introduction (page 79)

1. What is an alloy? An alloy is a mixture made of two or more elements that has the properties of metal.

▶ Properties of Metals (page 79)

2. What are three properties of metals?

a. They can conduct electricity.

b. They can be drawn out into thin wire.

c. They can be hammered into a sheet.

Name _____ Date _____ Class _____

▶ Properties of Alloys (page 80)

3. How is bronze a better material than the elements that compose it?

Bronze is harder than either copper or tin, the elements that compose it.

4. Why are alloys used much more than pure metals? Alloys are generally stronger and less likely to react with air or water.

5. Is the following sentence true or false? Gold alloys are much harder than pure gold. true

6. To make an airplane's "skin" strong, what is alloyed with aluminum?

Magnesium, copper, and traces of other metals are used.

7. Airplane turbine blades are made of nickel alloyed with iron, carbon, and cobalt. What properties does that alloy have that make it useful in turbines? It can spin around thousands of times per minute without changing shape. It can also withstand temperatures up to 1,100°C.

▶ Making Alloys (page 80)

8. How have copper alloys been made since the beginning of the Bronze Age?

The metals are melted and mixed together in carefully measured amounts.

9. Circle the letter of two techniques used to make modern alloys.

(a.) Firing a beam of ions at a metal

b. Dipping the different elements in ice water

(c.) Mixing the elements as powders and then heating them under high pressure

d. Melting the metals and then spraying them onto another metal's surface

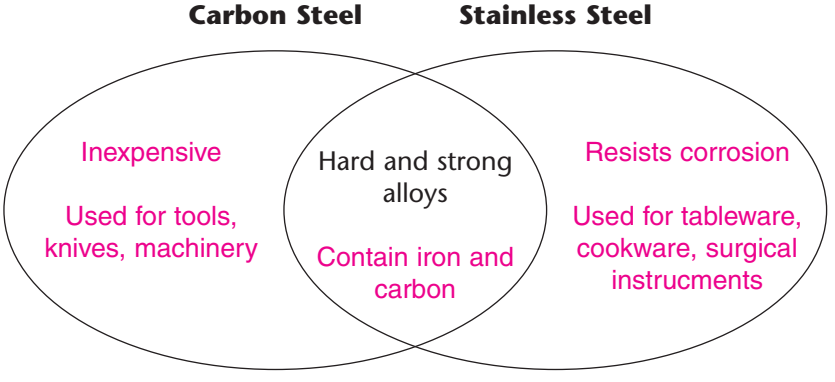
▶ Using Alloys (pages 82-84)

10. What properties does high-carbon steel have that make it more useful than wrought iron? High-carbon steel is stronger and harder than wrought iron.

11. Is the following sentence true or false? There are only three types of steel. false

12. What elements make up the alloy used to fill a cavity in a tooth? mercury and silver or gold

13. Complete the Venn diagram to compare two types of steel.



Match the alloy with the elements that make it up.

Alloy	Elements
b **14.** pewter	**a.** Iron, carbon, nickel, chromium
c **15.** brass	**b.** Tin, antimony, copper
e **16.** sterling silver	**c.** Copper, zinc
a **17.** stainless steel	**d.** Iron, carbon
d **18.** carbon steel	**e.** Silver, copper

19. What property does plumber's solder have that makes it useful for sealing joints and leaks in metal plumbing? It has a low melting point.

Name _____ Date _____ Class _____

SECTION 2–3 Ceramics and Glass
(pages 84-88)

This section describes the properties of ceramics and how ceramics are made and used. It also explains how glass is made and used.

▶ Making Ceramics (pages 84–85)

1. Hard, crystalline solids made by heating clay and other materials to high temperatures are called ceramics.

2. How does a potter get the water out of clay used to make ceramic pottery?
The potter heats the piece of pottery, and the water on the surface evaporates.

3. How does adding a glaze to a piece of pottery change the properties of the piece? The glaze makes the piece of pottery shiny and waterproof.

▶ Properties and Uses of Ceramics (pages 85–86)

4. Circle the letter of each property that makes ceramics useful.
   - **a.** Ceramics do not conduct electricity.
   - **b.** Ceramics resist moisture.
   - **c.** Ceramics are brittle and can shatter when struck.
   - **d.** Ceramics can withstand temperatures higher than those of molten metals.

5. Circle the letter of the reason why ceramic tiles are used on the bottoms of space shuttles.
   - **a.** They withstand high temperatures.
   - **b.** They protect against asteroids.
   - **c.** They keep the shuttle waterproof.
   - **d.** They let oxygen into the shuttle.

6. What are three long-standing uses of ceramics?

a. roofing tiles b. bricks c. sewer pipes

▶ Making Glass (pages 86–87)

7. What is a clear, solid material with no crystal structure, created by heating sand to a very high temperature? glass.

8. Why did early glassmakers add limestone and sodium carbonate to melting sand? The mixture melts at a lower temperature than sand alone, so it is easier to work with.

▶ Communication Through Glass (pages 87–88)

9. What is an optical fiber? An optical fiber is a threadlike piece of glass (or plastic) that can be used for transmitting light.

10. Circle the letter of each material that optical fiber is replacing.

(a.) telephone lines
b. ceramic pipelines
c. ceramic tiles
(d.) cable television lines

SECTION 2–4 Radioactive Elements (pages 89–95)

This section explains how radioactive elements change over time and describes how radioactive materials are used.

▶ Nuclear Reactions (page 90)

1. Why can't one element be made into another element by a chemical reaction? A chemical reaction only involves the electrons of an atom, not the nucleus. As long as the number of protons in the nucleus remains the same, the identity of the element doesn't change.

Name _____ Date _____ Class _____

2. What are nuclear reactions? They are reactions involving the particles in the nucleus of an atom.

▶ Isotopes (page 90)

3. Atoms with the same number of protons and different numbers of neutrons are called isotopes.

4. What is the mass number of an isotope? The mass number is the sum of the protons and neutrons in the nucleus of the atom.

5. What is the mass number of carbon-12? 12

6. Circle the letter of the correct number of protons and neutrons that an atom of carbon-14 has.

   a. 7 protons and 7 neutrons

   b. 14 protons and 14 neutrons

   c. 6 protons and 8 neutrons

   d. 8 protons and 6 neutrons

▶ Radioactive Decay (pages 90–91)

7. Is the following sentence true or false? The nucleus of an unstable atom does not hold together well. true

8. What happens in the process called radioactive decay? The atomic nuclei of unstable isotopes release fast-moving particles and energy.

9. The particles and energy produced during radioactive decay are forms of nuclear radiation.

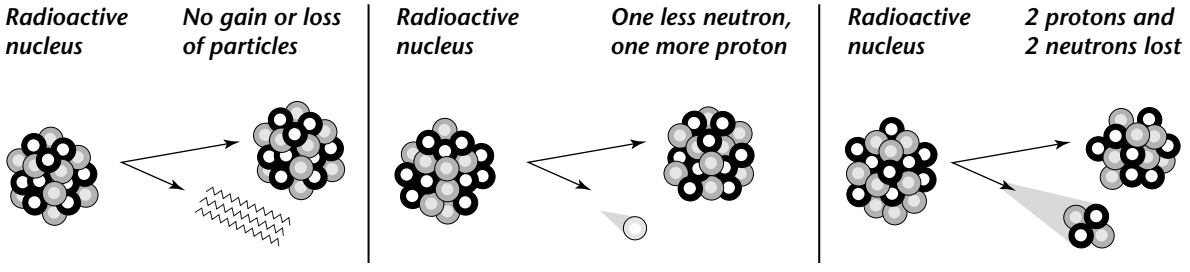
10. Circle the letter of the type of nuclear radiation that is most penetrating.

    a. alpha particle **b.** beta particle **c.** gamma radiation **d.** isotope

11. Complete the table about radioactive decay.

Radioactive Decay		
Type of Radiation	**Description**	**Type of Radioactive Decay**
Alpha particle	Two protons and two neutrons	Alpha decay
Beta particle	One electron	Beta decay
Gamma radiation	High-energy waves	Gamma decay

12. Label each illustration below according to which type of radioactive decay it represents.



Gamma decay _____ Beta decay _____ Alpha decay _____

▶ Half-Life (page 92)

13. What is the half-life of an isotope? The half-life is the length of time needed for half the atoms of a sample to decay.

14. Rank the following isotopes according to the length of their half-lives. Rank the isotope with the longest half-life as *1*.

4 iodine-131

2 carbon-14

1 uranium-238

3 cobalt-60

Name _____ Date _____ Class _____

15. The process of determining the age of an object using the half-life of one or more radioactive isotopes is called radioactive dating.

▶ Using Radioactive Isotopes (pages 93–94)

16. What are tracers? Tracers are radioactive isotopes that can be followed through the steps of a chemical reaction or an industrial process.

17. How can biologists learn where and how plants use phosphorus? They can add phosphorus-32 to the soil in which a plant is growing. Then they can use equipment that tracks the absorbed tracer through the plant.

18. How were the images made that are shown in Figure 24 on page 94? Technetium-99 was injected into the body. The isotope traveled to the lungs in one case and to the hand in the other case. Technicians made the images using equipment that detects radiation.

19. The process in which radioactive elements are used to destroy unhealthy cells is called radiation therapy.

20. What radioactive isotope do nuclear power plants most often use as fuel? uranium-235

▶ Safe Use of Radioactive Materials (page 95)

21. How may dangerous radioactive materials be disposed of in the future? They may be placed in specially designed containers, which can be buried in very dry underground tunnels.

WordWise

Solve the clues by filling in the blanks with key terms from Chapter 2. Then write the numbered letters in the correct order to find the hidden message.

Clues	Key Terms
Atoms with the same number of protons and different numbers of neutrons	isotopes (1)
Synthetic polymers that can be molded and shaped	plastics (2)
A process in which atomic nuclei of unstable isotopes release fast-moving particles and energy	radioactive (3) decay (4)
The time needed for half the atoms of an isotope sample to decay	half-life (5)
Hard, crystalline solids made by heating clay and other materials	ceramics (6)
A combination of two or more substances that creates a new material	composite (7)
A _____ reaction involves the particles in the nucleus of an atom.	nuclear (8)
The sum of the protons and neutrons in an atom	mass number (9)
A radioactive isotope that can be followed through the steps of a chemical reaction	tracer (10)
A clear solid material with no crystal structure	glass (11)
The particles and energy produced during radioactive decay	nuclear radiation (12, 13)
A substance made of two or more elements that has the properties of a metal	alloy (14)

Hidden Message

1	2	3	4	5		6	7		8	9		10	11	12	13	14	
S	t	e	e	l		i	s		a	n		a	l	l	o	y	.

Name _____ Date _____ Class _____

CHAPTER 3

Motion and Energy

SECTION 3–1 Motion (pages 102–109)

This section describes motion and explains the three laws of motion. The section also describes the two forms of energy.

▶ Motion (pages 102–104)

1. Is the following sentence true or false? An object is in motion when its distance from another object is changing. true

2. What is a reference point? A reference point is a place or object that can be used to determine if an object is in motion.

3. Is the following sentence true or false? When describing motion, you assume that the reference point is moving. false

4. Complete the following formula:

Speed = Distance/Time

5. Circle the units that can be used to express speed.

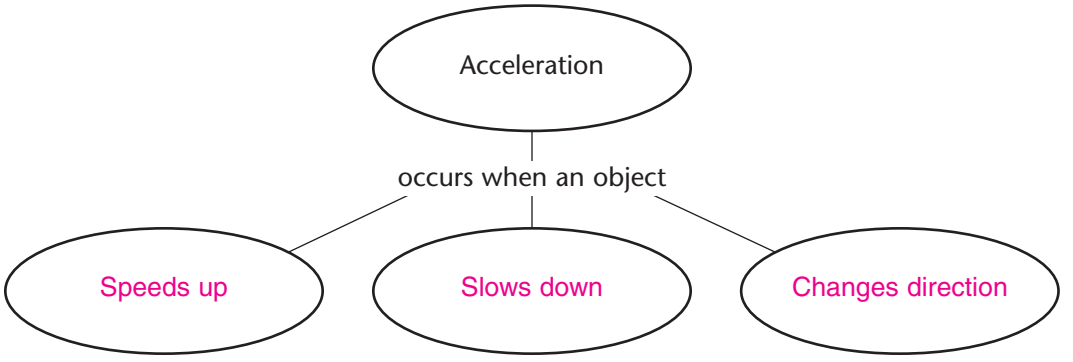
a. km **b.** m/h

c. hours **d.** km/min

6. The speed of an object moving in a particular direction is called its velocity.

7. What is acceleration? Acceleration is the rate at which the velocity of an object changes.

8. Complete the concept map.



▶ Force (pages 104–105)

9. What is a force? A force is a push or a pull exerted on an object.

10. Is the following sentence true or false? Although acceleration is always caused by a force, not every force causes acceleration.

true

11. Is the following sentence true or false? When two forces act on the same object in opposite directions, the smaller force is subtracted from the larger force. true

12. An object's motion will change when unbalanced forces act on it.

13. What are balanced forces? Balanced forces are equal forces that act on an object in opposite directions.

14. Is the following sentence true or false? Balanced forces change an object's motion. false

Name _____ Date _____ Class _____

▶ Newton's laws of Motion (pages 106–107)

15. Circle the letter of each statement that is true about Newton's first law of motion.

(a.) An object at rest will stay at rest.

b. A balanced force can change an object's motion.

(c.) A rolling object stops because the unbalanced forces of friction and air resistance slow it down.

(d.) A book on a desk will not move unless you push it.

16. Newton's second law of motion states that the net force on an object is equal to the mass of the object multiplied by its acceleration.

17. Write Newton's second law of motion as a formula. Force = Mass X Acceleration

18. State Newton's third law of motion. If one object exerts a force on a second object, the second object exerts a force of equal strength in the opposite direction on the first object.

19. When you hit a ball with a bat, the bat pushes on the ball and the ball pushes on the bat.

20. When you exert a force on an object that causes the object to move, you have done work.

21. How can work be calculated? The amount of work done on an object can be calculated by multiplying the force's size by the distance it moves the object.

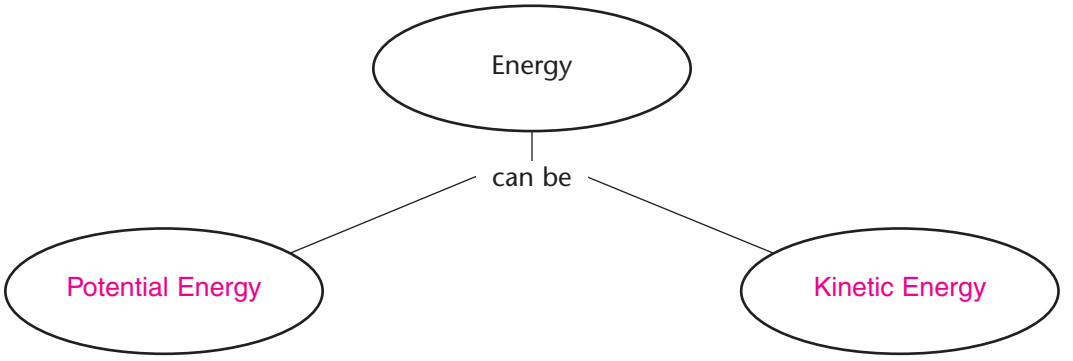
22. Write the formula that is used for calculating work. Work = Force X Distance

▶ Energy (pages 108-109)

23. The ability to do work is called energy.

24. Is the following sentence true or false? Work can be thought of as the transfer of energy. true

25. Complete the concept map.



26. Energy that is stored is called potential energy.

27. List two examples of potential energy.

a. elastic potential energy

b. gravitational potential energy

28. Gravitational potential energy depends on the height of the object.

29. Kinetic energy is the energy of moving objects.

30. What two factors determine the amount of kinetic energy that a moving object has?

a. mass **b.** velocity

31. Write the formula that is used to calculate kinetic energy.

Kinetic Energy = $\frac{\text{Mass} \times \text{Velocity}^2}{2}$

32. Is the following sentence true or false? An object's kinetic energy increases as its mass decreases. false

Name _____ Date _____ Class _____

33. An object's kinetic energy increases as its velocity increases.

34. Is the following sentence true or false? Only large objects have kinetic energy. false

SECTION 3–2 Temperature and Thermal Energy (pages 112-114)

This section describes the three common temperature scales and explains how temperature differs from thermal energy.

▶ Temperature (pages 112–113)

1. Is the following sentence true or false? All particles of matter have kinetic energy. true

2. What is temperature? Temperature is a measure of the average kinetic energy of the individual particles of an object.

3. Which particles are moving faster, the particles in a mug of hot cocoa or the particles in a glass of cold chocolate milk? The particles in a mug of hot cocoa are moving faster.

▶ Temperature Scales (pages 113–114)

4. What are the three common scales for measuring temperature?

a. Fahrenheit scale **b.** Celsius scale **c.** Kelvin scale

5. The most common temperature scale in the United States is the Fahrenheit scale.

6. The temperature scale used in most of the world is the Celsius scale.

7. The temperature scale commonly used in physical science is the Kelvin scale.

8. What are the intervals on the Fahrenheit scale called? degrees Fahrenheit

9. Which scale has units that are the same size as the Kelvin scale? Celsius scale

10. What is the temperature called at which no more energy can be removed from matter? absolute zero

11. Complete the following table. See Figure 12 on page 113.

Temperature Scales			
Scale	**Absolute zero**	**Water freezes**	**Water boils**
Fahrenheit	–460°	32°	212°
Celsius	–273°	0°	100°
Kelvin	0	273	373

▶ Thermal Energy (page 114)

12. The total energy of all of the particles in a substance is called thermal energy.

13. Circle the letter of each sentence that is true of thermal energy.

(a.) Thermal energy partly depends on the temperature of a substance.

b. Thermal energy partly depends on the scale used to measure the temperature of a substance.

(c.) Thermal energy partly depends on how the particles of a substance are arranged.

(d.) Thermal energy partly depends on the number of particles of a substance.

Name _____ Date _____ Class _____

SECTION 3–3 The Nature of Heat
(pages 115-121)

This section explains how heat is related to thermal energy and describes three ways heat is transferred.

▶ Introduction (pages 115–116)

1. What is heat? Heat is the movement of thermal energy from a substance at a higher temperature to another at a lower temperature.

2. Is the following sentence true or false? Heat is thermal energy moving from a warmer object to a cooler object. true

▶ How Is Heat Transferred? (pages 116–118)

3. Circle the letter of the three ways that heat can move.

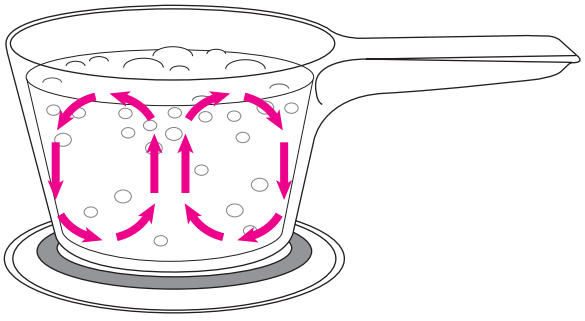
a. conduction **b.** current **c.** radiation **d.** convection

4. Think of a metal spoon in a pot of hot water. How do the particles of the water affect the particles of the spoon? The fast-moving particles of the hot water collide with the particles of the spoon, causing the particles of the spoon to move faster. As the particles move faster, the metal spoon becomes hotter.

5. How is heat transferred in convection? Heat is transferred by the movement of currents within a fluid.

6. The circular motion of fluid caused by rising and sinking of heated and cooler fluid is known as a(n) convection current.

7. The illustration shows a pot of liquid on a stovetop burner. Draw the convection currents that result.



8. Is the following sentence true or false? Radiation requires matter to transfer energy. false

9. Complete the table.

Heat Transfer		
Process	**How Heat Moves**	**Example**
Conduction	Transferred from one particle of matter to another without the movement of matter itself	Metal spoon in hot water
Convection	Transferred by the movement of currents within a fluid	Pot of hot water on a stove, heating a building or the atmosphere
Radiation	Transferred by electromagnetic waves	Bonfire, heat lamp, the sun heating Earth

▶ Heat Moves One Way (page 118)

10. When heat flows from one substance to another, what happens to the temperature of the substance giving off the heat and to the temperature of the substance receiving the heat? The temperature of the substance giving off the heat decreases, while the temperature of the substance receiving the heat increases.

Name _____ Date _____ Class _____

11. Why can't ice transfer coldness into another substance? There is no such thing as "coldness."

▶ Conductors and Insulators (pages 119–120)

12. A material that conducts heat well is called a(n) conductor.

13. A material that does not conduct heat well is called a(n) insulator.

14. Classify each of the following materials as either a conductor or an insulator by writing the correct term on the line.

a. air insulator **b.** wool insulator

c. wood insulator **d.** tile conductor

e. silver conductor **f.** fiberglass insulator

▶ Specific Heat (pages 120–121)

15. What is a substance's specific heat? It is the amount of energy required to raise the temperature of 1 kilogram of the substance by 1 kelvin.

16. What is the unit of measure for specific heat? joules per kilogram-kelvin, or J/(kg • K)

17. Materials with a high specific heat can absorb a great deal of thermal energy without a great change in temperature.

18. The energy gained or lost by an object is related to which of the following? Circle the letter of the terms that answer the question.

(a.) mass **b.** volume (c.) specific heat (d.) temperature

19. What is the formula you can use to calculate thermal energy changes? Change in energy = Mass × Specific heat × Change in temperature

SECTION 3–4 Thermal Energy and States of Matter (pages 125–130)

This section explains what causes matter to change state. It also explains why matter expands when it is heated.

▶ Three States of Matter (page 126)

1. Is the following sentence true or false? All matter can exist in three states.

true

2. Circle the letter of the terms that identify states of matter.

a. water **b.** gas **c.** liquid **d.** solid

3. The particles that make up a(n) solid are packed together in a relatively fixed position.

4. Circle the letter of each sentence that is true about liquids.

a. Liquids have a definite volume.

b. Liquids have a fixed shape.

c. Liquid particles can move around.

d. Liquid particles are moving around so fast that they don't even stay close together.

5. In which state of matter can the particles only vibrate back and forth?

solid

6. In which state of matter do the particles expand to fill all the space available? gas

▶ Changes of State (pages 126–127)

7. What is a change of state? It is the physical change from one state of matter to another.

Name _____ Date _____ Class _____

8. Circle the letter of each sentence that is true about matter.

a. The particles of a gas move faster than the particles of a liquid.

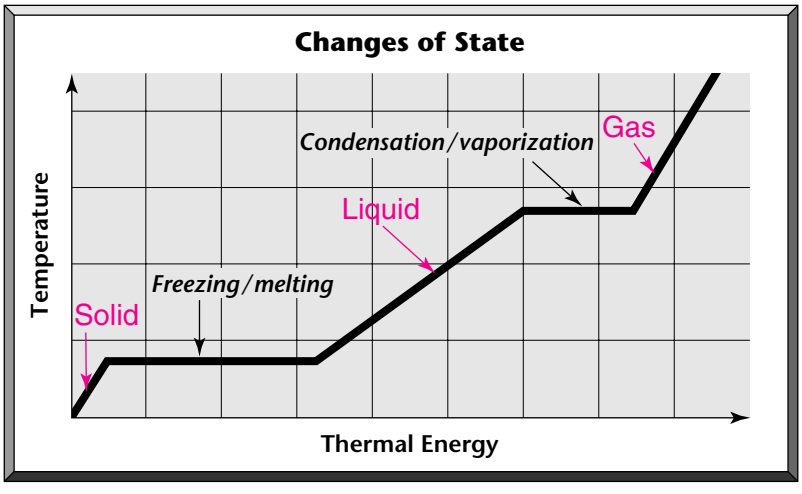
b. The particles of a solid move faster than the particles of a gas.

c. The particles of a liquid move faster than the particles of a solid.

d. The particles of a gas move faster than the particles of a solid.

9. Matter will change from one state to another if thermal energy is absorbed or released.

10. On the graph below, write labels for the regions of the graph that represent the gas, liquid, and solid states of matter.



▶ Solid-Liquid Changes of State (pages 127–128)

11. The change in state from a solid to a liquid is called melting.

12. The temperature at which a solid changes to a liquid is called the melting point.

13. The change in state from a liquid to a solid is called freezing.

14. The temperature at which a substance changes from a liquid to a solid is called its freezing point.

▶ Liquid-Gas Changes of State (pages 128–129)

15. What is vaporization? Vaporization is the process by which matter changes from the liquid to the gas state.

16. If vaporization takes place on the surface of a liquid it is called evaporation.

17. What is vaporization called when it occurs below the surface of a liquid? boiling

18. The temperature at which liquid boils is called its boiling point.

19. A change from the gas state to the liquid state is called condensation.

▶ Thermal Expansion (pages 129–130)

20. The expanding of matter when it is heated is known as thermal expansion.

21. What happens to the liquid in a thermometer when it is heated?

It expands and climbs up the tube.

22. Heat-regulating devices are called thermostats.

23. In thermostats, what are strips of two different metals joined together called? bimetallic strips

24. In thermostats, bimetallic strips are used because different metals expand at different rates.

Reading Skill Practice

You can often increase your understanding of what you've read by making comparisons. A compare/contrast table helps you do this. On a separate sheet of paper, draw a table to compare the three states of matter as explained on page 126. The three row heads will be *Solid, Liquid,* and *Gas*. Column heads should include *State, Particles, Shape,* and *Volume*. For more information about compare/contrast tables, see page 688 in the Skills Handbook of your textbook.

Student's tables should include the basic information about the three states contained in the short paragraphs on page 126.

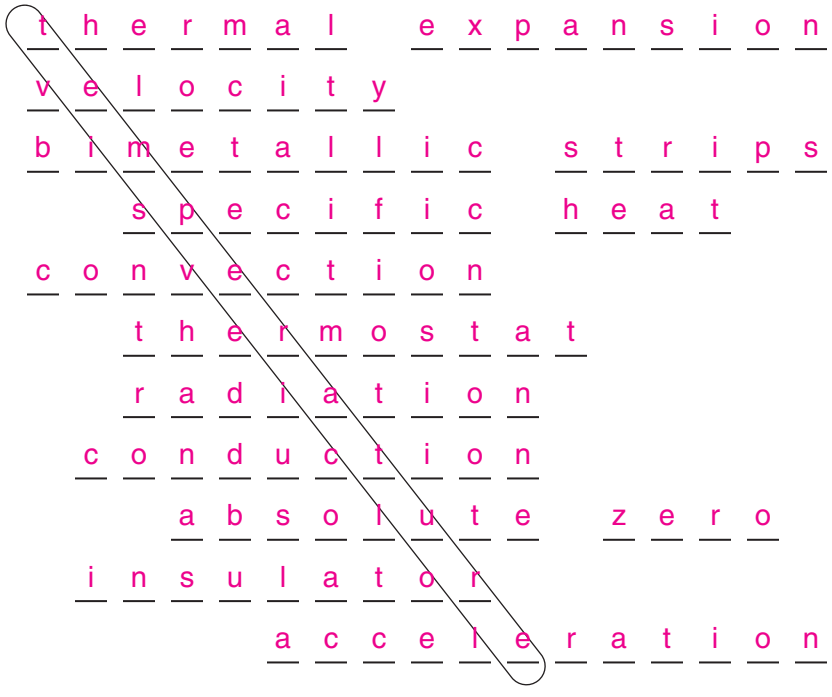
Name _____ Date _____ Class _____

WordWise

Use the clues below to identify key terms from Chapter 3. Write the terms on the lines, putting one letter in each blank. When you finish, the word enclosed in the diagonal will reveal an important term related to kinetic energy.

Clues

1. The expanding of matter when it is heated
2. The speed of an object moving in a particular direction
3. Strips of two different metals joined together
4. The amount of energy required to raise the temperature of 1 kilogram of a substance 1 kelvin
5. Heat is transferred by the movement of these currents.
6. A heat-regulating device
7. The transfer of energy by electromagnetic waves
8. The transfer of heat from one particle of matter to another without the movement of matter itself
9. The temperature at which no more energy can be removed from matter
10. A material that does not conduct heat well
11. The rate at which the velocity of an object changes



MathWise

For the problems below, show your calculations. If you need more space, use another sheet of paper. Write the answers for the problems on the lines below.

▶ Specific Heat (pages 120–121)

1. Heat absorbed = (2 kg)(450 J/(kg·K))(5 K) = 4,500 J

2. Heat absorbed = (7 kg)(664 J/(kg·K))(20 K) = 92,960 J

3. Aluminum has a specific heat of 903 J/(kg·K). How much heat is required to raise the temperature of 6 kilograms of aluminum 15 kelvins?

Heat absorbed = (6 kg)(903 J/(kg•K))(15 K) = 81,270 J

Answer: Heat absorbed = 81,270 J

4. Sand has a specific heat of 670 J/(kg·K). How much heat is required to raise the temperature of 16 kilograms of sand 5 kelvins?

Heat absorbed = (16 kg)(670 J/(kg•K))(5 K) = 53,600 J

Answer: Heat absorbed = 53,600 J

5. Water has a specific heat of 4,180 J/(kg·K). How much heat is required to raise the temperature of 3 kilograms of water 20 kelvins?

Heat absorbed = (3 kg)(4,180 J/(kg•K))(20 K) = 250,800 J

Answer: Heat absorbed = 250,800 J

Name _____ Date _____ Class _____

CHAPTER 4

CHARACTERISTICS OF WAVES

SECTION 4–1 What Are Waves? (pages 136-139)

This section explains what causes waves and identifies the three main types of waves.

▶ Waves—Matter and Energy Interacting (pages 136-137)

1. What is a wave? A wave is a disturbance that transfers energy from place to place.

2. The material through which a wave travels is called a(n) medium.

3. Circle the letter of each of the following that can act as media.
   a. solids **b.** liquids **c.** gases **d.** empty space

4. Waves that require a medium through which to travel are called mechanical waves.

5. Is the following sentence true or false? When waves travel through a medium, they carry the medium with them. false

6. Explain what happens to a duck on the surface of a pond when a wave passes under it. The duck moves up and down but does not move along the surface of the water.

7. Give an example of a wave that can travel through empty space. A light wave from the sun can travel through empty space.

8. Waves are created when a source of energy causes a medium to vibrate.

9. What is a vibration? A vibration is a repeated back-and-forth or up-and-down motion.

▶ Generating Different Types of Waves (pages 138–139)

10. How are waves classified? Waves are classified according to how they move.

11. Waves that move the medium at right angles to the direction in which the waves are traveling are called transverse waves.

12. Suppose you move the free end of a rope up and down to create a wave. In that case, the rope is the medium. What is the relationship between the movement of the wave and the movement of the particles of the medium? As a transverse wave moves in one direction, the particles of the medium move across the direction of the wave.

13. The highest parts of a transverse wave are called crests.

14. The lowest parts of a transverse wave are called troughs.

15. What type of waves move the particles of the medium parallel to the direction that the waves are traveling? longitudinal waves

16. In longitudinal waves in a spring, the parts where the coils are close together are called compressions.

17. In longitudinal waves in a spring, the parts where the coils are spread out are called rarefactions.

18. Waves that are combinations of transverse and longitudinal waves are called surface waves.

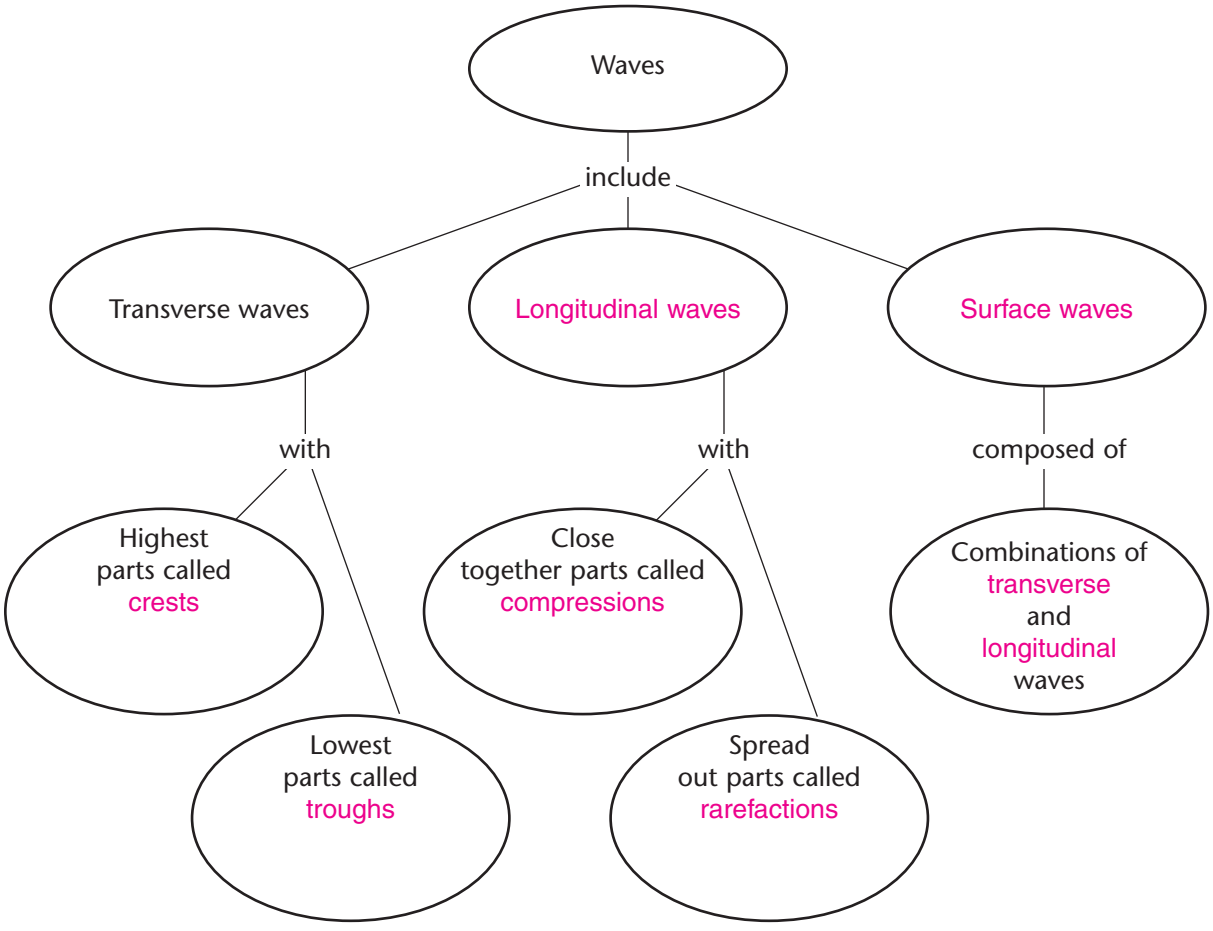
19. Where do surface waves occur? They occur at the surface between two media.

Name _____ Date _____ Class _____

20. In surface waves, the combination of motions produces

circular motion.

21. Complete this concept map about types of waves.



SECTION 4–2 Properties of Waves (pages 140-145)

This section describes the basic properties of waves. It also explains how a wave's speed is related to its wavelength and frequency.

▶ Introduction (page 140)

1. What are the basic properties of waves?

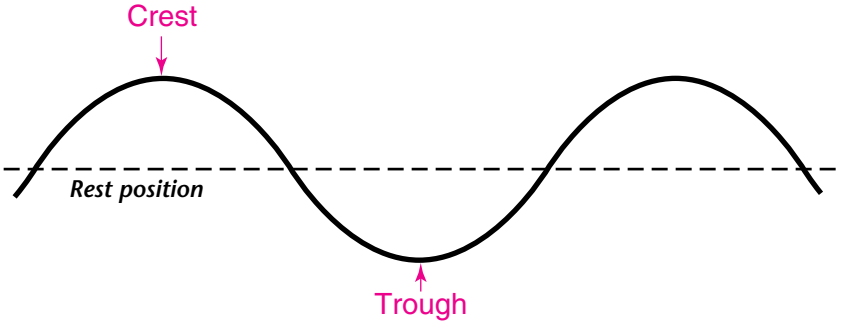
a. amplitude **b.** wavelength

c. frequency **d.** speed

▶ Wave Diagrams (pages 140–141)

2. On the transverse wave in Figure 5 on page 141, what does the line called the rest position represent? It represents the position of the rope before it is disturbed.

3. On the wave diagram below, label a crest and a trough.



4. If you were to draw a longitudinal wave, you should think of the compressions as crests on a transverse wave and the rarefactions as troughs on a transverse wave.

▶ Amplitude (pages 141–142)

5. The maximum distance the particles of the medium carrying a wave move away from their rest position is called the wave's amplitude.

6. Explain what the amplitude of a water wave is. It is the maximum distance a water particle moves above or below the surface level of calm water.

7. The amplitude of a wave is a direct measure of its energy.

8. What is the amplitude of a longitudinal wave? It's a measure of how compressed or rarefied the medium becomes.

Name _____ Date _____ Class _____

9. Circle the letter of each phrase that correctly defines the amplitude of a transverse wave.

a. The distance from the bottom of a trough to the top of a crest

b. The maximum distance the particles of the medium move up or down from their rest position

c. The maximum distance from one point on the rest position to another point on the rest position

d. The distance from the rest position to a crest or to a trough

10. Suppose a longitudinal wave has crowded compressions and loose rarefactions. Does it have a large or a small amplitude?

large

▶ Wavelength (page 143)

11. The distance between two corresponding parts of a wave is its wavelength.

12. How can you find the wavelength of a longitudinal wave? You can measure the distance from one compression to the next.

▶ Frequency (page 144)

13. The number of complete waves that pass a given point in a certain amount of time is called the wave's frequency.

14. If you make a wave in a rope so that one wave passes every second, what is its frequency? 1 wave per second

15. Circle the letter of the unit used to measure frequency.

a. watt **b.** seconds **c.** joule **d.** hertz

▶ Speed (pages 144–145)

16. The speed of a wave is how far the wave travels in one unit of time.

Complete the following formulas.

17. Speed = Wavelength × Frequency

18. Frequency = $\frac{\text{Speed}}{\text{Wavelength}}$

19. Wavelength = $\frac{\text{Speed}}{\text{Frequency}}$

20. Circle the letter of each sentence that is true about the speed of waves.

a. All sound waves travel at the same speed.

b. In a given medium and under the same conditions, the speed of a wave is constant.

c. If the temperature and pressure of air changes, the speed of sound waves traveling through the air will change.

d. Waves in different media travel at different speeds.

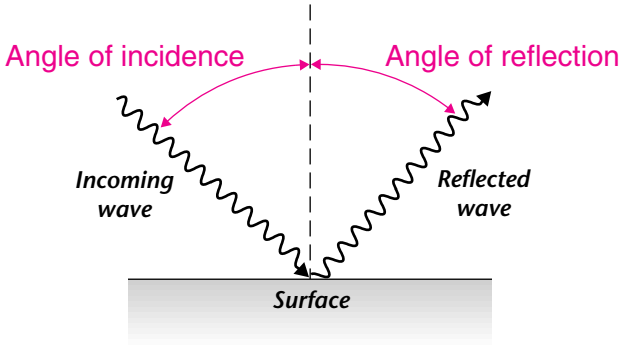
21. If you increase the frequency of a wave, the wavelength must decrease.

SECTION 4–3 Interactions of Waves (pages 146–151)

This section describes how waves bend and how waves interact with each other.

▶ Reflection (page 146)

1. On the illustration below, write labels and draw arrows to show the location of the angle of incidence and the angle of reflection.



Name _____ Date _____ Class _____

2. The bouncing back of a wave when it hits a surface through which it cannot pass is called reflection.

3. What does the law of reflection state? The angle of reflection equals the angle of incidence.

4. Is the following sentence true or false? Only transverse waves obey the law of reflection. false

▶ Refraction (page 147)

5. What happens when a wave moves from one medium into another medium at an angle? It changes speed as it enters the second medium, which causes it to bend.

6. The bending of waves as they enter a different medium is called refraction.

7. All waves change speed when they enter a new medium, but they don't always bend. When does bending occur? Bending occurs when one side of the wave enters the new medium before the other side of the wave.

8. The bending of a wave entering a new medium occurs because the two sides of the wave are traveling at different speeds.

▶ Diffraction (pages 147–148)

9. What happens when a wave passes a barrier or moves through a hole in a barrier? It bends and spreads out.

10. The bending of waves around the edge of a barrier is known as diffraction.

11. Look at Figure 11 on page 148. What happens when waves go through a hole in a barrier? They spread out.

▶ Interference (pages 148–149)

12. When two waves meet, they have an effect on each other. This interaction is called interference.

13. When does constructive interference occur? It occurs whenever two waves combine to make a wave with a larger amplitude.

14. Describe what Figure 12A on page 149 shows. The crests of the two waves at the top align. The result is that the waves add together and produce a wave with twice the original amplitude.

15. When the amplitudes of two waves combine with each other to produce a smaller amplitude, the result is called destructive interference.

16. In Figure 12B on page 149, why does the resulting wave at the bottom have an amplitude of zero? The crests of the first wave occur at the same place as the troughs of the second wave, and they cancel each other out.

17. What happens when two identical waves travel along the same path, one a little behind the other? The waves combine constructively in some places and destructively in others.

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▶ Standing Waves (pages 149–151)

18. What is a standing wave? A standing wave is a wave that appears to stand in one place, even though it is really two waves interfering as they pass through each other.

19. When destructive interference causes two waves to combine to produce an amplitude of zero, the point is called a(n) node.

20. The crests and troughs of a standing wave are called antinodes.

21. Is the following sentence true or false? Most objects have a natural frequency of vibration. true

22. When does resonance occur? It occurs when vibrations traveling through an object match the object's natural frequency.

23. Is the following sentence true or false? If an object is not very flexible, resonance can cause it to shatter. true

Match the interaction of water waves with its description.

	Interaction
b	**24.** refraction
e	**25.** diffraction
c	**26.** constructive interference
a	**27.** destructive interference
d	**28.** reflection

Description

a. When two waves combine to make a wave with a smaller amplitude

b. When a wave bends as it moves from deep water to shallow water

c. When two waves combine to make a wave with a larger amplitude

d. When a wave bounces back from a barrier at the same angle it hits

e. When waves bend or spread out around or behind an obstacle

Reading Skill Practice

You may sometimes forget the meanings of key terms that were introduced earlier in the textbook. When this happens, you can check the meanings of the terms in the Glossary, on pages 712–724, which gives meanings of all the key terms in the textbook. You'll find the terms in alphabetical order. Use the Glossary to review the meanings of all the key terms introduced in Section 4–3. Write their definitions on a separate sheet of paper.

The wording of the definitions in the Glossary are often slightly different than how the terms are defined in the flow of the text. Students should write the Glossary definition of each term.

SECTION 4–4

Seismic Waves

(pages 154–156)

This section explains how earthquakes produce waves that move through Earth.

▶ Types of Seismic Waves (page 155)

1. What movement creates stress on rock beneath Earth's surface? The movement of Earth's plates creates stress on rock beneath Earth's surface.

2. What happens when stress on rock builds up enough? The rock breaks or changes shape, releasing energy in the form of waves or vibrations.

3. The waves produced by earthquakes are known as seismic waves.

4. Circle the letter of each sentence that is true about seismic waves.

   a. Seismic waves can travel from one side of Earth to the other.

   b. Even though seismic waves move through Earth, they don't carry energy.

   c. There is only one kind of seismic wave.

   d. Seismic waves ripple out in all directions from the point where the earthquake occurred.

Name _____ Date _____ Class _____

5. Why can't secondary waves travel through Earth's core? Secondary waves cannot travel through liquid, and part of Earth's core is liquid.

6. Which type of seismic waves arrives at distant points before any other seismic waves? primary waves

7. Which type of seismic waves produces the most severe ground movements? surface waves

8. Which type of seismic waves cannot be detected on the side of Earth opposite an earthquake? secondary waves

9. What are tsunamis? Tsunamis are huge surface waves on the ocean caused by earthquakes that occur underwater.

10. Complete the table about seismic waves.

Seismic Waves		
Type of Seismic Wave	**Transverse or Longitudinal?**	**Travel Characteristics**
Primary waves	Longitudinal	Travel through all parts of Earth
Secondary waves	Transverse	Travel through Earth but not through core
Surface waves	Combination	Travel only along Earth's surface

▶ Detecting Seismic Waves (page 156)

11. Circle the letter of the instrument scientists use to detect earthquakes.
a. rarefactions **b.** telegraphs **c.** seismographs **d.** tsunamis

12. What does a seismograph record? It records the ground movements caused by seismic waves as they move through Earth.

CHAPTER 4, Characteristics of Waves *(continued)*

13. What is the frame of a seismograph attached to? It is attached to the ground.

14. What happens to a seismograph's frame when seismic waves arrive?
The frame shakes.

15. How can scientists tell how far away an earthquake was from a seismograph? They can tell by measuring the time between the arrival of P waves and S waves.

16. How can scientists tell where an earthquake occurred? They tell by comparing readings from at least three seismographs at different places on Earth.

17. Complete the flowchart about how geologists locate valuable substances under Earth's surface.

To find out what is underground, geologists set off **explosives**.

↓

The explosives produce a small **earthquake**.

↓

The small earthquake sends out **seismic waves**.

↓

The seismic waves reflect from structures deep **underground**.

↓

The reflected seismic waves are recorded by **seismographs** located around the site of the explosion.

Name _____ Date _____ Class _____

WordWise

The block of letters below contains 15 key terms from Chapter 4. You might find them across, down, or on the diagonal. Use the clues to identify the terms you need to find. Circle each of the terms in the block of letters.

Clues

1. A disturbance that transfers energy from place to place
2. The material through which a wave travels
3. A repeated back-and-forth or up-and-down motion
4. The highest part of a wave
5. The lowest part of a wave
6. The maximum distance the particles of the medium carrying the wave move away from their rest position
7. The distance between two corresponding parts of a wave
8. The number of complete waves that pass a given point in a certain amount of time
9. The unit in which frequency is measured
10. The bending of waves due to a change of speed
11. The bending of waves around the edge of a barrier
12. A point of zero amplitude on a standing wave
13. A point of maximum amplitude on a standing wave
14. What occurs when vibrations traveling through an object match the object's natural frequency
15. A huge surface wave on the ocean caused by an earthquake

d	t	s	u	n	a	m	i	p	a	q	w
i	v	i	b	r	a	t	i	o	n	m	a
f	r	e	q	u	e	n	c	y	t	a	v
f	u	n	n	p	w	b	v	x	i	m	e
r	e	f	r	a	c	t	i	o	n	p	l
a	x	n	e	e	r	g	y	u	o	l	e
c	i	w	a	v	e	z	a	p	d	i	n
t	z	e	e	v	s	z	u	j	e	t	g
i	o	d	d	e	t	x	w	e	g	u	t
o	o	u	t	r	o	u	g	h	y	d	h
n	i	r	e	s	o	n	a	n	c	e	r
n	y	h	m	e	d	i	u	m	r	t	z

MathWise

For the problems below, show your calculations. If you need more space, use another sheet of paper. Write the answers for the problems on the lines below.

▶ Calculating Speed, Frequency, and Wavelength (pages 480–481)

1. Speed = 25 cm × 4 Hz = 100 cm/s

2. A wave has a wavelength of 18 mm and a frequency of 3 Hz. At what speed does the wave travel?

Speed = 18 mm × 3 Hz = 54 mm/s

Answer: Speed = 54 mm/s

3. Frequency = $\frac{75 \text{ cm/s}}{5 \text{ cm}}$ = 15 Hz

4. The speed of a wave is 16 m/s and its wavelength is 4 m. What is its frequency?

Frequency = $\frac{16 \text{ m/s}}{4 \text{ m}}$ = 4 Hz

Answer: Frequency = 4 Hz

5. Wavelength = $\frac{60 \text{ cm/s}}{3 \text{ Hz}}$ = 20 cm

6. The speed of a wave on a violin is 125 m/s, and the frequency is 1,000 Hz. What is the wavelength of the wave?

Wavelength = $\frac{125 \text{ m/s}}{1{,}000 \text{ Hz}}$ = 0.125 m = 125 mm

Answer: Wavelength = 125 mm

Name _____ Date _____ Class _____

CHAPTER 5

Sound Waves

SECTION 5–1 The Nature of Sound Waves (pages 162–166)

This section explains what sound is and identifies the factors that affect the speed of sound.

▶ Sound and Longitudinal Waves (pages 162–164)

1. What is sound? Sound is a disturbance that travels through a medium as a longitudinal wave.

2. Suppose a sound is made far away from you. When do you hear the sound?
You hear the sound when the disturbance reaches the air near your ears.

3. Complete the flowchart about how you make sound with your voice.

You force air through the vocal cords of your **larynx**.

↓

The air rushing past your vocal cords makes them **vibrate**.

↓

The vibrating vocal cords produce longitudinal waves in the **air**.

↓

The longitudinal waves in the air travel to your and others' **ears**.

4. Why doesn't sound travel through outer space? Sound can travel only if there is a medium to transmit the compressions and rarefactions. In outer space, there are no molecules to compress or rarefy.

5. What happens to sound waves when they go through a doorway into a room? Diffraction causes the sound waves to spread out throughout the room.

▶ The Speed of Sound in Different Media (pages 164–165)

6. The speed of a sound depends on these three properties of the medium.
   a. elasticity b. density c. temperature

7. Use the table in Figure 4 on page 164 to answer the following question. Through which medium does sound travel faster, air or water?
   water

8. The ability of a material to bounce back after being disturbed is called elasticity.

9. Is the following sentence true or false? Sound travels more slowly in media that have a high degree of elasticity. false

10. How much matter, or mass, there is in a given amount of space, or volume, is called density.

11. Is the following sentence true or false? In materials in the same state of matter, sound travels at the same speed. false

12. Why does sound travel slower through a medium when it is at a low temperature? At a low temperature, the particles of a medium are more sluggish.

Name _____ Date _____ Class _____

▶ Moving Faster Than Sound (page 166)

13. In 1947, what did Captain Chuck Yeager do that nobody had ever done before? He flew an airplane faster than the speed of sound.

14. In 1997, what did Andy Green do that nobody had ever done before? He drove a land vehicle faster than the speed of sound.

SECTION 5–2 Properties of Sound Waves (pages 168–173)

This section describes several properties of sound, including loudness and pitch. It also explains what you hear as the source of a sound moves.

▶ Intensity and Loudness (pages 168–169)

1. The amount of energy a wave carries per second through a unit area is called the sound wave's intensity.

2. Describe the molecules of the medium when a sound wave carries a large amount of energy. The molecules move a greater distance as the sound waves pass by.

3. What is loudness? Loudness describes what you actually hear.

4. In what units is loudness measured? decibels

5. Each 10 dB increase in sound level represents how much of an increase in intensity? tenfold

6. Can loud music cause damage to your ears? It can cause damage after long exposure.

▶ Frequency and Pitch (pages 170–171)

7. Circle the letter of each sentence that is true about how a person changes the pitch of sounds when singing.

   a. A person relaxes the vocal cords to produce lower-frequency sound waves.

   b. A person stretches the vocal cords to produce lower-frequency sound waves.

   c. A person stretches the vocal cords to produce higher-frequency sound waves.

   d. A person relaxes the vocal cords to produce higher-frequency sound waves.

8. Sound waves with frequencies above the normal human range of hearing are called ultrasound.

9. Sound waves with frequencies below the normal human range of hearing are called infrasound.

10. What is the pitch of a sound? The pitch of a sound is a description of how high or low the sound seems to a person.

11. What does the pitch of a sound you hear depend on? It depends on the frequency of the sound wave.

▶ The Doppler Effect (pages 172–173)

12. What is the Doppler effect? The Doppler effect is the apparent change in frequency as a wave source moves in relation to the listener.

13. Is the following sentence true or false? A sonic boom is a sound shock wave produced when the sound barrier is broken. true

14. Complete the table about the Doppler effect.

Doppler Effect		
Action	**Change in Frequency—Higher or Lower?**	**Change in Pitch—Higher or Lower?**
A police car with siren on moves toward you	Higher	Higher
A train with a band playing moves away from you	Lower	Lower
A train with a band playing moves toward you	Higher	Higher
A police car with siren on moves away from you	Lower	Lower

SECTION 5–3 Combining Sound Waves (pages 174–181)

This section explains what produces the quality of sounds. It also explains the difference between music and noise and describes what happens when sound waves interact.

▶ Sound Quality (page 175)

1. The resonant frequency of an object produces a pitch called the fundamental tone.

2. When a string vibrates at several frequencies at the same time, the higher frequencies produce sounds called overtones.

3. What describes the quality of the sound you hear? timbre

4. What makes up the timbre of a particular sound? The blending of the fundamental tone and the overtones makes up the timbre.

▶ Making Music (pages 176–179)

5. What is music? Music is a set of tones combined in ways that are pleasing to the ear.

CHAPTER 5, Sound Waves *(continued)*

6. How do musicians vary the pitch on stringed instruments? They place their fingers on different places along the string.

7. Why do many stringed instruments have a box? The box improves the quality of the sound produced by the strings.

8. What vibrates within a brass instrument that the player can adjust? The air column vibrates, and the musician can adjust the length of the air column by pressing valves or moving slides.

9. What vibrates when a player blows into the mouthpiece of a woodwind instrument? The reed vibrates, along with the column of air.

10. Is the following sentence true or false? The sound a percussion instrument makes depends on the material from which it is made.

true

11. Complete the table by classifying each instrument into one of the major groups of instruments—Strings, Brass, Woodwinds, or Percussion.

Musical Instruments			
Instrument	**Major Group**	**Instrument**	**Major Group**
Guitar	Strings	Cello	Strings
Drums	Percussion	Oboe	Woodwinds
Violin	Strings	Trumpet	Brass
Trombone	Brass	Double bass	Strings
Clarinet	Woodwinds	Harp	Strings

Name _____ Date _____ Class _____

▶ Noise (page 177)

12. A mixture of sound waves that do not sound pleasing together is called noise.

13. Circle the letter of each sentence that is true about noise.

a. Sounds that are music to some people are noise to others.

b. Noise has no pleasing timbre.

c. Sounds that have rhythm are always called noise.

d. Noise has no identifiable pitch.

14. The sound produced when notes that have no musical relationship are played together is called dissonance.

▶ Interference of Sound Waves (pages 180–181)

15. When does interference of sound waves occur? It occurs when two or more sound waves interact.

16. Is the following sentence true or false? When the interference of two sound waves is constructive, the sound is louder than either of the two original sounds. true

17. The study and description of how well sound can be heard in a particular room or hall is called acoustics.

18. Circle the letter of the term that describes the repeated changes in loudness that occurs when sound waves interfere both constructively and destructively.

a. frequency **b.** beats **c.** tuners **d.** intervals

19. What does a piano tuner do when he or she hears beats? The piano tuner adjusts the piano string until no beats are heard.

Reading Skill Practice

You can often increase your understanding of what you've read by making comparisons. A compare/contrast table helps you to do this. On a separate sheet of paper, draw a table to compare the different instruments in *Exploring Making Music* on pages 178–179. List the five instruments to be compared across the top of your table. Then list the characteristics that will form the basis of your comparison in the left-hand column. These characteristics should include *Major Group, How Music Is Produced,* and *How Pitch Is Changed.* For more information about compare/contrast tables, see page 688 in the Skills Handbook of your textbook.

Students should complete the table with information about the violin, clarinet, harp, electronic keyboard, and French horn.

SECTION 5–4 How You Hear Sound Waves (pages 184–186)

This section describes how you hear sound and explains what causes hearing loss.

▶ How You Hear Sound (pages 184–185)

Match the three main sections of the ear with their functions.

	Main Section	Function
b	1. outer ear	**a.** Transmits sound waves inward
a	2. middle ear	**b.** Funnels sound waves
c	3. inner ear	**c.** Converts sound waves into a form the brain can understand

4. The outermost part of your ear collects sound waves and directs them into a narrower region known as the ear canal.

5. What is the eardrum and where is it located? It is a small, tightly stretched, drumlike membrane at the end of the ear canal.

6. What cavity of the inner ear is filled with fluid? the cochlea

Name _____ Date _____ Class _____

7. What part of the ear contains the three smallest bones in your body?

middle ear

▶ Hearing Loss (page 186)

8. Circle the letter of each cause of hearing loss.

(a.) aging (b.) injury c. nerve fibers (d.) infection

9. Why is it dangerous to put objects into your ear, even to clean it?

Your eardrum could be damaged or punctured, which could cause hearing loss.

10. How can a viral or bacterial infection cause hearing loss? It can damage the delicate inner ear.

11. What is the most common type of hearing loss? The most common type is hearing loss due to aging, in which the tiny hair-like cells in the cochlea become less effective in detecting signals.

12. When you know you are going to be exposed to loud noises, what should you do to prevent hearing loss? You should wear ear plugs or use other hearing protection.

13. Is the following sentence true or false? Hearing aids are amplifiers.

true

SECTION 5–5 Applications of Sound Waves (pages 188–192)

This section explains how sound waves are used to tell distances. It also describes how animals use sounds and how sound is used in medicine.

▶ Reflection of Sound Waves (page 188)

1. A reflected sound wave is called a(n) echo.

2. What does a sound wave do when it hits a surface through which it cannot pass? It bounces back, or reflects.

▶ Sonar (page 189)

3. Circle the letter of the following that are uses of reflected sound waves.

a. To raise a sunken ship to the surface of water

b. To determine the depth of water

c. To locate boats out on the ocean

d. To find schools of fish

4. What is sonar? Sonar is a system of detecting reflected sound waves.

5. Complete the flowchart about how sonar works in calculating the depth of the ocean.

A sonar machine sends a burst of ultrasonic **sound waves** through the water.

↓

When the sound waves hit the ocean floor, they bounce back, or **reflect**.

↓

The reflected sound waves are detected by the **sonar machine**.

↓

The sonar machine measures the **time** it takes to detect the reflected sound waves.

Name _____ Date _____ Class _____

6. What does the intensity of the reflected sound waves tell the sonar machine about the object that reflected the waves? The intensity tells the size and shape of the object.

▶ Uses of Ultrasound and Infrasound (pages 190–192)

7. Is the following sentence true or false? Some animals communicate using sounds with frequencies that humans cannot hear.

true

8. The use of sound waves to determine distances or to locate objects is called echolocation.

9. Describe how a bat uses echolocation to avoid bumping into an object as it flies. A bat sends out pulses of sound. Then it listens to how long the sound takes to return. By picking up the echoes, the bat can tell if it is about to bump into something.

10. A picture of the inside of the human body using ultrasound is called a(n) sonogram.

11. In Figure 25 on page 191, what is the doctor trying to see with the ultrasound machine? The doctor is trying to see the developing baby inside the pregnant woman.

12. What are three examples of common household objects that use ultrasound waves? Electric toothbrush, ultrasonic jewelry cleaner, automatic focus camera

WordWise

Use the clues to help you unscramble the key terms from Chapter 5. Then put the numbered letters in order to find the answer to the riddle.

Clues	Key Terms	
The membrane that separates the outer ear from the middle ear	mrrudae	e a r d r u m (1)
The cavity filled with liquid in the inner ear	ccleoah	c o c h l e a (2)
How high or low a sound seems to a person	hctip	p i t c h (3)
Sound waves with frequencies above the normal human range of hearing	dnuosartlu	u l t r a s o u n d (4)
The ability of a material to bounce back after being disturbed	ttiiscyale	e l a s t i c i t y (5)
A mixture of sound waves that do not sound pleasing together	ensoi	n o i s e (6)
How well sounds can be heard in a particular room or hall	ccuossiat	a c o u s t i c s (7)
Your voice box	xyarnl	l a r y n x (8)
The quality of the sound you hear	erbmit	t i m b r e (9)
Sound with a pleasing timbre and clear pitch	smcui	m u s i c (10)
The sound produced when tones are played together that seem to have no musical relationship	sseaionncd	d i s s o n a n c e (11)
The amount of energy a sound wave carries per second through a unit area	ynittiens	i n t e n s i t y (12)

Riddle: What is the use of sound to find distance?

Answer: e (1) c (2) h (3) o (4) l (5) o (6) c (7) a (8) t (9) i (10) o (11) n (12)

Name _____ Date _____ Class _____

CHAPTER 6

THE ELECTROMAGNETIC SPECTRUM

SECTION 6–1 The Nature of Electromagnetic Waves (pages 202–205)

This section explains what light is and describes how scientists explain properties of light.

▶ Electromagnetic Waves (pages 203–204)

1. What are electromagnetic waves? They are transverse waves that have some electrical properties and some magnetic properties.

2. Is the following sentence true or false? Electromagnetic waves can transfer energy only through a medium. false

3. What do electromagnetic waves consist of? They consist of changing electric and magnetic fields.

4. Complete the table about electric and magnetic fields.

Electric and Magnetic Fields	
Field	**Definition**
Electric field	A region in which charged particles can be pushed or pulled
Magnetic field	A region in which magnetic forces are present

5. The energy that is transferred by electromagnetic waves is called electromagnetic radiation.

6. Circle the letter of each sentence that is true about electric and magnetic fields.

   a. An electromagnetic wave occurs when electric and magnetic fields vibrate at right angles to each other.

   b. Electromagnetic waves are longitudinal waves.

   c. When an electric field vibrates, so does the magnetic field.

   d. An electric current is surrounded by a magnetic field.

7. Is the following sentence true or false? All electromagnetic waves travel at the same speed. true

▶ Waves or Particles? (pages 204–205)

8. Light has many of the properties of waves. But light can also act as though it is a stream of particles.

9. What happens when light enters a polarizing filter? Only some waves can pass through.

10. The light that passes through a polarizing filter is called polarized light.

11. When light passes through a polarizing filter, does it have the properties of a wave or a particle? a wave

12. Is the following sentence true or false? If two polarizing filters are placed so that one is rotated 90° from the other, all light can come through. false

13. The movement of electrons in a substance when light is shined on it is called the photoelectric effect.

14. The photoelectric effect can only be explained by thinking of light as a stream of tiny packets of energy, or as particles.

15. What are particles of light energy called? photons

Name _____ Date _____ Class _____

SECTION 6–2 Waves of the Electromagnetic Spectrum

(pages 206–214)

This section explains how electromagnetic waves differ from one another. It also describes the different waves of the electromagnetic spectrum.

▶ Characteristics of Electromagnetic Waves (pages 206–207)

1. Circle the letter of each sentence that is true about electromagnetic waves.

a. Different electromagnetic waves have different frequencies.

b. All electromagnetic waves have the same wavelength.

c. Different electromagnetic waves have different wavelengths.

d. All electromagnetic waves travel at the same speed.

2. Circle the letter of each sentence that is true about electromagnetic waves.

a. As the wavelength of electromagnetic waves decreases, the frequency increases.

b. Waves with the longest wavelengths have the lowest frequencies.

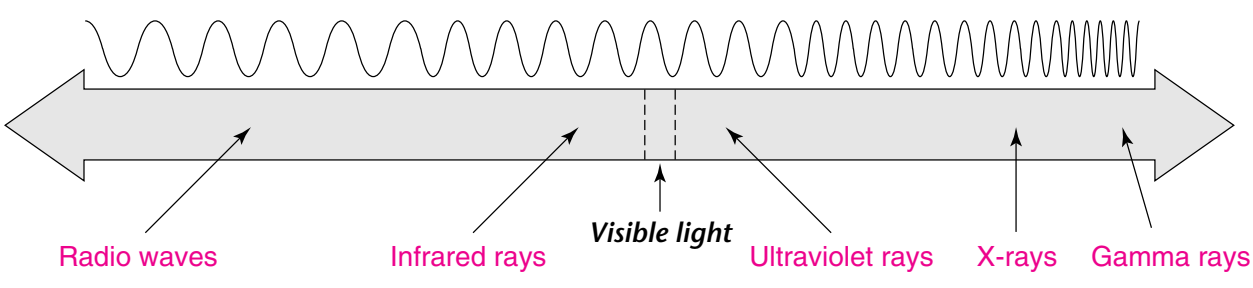
c. As the frequency of electromagnetic waves decreases, the wavelength increases.

d. Waves with the shortest wavelengths have the lowest frequencies.

3. What is the name for the range of electromagnetic waves when they are placed in order of increasing frequency? The electromagnetic spectrum

4. Label the electromagnetic spectrum below with the names of the different waves that make up the spectrum.

Electromagnetic Spectrum



CHAPTER 6, The Electromagnetic Spectrum *(continued)*

▶ Radio Waves (pages 207–209)

5. Each radio station in an area broadcasts at a different frequency.

6. A radio converts radio waves into sound.

7. Is the following sentence true or false? Microwaves are a kind of radio waves. true

8. Circle the letter of the reason why you shouldn't put a metal object in a microwave oven.
   a. Microwaves can pass right through metal objects.
   b. Microwaves are easily blocked by buildings.
   c. Microwaves cause a buildup of electrical energy in metal.
   d. Microwaves are easily absorbed into metal objects.

9. A system of detecting reflected microwaves that is used to locate objects is called radar.

10. What is the use of radio waves in medicine to produce pictures of tissues in the human body called? Magnetic resonance imaging, or MRI

▶ Infrared Rays (pages 209–211)

11. The energy you feel as heat from an electric burner is electromagnetic waves called infrared rays.

12. Circle the letter of each sentence that is true about infrared rays.
   a. Infrared rays have longer wavelengths than visible light.
   b. Most objects give off infrared rays.
   c. The longest infrared rays are sometimes called heat rays.
   d. Heat lamps give off no infrared rays.

13. A picture produced by an infrared camera using infrared rays is called a(n) thermogram.

Name _____ Date _____ Class _____

▶ Visible Light (page 212)

14. The part of the electromagnetic spectrum that you can see is called visible light.

15. Look at Figure 5 on page 539. What are the colors of light that make up visible light? Write their names from longest wavelength to shortest wavelength.

a. red **b.** orange **c.** yellow

d. green **e.** blue **f.** violet

16. Is the following sentence true or false? Most visible light is made up of a mixture of the colors in the visible spectrum. true

▶ Ultraviolet Rays (pages 212–213)

17. Electromagnetic waves with wavelengths just shorter than those of visible light are called ultraviolet rays.

18. Circle the letter of each sentence that is true about ultraviolet rays.

(**a.**) Too much exposure to UV rays can cause skin cancer.

b. Humans with good vision can see UV rays.

(**c.**) UV rays cause skin cells to produce vitamin D.

(**d.**) Lamps that produce UV rays are used to kill bacteria.

▶ X-Rays (page 213)

19. Electromagnetic waves with frequencies higher than ultraviolet rays but lower than gamma rays are X-rays.

20. Circle the letter of the reason why bones show up as lighter areas on photographic plates in an X-ray machine.

(**a.**) Bones absorb X-rays and don't allow them to pass through.

b. X-rays pass right through skin and bones.

c. Bones cause the photographic plate in an X-ray machine to darken.

d. X-rays cannot pass through the skin above the photographic plates.

▶ Gamma Rays (page 214)

21. The electromagnetic waves with the shortest wavelengths and the highest frequencies are called gamma rays.

22. Why are gamma rays the most penetrating of all the electromagnetic rays?

They have the greatest amount of energy.

SECTION 6–3 Generating Visible Light Waves (pages 216–219)

This section describes different kinds of light bulbs. It also identifies the colors of light produced by the most common kind of light bulb.

▶ Introduction (page 216)

1. Complete the table below by writing the correct terms.

Kinds of Objects	
Kind of Object	**Description**
Illuminated	An object that can be seen because it reflects light
Luminous	An object that gives off its own light

2. To view the different colors of light produced by each type of light bulb, you can use an instrument called a(n) spectroscope.

▶ Incandescent Lights (pages 216–217)

3. A light that glows when a filament inside it gets hot is called a(n) incandescent light.

4. What is the filament of a light bulb? The filament is a thin wire coil made of tungsten inside the light bulb.

5. Circle the letter of each sentence that is true about incandescent lights.
   - **a.** Most of the energy produced by incandescent bulbs is given off as infrared rays.
   - **b.** Incandescent bulbs give off all the colors of visible light.
   - **c.** Incandescent bulbs are very efficient in giving off light.
   - **d.** Inventor Thomas Edison developed a long-lasting incandescent bulb.

6. Is the following sentence true or false? Less than ten percent of the energy used to operate an incandescent bulb is given out as light.

   true

▶ Fluorescent Lights (page 217)

7. Lights that glow when an electric current causes ultraviolet waves to strike a coating inside a tube are called fluorescent lights.

8. The process of ultraviolet waves hitting the powder coating inside a fluorescent bulb and causing the coating to emit visible light is called fluorescing.

9. Circle the letter of each sentence that is true about fluorescent lights.
   - **a.** Fluorescent lights give off most of their energy as light.
   - **b.** Each glass fluorescent-light tube contains a gas.
   - **c.** Fluorescent lights emit visible light when UV rays strike the powder coating on the inside of the glass tube.
   - **d.** Fluorescent lights usually don't last as long as incandescent lights.

▶ Neon Lights (page 218)

10. A sealed glass tube filled with neon gas that produces light is called a(n) neon light.

11. Circle the letter of each sentence that is true about neon lights.
   - **a.** Neon lights are commonly used for bright, flashy signs.
   - **b.** Pure neon gives out red light.
   - **c.** Each glass neon-light tube is coated on the inside with a powder.
   - **d.** Often, what is called a neon light has a mixture of gases in the tube.

▶ Sodium Vapor Lights (page 218)

12. Circle the letter of each sentence that is true about sodium vapor lights.

a. Sodium vapor lights require very little electricity for a lot of light.

b. In a sodium vapor light, heat from gases change sodium from a solid to a gas.

c. Particles of sodium vapor give off a greenish blue light.

d. Sodium vapor lights are often used for street lighting.

▶ Tungsten-Halogen Lights (page 219)

13. Circle the letter of each sentence that is true about tungsten-halogen lights.

a. Tungsten-halogen lights work like fluorescent lights.

b. The halogen gas in a tungsten-halogen light makes the filament give off a bright white light.

c. In a tungsten-halogen light, a filament gets hot and glows.

d. Halogen bulbs become very hot.

▶ Bioluminescence (page 219)

14. The process by which living organisms produce their own light with a chemical reaction is called bioluminescence.

15. What are three kinds of organisms that produce light through bioluminescence? Fireflies, jellyfish, and deep-sea fish

Reading Skill Practice

A flowchart can help you remember the order in which events occur. Create a flowchart that describes how an electric current produces light in an incandescent light, as explained on pages 216–217 of your book. Create a second flowchart that describes how an electric current produces light in a fluorescent light, as explained on page 217 of your book. For more information on flowcharts, see page 689 in the Skills Handbook of your book. Do your work on a separate sheet of paper.

Students should make two flowcharts. Each should begin with an electric current passing into a bulb. Each should end with the production of light from the bulb. The steps between should reflect the processes described in the text.

Name _____ Date _____ Class _____

SECTION 6–4 Wireless Communication
(pages 222-229)

This section describes how radio waves are used in communication, how cellular phones and pagers work, and how satellites relay information.

▶ Radio and Television Waves (pages 222–225)

1. Is the following sentence true or false? Both radio and television programs are transmitted by radio waves. true

2. Look at the radio dial shown in Figure 21 on page 223. What does each number on the dial represent? Each number represents a different frequency.

3. Rank the measurements below from highest to lowest frequency. Rank the highest as *1*.

3 **a.** 1,030 kHz

1 **b.** 107 MHz

4 **c.** 550 kHz

2 **d.** 95 MHz

4. What does AM stand for? amplitude modulation

5. Complete the flowchart below about the broadcast of AM radio.

The radio station converts sound into electronic signals.

↓

These signals are converted into a pattern of changes in the amplitude of radio waves.

↓

Your radio picks up the radio waves and converts them back into electronic signals.

↓

These signals travel to your radio's speaker and come out as sound waves.

6. What does FM stand for? frequency modulation

7. How do FM signals travel? They travel as changes, or modulations, in the frequency of the wave.

8. Is the following sentence true or false? The frequencies of FM stations are much lower than the frequencies of AM stations. false

9. Why can't FM waves travel as far as AM waves? FM waves have more energy than AM waves. As a result, FM waves pass through the atmosphere instead of being reflected back.

10. How are television broadcasts different than radio broadcasts? Television broadcasts carry picture signals as well as sound.

11. What are the two main bands of television wave frequencies?
    a. Very High Frequency (VHF) b. Ultra High Frequency (UHF)

▶ Cellular Telephones (page 225)

12. Circle the letter of the kind of radio waves that transmit signals from cellular telephones.
    a. X-rays **b.** infrared rays **c.** gamma rays **d.** microwaves

13. In a cellular telephone system, what does each cell have? Each cell has its own transmitter and receiver.

▶ Cordless Telephones (page 226)

14. What kind of waves transmits the signals from the handset to the base of a cordless telephone? radio waves

Name _____ Date _____ Class _____

▶ Pagers (pages 226–227)

15. When you leave a message for a pager, how does the information get to the correct pager? The information is first sent to a receiving station. There it is coded and sent as electromagnetic waves to the correct pager.

▶ Communications Satellites (pages 228–229)

16. Is the following sentence true or false? Communications satellites are remote-controlled spacecraft that orbit Earth. true

17. Circle the letter of each sentence that is true about communications satellites.

(a.) It is necessary to have more than one satellite in orbit for any given purpose.

b. Communications satellites receive sound waves from Earth and send radio waves back to Earth.

(c.) Most satellites strengthen the signals they receive before they send them back to Earth.

(d.) Communications satellites can relay several signals at once.

18. How do satellite telephone systems affect long-distance telephone calls? They make long-distance calls more easily available and less costly.

19. What do television networks use communications satellites for? They use satellites to send signals to local stations across the country.

20. If you had a GPS receiver, what could you determine by receiving signals from the Global Positioning System? You could determine your exact location on Earth, or even in the air.

WordWise

Complete the sentences by using one of the scrambled words below.

Word Bank

ouuilmns	mmargoerht	uoeescntrfl ghtsli	noothp	tionaidar
oidar sevaw	yasr-X	cancentdesin ghtsil	andetimluli	
iielbsv tighl	maggnii	eaoimcrwvs		

The energy that is transferred by electromagnetic waves is called electromagnetic radiation.

Each tiny packet of light energy is called a(n) photon.

The radio waves with the longest wavelengths and lowest frequencies are called radio waves.

The radio waves with the shortest wavelengths and the highest frequencies are microwaves.

The process of using radio waves to produce pictures of tissues in the human body is called magnetic resonance imaging.

A picture taken with an infrared camera that shows regions of different temperatures in different colors is a(n) thermogram.

The part of the electromagnetic spectrum that you can see is called visible light.

Electromagnetic waves with wavelengths just a little higher than ultraviolet rays are called X-rays.

An object that can be seen because it reflects light is said to be illuminated.

An object that gives off its own light is said to be luminous.

Lights that glow when a filament inside them gets hot are called incandescent lights.

Lights that glow when an electric current causes ultraviolet waves to strike a coating inside a tube are called fluorescent lights.

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CHAPTER 7

LIGHT WAVES

SECTION 7–1 Wave Reflection and Mirrors (pages 238–242)

This section describes what happens when light waves strike an object and identifies three kinds of mirrors.

▶ When Light Waves Strike an Object (page 238)

1. What three things can occur when light waves strike an object? They can be reflected, absorbed, or transmitted.

2. Complete the table about kinds of objects.

Kinds of Objects		
Object	**Description**	**Examples**
Transparent	A material that transmits light waves	Clear glass, water, air
Translucent	A material that scatters light waves as it passes through	Frosted glass, wax paper
Opaque	A material that reflects or absorbs all of the light waves that strike it	Wood, metal, cotton, wool

▶ Kinds of Wave Reflection (page 239)

3. To show how light travels and reflects, you can represent light waves as straight lines called rays.

4. What occurs when parallel rays of light hit a smooth surface? Regular reflection occurs.

5. What occurs when parallel rays of light hit a bumpy, or uneven, surface? Diffuse reflection occurs.

▶ Mirrors (pages 240–242)

6. What is a mirror? A mirror is a sheet of glass that has a smooth, silver-colored coating on the back side.

7. A copy of an object formed by reflected or refracted rays of light is a(n) image.

8. What size of image does a plane mirror produce? same-size image

9. An upright image formed where rays of light appear to meet behind a mirror is called a(n) virtual image.

10. The point at which light rays meet is called the focal point.

11. An image formed when rays actually meet at a point is called a(n) real image.

12. Complete the table about kinds of mirrors.

Kinds of Mirrors			
Kind of Mirror	**Description**	**Virtual or Real Image?**	**Upright or Inverted?**
Plane mirror	Flat	Virtual	Upright
Concave mirror	Curved inward	Virtual or real	Inverted or upright
Convex mirror	Curved outward	Virtual	Upright

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SECTION 7–2 Wave Refraction and Lenses
(pages 243–247)

This section explains what happens when light rays enter a medium at an angle. It also describes how images are formed when light is refracted by transparent material.

▶ Refraction of Light Waves (pages 243–245)

1. When light waves enter a new medium at an angle, what does the change in speed cause the waves to do? The change in speed causes the waves to bend, or change direction.

2. Rank the following media according to how fast light waves travel through them. Rank the fastest as *1*.

2 **a.** water 3 **b.** glass 1 **c.** air

3. What is a material's index of refraction? It is a measure of how much a ray of light bends when it enters the material.

4. Glass causes light to bend more than air does. Which material has a higher index of refraction? glass

5. What does Figure 9 on page 244 show happens to white light when it enters a prism? The prism causes white light to separate into its component colors.

6. Explain why a rainbow can form when light shines through tiny raindrops of water. Raindrops act like tiny prisms, refracting and reflecting the light and separating the colors.

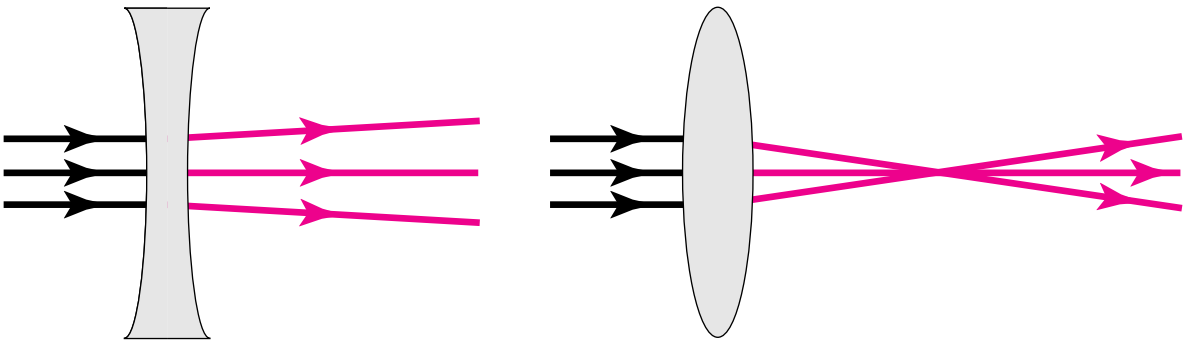
7. An image of a distant object caused by the refraction of light is called a(n) mirage.

▶ Light Waves and Lenses (pages 246–247)

8. A curved piece of glass or other transparent material that is used to refract light is called a(n) lens.

9. How does a lens form an image? A lens forms an image by refracting light rays that pass through it.

10. Label each lens as either a convex lens or a concave lens. Then show what happens to the light rays as they pass through each lens.



Concave lens

Convex lens

11. Complete the following table about lenses.

Kinds of Lenses		
Shape of Lens	**Description**	**Real or Virtual Image?**
Concave	Thinner in the center than at the edges	Virtual
Convex	Thicker in the center than at the edges	Real or virtual

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SECTION 7–3

Color

(pages 249–253)

This section explains what determines the color of an object. It also identifies the primary colors of light and explains how mixing colored substances is different from mixing light.

▶ The Color of Objects (pages 249–251)

1. The color of an object is the color of the light it _____reflects_____.

2. Complete the flowchart about why you see the petals of a lily as orange.

_____White_____ light strikes the petals of a lily.

↓

The petals reflect mostly the _____orange wavelengths_____.

↓

The petals absorb the _____wavelengths_____ of light other than orange.

↓

The orange wavelengths reflect off the petals and enter your _____eyes_____.

↓

You see the petals as the color _____orange_____.

3. What do you see when white light strikes a material that reflects all the colors, such as a skunk's stripe? _____You see white light._____

4. What do you see when white light strikes a material that absorbs all the colors, such as a skunk's legs? _____You see black._____

5. Is the following sentence true or false? Objects can look a different color depending on the color of light in which they are seen.

true

6. Circle the letter of the color of light that a red filter allows to pass through it.

a. blue **b.** magenta **c.** cyan **d.** red

▶ Combining Colors (pages 251–253)

7. The three colors that can be used to make any other color are called primary colors.

8. Any two primary colors combined in equal amounts produce secondary colors.

9. What are the three primary colors?

a. red **b.** green **c.** blue

10. When combined in equal amounts, what do the primary colors of light produce? white light

11. Complete the following "equations" by writing the secondary color the two primary colors of light produce.

a. Green + Blue = Cyan

b. Red + Green = Yellow

c. Red + Blue = Magenta

12. Any two colors of light that combine to form white light are called complementary colors.

13. What are pigments? Pigments are substances that are used to color other materials.

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14. Complete the following "equations" by writing the secondary color the two primary colors of pigments produce.

a. Magenta + Cyan = Blue

b. Magenta + Yellow = Red

c. Cyan + Yellow = Green

SECTION 7–4 Seeing Light Waves (pages 255–258)

This section explains how your eyes allow you to see. It also describes what kinds of lenses are used to correct vision problems.

▶ The Eye—An Organ System (pages 256–257)

Match the part of the eye with its description.

	Part of Eye	Description
b	**1.** Cornea	**a.** The hole through which light enters the eye
d	**2.** Iris	**b.** The transparent front surface of the eye
a	**3.** Pupil	**c.** The short, thick nerve through which signals travel to the brain
e	**4.** Lens	**d.** The ring of colored muscle around the pupil
f	**5.** Retina	**e.** The curved part behind the pupil that refracts light
c	**6.** Optic nerve	**f.** The layer of cells lining the inside of the eyeball

7. What do your eyelids do for your eyes each time you blink? They clean and moisten the cornea.

8. What part gives the eye its color? the iris

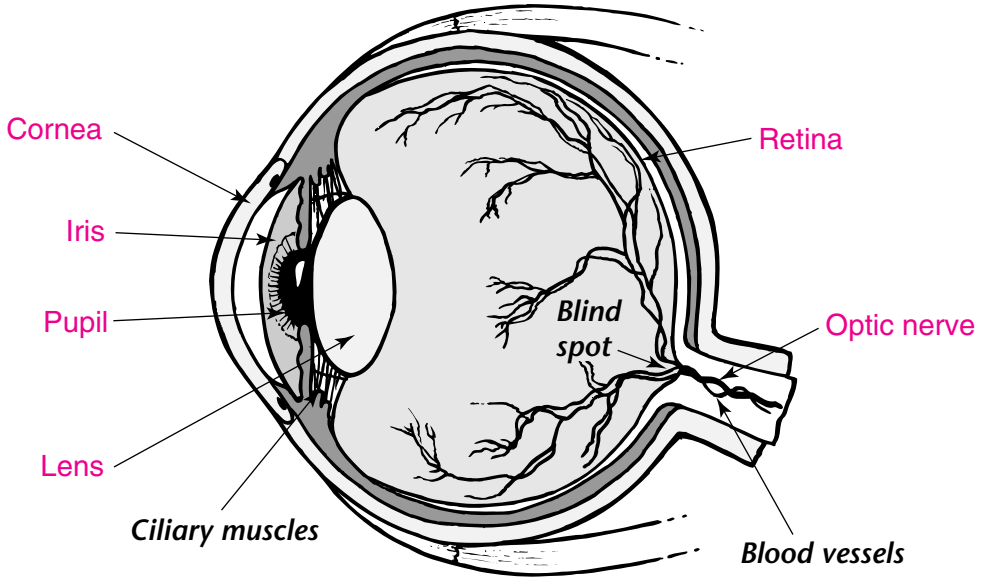
9. Why does the pupil look black? It is an opening into the dark inside of the eye.

10. What is the retina made of? It is made of millions of tiny, light-sensitive cells called rods and cones.

11. The cells of the retina that distinguish among black, white, and shades of gray are called rods.

12. The cells of the retina that respond to colors are called cones.

13. Label the parts of the eye on the illustration.



▶ Correcting Vision (pages 257–258)

14. Complete the table about correcting vision.

Correcting Vision			
Vision Problem	**Shape of Eyeball**	**Vision Perception**	**Type of Correction Lens**
Nearsightedness	A little too long	Distant objects appear blurry	Concave
Farsightedness	A little too short	Nearby objects appear blurry	Convex

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Reading Skill Practice

An outline can help you remember the main points of a section in the order in which they appear. Write an outline of Section 7–4. The title of your outline should be the same as the title of the section. Use the section's major headings for your major topics. Use the section's subheadings for your subtopics. List details about each subtopic under your subheadings. When you finish, you'll have an outline of the section. Do your work on a separate sheet of paper.

Students' outlines should match the headings of Section 7–4. Major headings are *The Eye—An Organ System* and *Correcting Vision.* Under each subhead, students should list two or three important details.

SECTION 7–5

Using Light

(pages 259–268)

This section describes how telescopes, microscopes, and cameras work. It also explains how a special kind of light differs from ordinary light.

▶ Telescopes (page 260)

1. An instrument that forms enlarged images of distant objects and makes them appear closer is called a(n) telescope.

2. What is the most common use of telescopes? To collect light from space

3. Complete the table about telescopes.

Kinds of Telescopes		
Type of Telescope	**Lenses or Mirrors?**	**Upright or Upside Down Image?**
Refracting telescope	Lenses	Upside down
Reflecting telescope	Mirrors	Upside down

4. What does the objective lens of a refracting telescope do? It gathers light from an object and focuses the rays to form a real image.

5. What does the eyepiece lens of a refracting telescope do? It magnifies the image so you can see it clearly.

▶ Microscopes (page 261)

6. An instrument that uses a combination of lenses to produce enlarged images of tiny objects is called a(n) microscope.

7. On a microscope, what is the function of the objective lens? It forms a real, but enlarged, image of a tiny object.

▶ Cameras (pages 261–262)

8. An instrument that uses lenses to focus light and record an image of an object is called a(n) camera.

9. What happens when you press the button of a camera? The shutter briefly opens, allowing light to hit the film.

10. How is the diaphragm of a camera like the iris of an eye? The diaphragm controls the amount of light that enters the camera through the aperture. Similarly, the iris controls the amount of light that enters the eye through the pupil.

▶ Lasers (pages 262–263)

11. A device that produces coherent light, which consists of light waves that all have the same wavelength is called a(n) laser

12. In a laser beam, the crests and troughs of all the waves align with each other.

Name _____ Date _____ Class _____

13. What does a laser consist of? A laser consists of a tube that contains a material such as ruby or a helium-neon mixture.

▶ Uses of Lasers (pages 264–267)

14. Circle the letter of each sentence that is true about the uses of lasers.

(a.) Some lasers are used to cut through steel.

(b.) A laser beam is used to play compact discs, or CDs.

(c.) Doctors use lasers in surgery.

d. Laser incisions usually heal more slowly than scalpel cuts.

15. What is a hologram? A hologram is a three-dimensional photograph created by using the light from a laser.

▶ Optical Fibers (pages 266–268)

16. Is the following sentence true or false? Laser beams can carry signals by modulation like radio waves. true

17. What are optical fibers? They are long, thin strands of glass or plastic that can carry light for long distances without allowing the light to fade out.

18. The complete reflection of light by the inside surface of a medium is called total internal reflection.

19. Circle the letter of each sentence that is true about the uses of optical fibers.

a. An optical fiber can carry only one telephone call at a time.

(b.) Doctors use optical fibers to examine internal organs.

(c.) Optical fibers are much thinner than copper wire.

(d.) Optical fibers have led to great improvements in computer networks.

WordWise

Answer the questions by writing the correct key terms in the blanks. Use the circled letter in each term to find the hidden key term. Then write a definition for the hidden key term.

What is a curved piece of glass or other transparent material that is used to refract light? l e (n) s

What is a copy of an object formed by reflected or refracted rays of light? i m a g (e)

What is an instrument called that uses lenses to focus light and record an image of an object? c (a) m e r a

What is the transparent front surface of the eye called? c o (r) n e a

What is a device called that produces coherent light, which consists of light waves that all have the same wavelength? l a (s) e r

What is an instrument called that uses a combination of lenses to produce enlarged images of tiny objects? m (i) c r o s c o p e

What are substances called that are used to color other materials? p i (g) m e n t s

What is a person called who can see distant objects clearly, but nearby objects appear blurry? f a r s i g (h) t e d

What is the layer of cells that line the inside of the eyeball called? r e (t) i n a

What is a material called that reflects or absorbs all of the light that strikes it? o p a q u (e)

What is the measure of how much a ray of light bends when it enters the material called? i n (d) e x o f r e f r a c t i o n

Hidden Term: n e a r s i g h t e d

Definition: A nearsighted person is someone who can see nearby things clearly, but objects at a distance appear blurry.

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CHAPTER 8

Characteristics of the Universe

SECTION 8–1 Tools of Modern Astronomy (pages 274–280)

This section describes telescopes and other tools astronomers use to study the universe.

▶ Introduction (page 274)

1. What is a constellation? A constellation is a pattern of stars in the sky.

2. Is the following sentence true or false? Stars in a constellation look as if they are close together because they all are the same distance from Earth.
false

▶ Looking at Stars (pages 275–277)

3. Like the sun, stars are spheres of hot, glowing gas.

4. What are two types of electromagnetic radiation given off by stars?
   a. visible light
   b. radio waves

5. Is the following sentence true or false? All of modern astronomy is based on detection of visible light. false

▶ Visible Light Telescopes (pages 275–276)

6. What do most telescopes collect and focus? They collect and focus different types of electromagnetic radiation, including visible light.

7. What kind of telescope did Galileo use? refracting telescope.

8. What are the two lenses in a refracting telescope called? They are the objective lens and the eyepiece lens.

9. Complete the table about telescopes.

Telescopes	
Type	**Description**
Refracting telescope	A telescope that uses convex lenses to gather a large amount of light onto a small area
Reflecting telescope	A telescope that uses mirrors to focus a large amount of light onto a small area
Radio Telescope	A telescope that uses curved, reflecting surfaces to concentrate faint radio waves from outer space onto small antennas

10. The largest visible light telescopes are now all reflecting telescopes.

11. What other kinds of radiation are detected by telescopes? Infrared radiation, ultraviolet radiation, X-rays, and gamma rays

▶ Observatories (page 277)

12. A building that contains one or more telescopes is called a(n) observatory.

13. Why have astronomers built the largest visible light telescopes on the tops of mountains? Earth's atmosphere makes objects in space look blurry. The sky on some mountaintops is clearer and is not brightened much by city lights.

Name _____ Date _____ Class _____

▶ Satellites (page 278)

14. Why can the Hubble Space Telescope make images in visible light that are much better than images made by telescopes on Earth? It makes better images because it is above Earth's atmosphere.

▶ Spectrographs (pages 279–280)

15. What does a spectrograph do? A spectrograph breaks the light from an object into colors and photographs the resulting spectrum.

16. What are two kinds of information that astronomers can collect from stars by using spectrographs?

a. chemical composition

b. temperatures

17. Is the following sentence true or false? Each element has a unique set of lines on a spectrum. true

18. How can astronomers infer which elements are found in a star? They can compare a star's spectrum with the known spectra of different elements.

19. Stars at different temperatures produce different line spectra.

20. How can astronomers infer how hot a star is? They can compare a star's spectrum with the known spectra of elements at different temperatures.

SECTION 8–2 Characteristics of Stars
(pages 283–289)

This section explains how astronomers measure distances to stars. It also describes how stars are classified.

▶ Introduction (page 283)

1. A cluster of stars, gases, and dust held together by gravity is called a(n) galaxy.

2. What is the universe? The universe is all of space and everything in it.

3. Most of the universe is empty space.

▶ Distances to Stars (page 284)

4. Why don't scientists measure distances to stars in kilometers?
Distances to stars are so large that the kilometer is not a very practical unit.

5. What is a light year? The distance light travels in one year, about 9.5 million million kilometers.

6. Is the following sentence true or false? The light-year is a unit of time.
false

▶ Measuring Distances to Stars (pages 284–285)

7. What is parallax? Parallax is the apparent change in position of an object when you look at it from different places.

Name _____ Date _____ Class _____

8. Circle the letter of what astronomers use parallax to measure the distance to.

a. distant stars **b.** the sun **c.** the planets **d.** nearby stars

9. To measure parallax shift, astronomers look at the same star twice, when Earth is on different sides of the sun.

▶ Classifying Stars (page 285)

10. What are the three main characteristics used to classify stars?

a. size **b.** temperature **c.** brightness

▶ Sizes of Stars (page 286)

11. Stars that are much larger than the sun are called giant or supergiant stars.

12. Which kinds of stars are smaller than the sun?

a. neutron star **b.** giant star **c.** supergiant star **d.** white dwarf star

▶ Color and Temperature of Stars (page 286)

13. What reveals a star's temperature? Its color reveals its temperature.

14. Circle the letter of what is revealed by the red color of the supergiant star called Betelgeuse.

a. It is an extremely hot star. **b.** It is in a constellation.

c. It is far away. **d.** It is a cool star.

▶ Brightness of Stars (pages 287–288)

15. The amount of light a star gives off is called its brightness.

16. Why does Rigel shine as brightly as Betelgeuse, even though Rigel is much smaller than Betelgeuse? Rigel is very hot and gives off a lot of light. Betelgeuse is a cool star, and doesn't give off much light.

17. How bright a star looks from Earth depends on what two factors?

a. How far the star is from Earth

b. How bright the star actually is

18. Complete the table about the measurement of a star's brightness.

Brightness of Stars	
Measurement of Brightness	**Definition**
Apparent magnitude	A star's brightness as seen from Earth
Absolute magnitude	A star's brightness if it were a standard distance from Earth

19. Is the following sentence true or false? The closer a star is to Earth, the brighter it is. true

20. What two things must an astronomer find out in order to calculate a star's absolute magnitude?

a. The star's apparent magnitude

b. The star's distance from Earth

▶ The Hertzsprung-Russell Diagram (pages 288–289)

21. The diagram that shows the relationship between the surface temperature and the brightness of stars is called the Hertzsprung-Russell diagram.

22. Look at the Hertzsprung-Russell diagram in Figure 11 on page 289. Write what is measured on each of the two axes of the diagram.

x-axis (horizontal axis): Surface Temperature (°C)

y-axis (vertical axis): Brightness

23. An area on the Hertzsprung-Russell diagram that runs from the upper left to the lower right and includes more than 90 percent of all stars is called the main sequence.

Name _____ Date _____ Class _____

24. Circle the letter of each sentence that is true based on the Hertzsprung-Russell diagram.

a. The sun is a main-sequence star.

b. White dwarfs are brighter than supergiants.

c. Rigel is hotter than Betelgeuse.

d. Polaris is brighter than the sun.

Reading Skill Practice

A flowchart can help you remember the order of steps in a process. On a separate sheet of paper, create a flowchart that describes the steps that astronomers use to measure the distance to stars, as described on pages 284–285. The first step in your flowchart should be: Astronomers look at a star when Earth is on one side of the sun. For more information about flowcharts, see page 689 in the Skills Handbook of your textbook.

Students' flowcharts should include the steps described in the text on pages 284–285 and Figure 7 on page 285.

SECTION 8–3

Lives of Stars

(pages 292-296)

This section explains how the life of a star begins. It also explains what determines how long a star lives and what happens when a star runs out of fuel.

▶ Introduction (page 292)

1. A neutron star that gives off pulses of radio waves is called a(n) pulsar.

▶ Studying the Lives of Stars (page 292)

2. Since astronomers can't study a single star for billions of years, how do they know that stars go through stages in their lives? Astronomers study many stars and see how they differ from each other.

▶ A Star Is Born (page 293)

3. A large amount of gas and dust spread out in an immense volume is called a(n) nebula.

4. Is the following sentence true or false? All stars begin their lives as part of nebulas. true

5. The earliest stage of a star's life is called a(n) protostar.

6. Describe how a star is born. A star is born when the contracting gas and dust become so hot that nuclear fusion starts.

▶ Lifetimes of Stars (page 293)

7. Circle the letter of the factor that determines how long a star lives.
   (a.) its mass **b.** its brightness **c.** its volume **d.** its temperature

8. Is the following sentence true or false? Stars with more mass last longer than stars with less mass. false

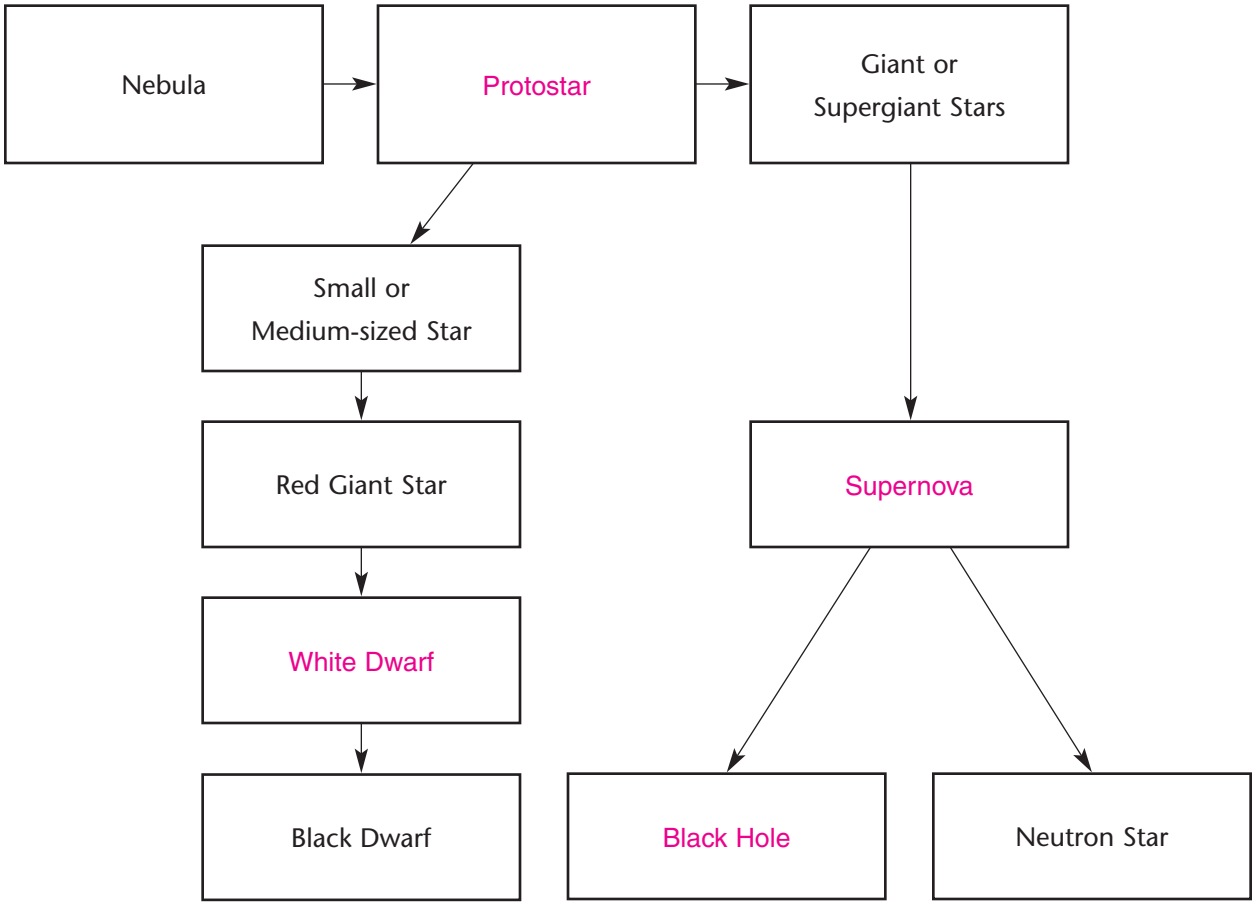
▶ Deaths of Stars (pages 294–296)

9. Complete the table by writing the definition of each term.

Deaths of Stars	
Term	**Definition**
White dwarf	The remaining blue-white hot core of a red giant after the outer part has drifted away
Black dwarf	A dead star—a white dwarf that has run out of fuel
Supernova	An explosion of a red giant or supergiant
Neutron star	A tiny star that remains after a supernova
Black hole	The remains of a massive star pulled into a small volume by gravity

Name _____ Date _____ Class _____

10. Use the information in *Exploring the Lives of the Stars* on page 295 to complete the flowchart.



11. How do astronomers think the sun may have begun? The sun may have begun as a nebula that contained material from a supernova explosion.

12. Because no form of radiation can ever get out of a black hole, how can astronomers detect where black holes are? They can detect X-rays coming from rotating hot gas near a black hole. They can also calculate the mass of a black hole from the effect of its gravity on a nearby star.

13. A distant galaxy with a black hole at its center is called a(n) quasar.

SECTION 8–4 Star Systems and Galaxies (pages 297–300)

This section explains what a star system is and describes the three types of galaxies.

▶ Star Systems and Planets (pages 297–299)

1. What are star systems? They are groups of two or more stars.

2. Star systems with two stars are called double stars or binary stars.

3. What does the double star Alpha Centauri A and Alpha Centauri B form with Proxima Centauri? a triple star system

4. A star system in which one star blocks the light from another star is a(n) eclipsing binary.

5. Circle the letter of the correct explanation of how astronomers can tell if there is an unseen second star in a system?
   - **a.** They observe the effects of its gravity.
   - **b.** They measure the parallax of the second star.
   - **c.** They send a probe to the second star.
   - **d.** They observe its supernova.

6. How did astronomers deduce that the star called 51 Pegasi has a planet revolving around it? They observed the effects of the planet's gravity on the star.

▶ Galaxies (pages 299–300)

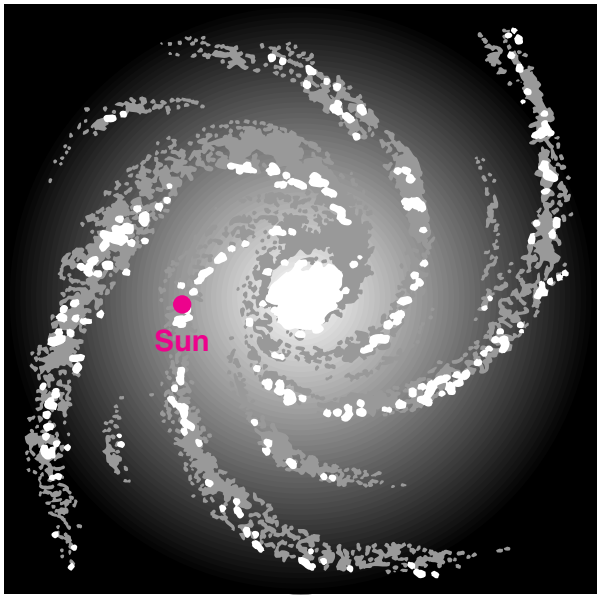
7. The galaxy in which our solar system is located is called the Milky Way.

8. How many galaxies are there in the universe? billions

Name _____ Date _____ Class _____

9. On the drawing of the Milky Way Galaxy below, place a dot and write a label that shows where the sun is located.

Milky Way Galaxy



10. Complete the table about types of galaxies.

Types of Galaxies	
Type	**Description of Shape**
Spiral galaxies	Galaxies with arms that spiral outward, like pinwheels
Elliptical galaxies	Galaxies that look like flattened balls
Irregular galaxies	Galaxies that do not have regular shapes

11. For each galaxy below, write the type that it is.

Milky Way Galaxy: spiral galaxy

Large Magellanic Cloud: irregular galaxy

12. Circle the letter of each sentence that is true about galaxies.

a. Ellipitical galaxies contain only new stars.

b. There is lots of gas and dust between the stars in the Milky Way Galaxy.

c. The center of the Milky Way Galaxy is about 25,000 light years from the sun.

d. All galaxies have regular shapes.

SECTION 8–5 History of the Universe (pages 301-304)

This section explains how astronomers think the universe and the solar system formed.

▶ Moving Galaxies (pages 301–302)

1. To study how and when the universe formed, what kind of information do astronomers use? They use information about how galaxies are moving.

2. Is the following sentence true or false? The farther away a galaxy is from us, the faster it is moving away from us. true

3. How is the universe like rising raisin bread dough? The galaxies in the universe, like the raisins in the bread dough, are moving away from each other. In the universe, it is space that is expanding, like the dough between the raisins.

▶ Origin of the Universe (pages 302–303)

4. The rapid expansion that resulted in the formation of the universe is called the big bang.

5. When did the big bang occur? It occurred about 10 to 15 billion years ago.

6. What can astronomers use to infer approximately how long the universe has been expanding? They know approximately how fast the universe is expanding now.

Name _____ Date _____ Class _____

▶ Origin of the Solar System (page 303)

7. Our solar system formed about five billion years ago.

8. How did our solar system form? A giant cloud of gas and dust, or nebula, collapsed to form the solar system.

9. What events led to the birth of the sun? The nebula shrank to form a spinning disk. Gravity pulled some gas into the center of the disk, and the gas became hot and dense enough for nuclear fusion to begin. Then the sun was born.

▶ Unanswered Questions about the Universe (page 304)

10. Describe two possibilities of what will happen to the universe in the future.

a. The universe will continue to expand and some scientists suggest that the rate is speeding up.

b. The force of gravity will begin to pull the galaxies back together. The result will be a reverse big bang, or "big crunch."

WordWise

Solve the clues by filling in the blanks with key terms from Chapter 8. Then write the numbered letters in the correct order to find the hidden message.

Clues	Key Terms
The earliest stage of a star's life	p r o t(1) o s t a r
The remains of a massive star pulled into a small volume by gravity	b l a c k h(2) o l e
An instrument that breaks the light from an object into colors and photographs the resulting spectrum	s p e(3) c t r o g r a p h
All of space and everything in it	u n i v e r s(4) e
A tiny star that remains after a supernova	n e u(5) t r o n s t a r
The rapid expansion that formed the universe	b i g b a n(6) g
A pattern of stars in the sky	c o n s t e l l a t i(7) o n
The explosion of a dying giant or supergiant star	s(8) u p e r n o v a
A galaxy that has a pinwheel shape	s p i r a l(9) g a l a x y
A building that contains one or more telescopes	o b s(10) e r v a t o r y
A device used to detect radio waves from objects in space	r a d i o t(11) e l e s c o p e
The apparent change in position of an object when you look at it from different places	p a r a(12) l l a x
A distant galaxy with a black hole at its center	q u a s a r(13)

Hidden Message

T(1) h(2) e(3) s(4) u(5) n(6) i(7) s(8) a(9) s(10) t(11) a(12) r(13).

Name _____ Date _____ Class _____

CHAPTER 9

PLATE TECTONICS

SECTION 9–1 Earth's Interior (pages 314–322)

This section explains how scientists learn about Earth's interior. The section also describes the layers that make up Earth and explains why Earth acts like a giant magnet.

▶ The Science of Geology (page 315)

1. Why must scientists rely on indirect methods to observe Earth's interior?
Scientists must rely on indirect methods because they cannot observe Earth's interior directly.

2. When earthquakes occur, they produce waves called
seismic waves.

3. How do geologists use seismic waves to learn about Earth? Geologists record seismic waves and study how they travel through Earth. The speed of the seismic waves and the paths they take reveal how the planet is put together.

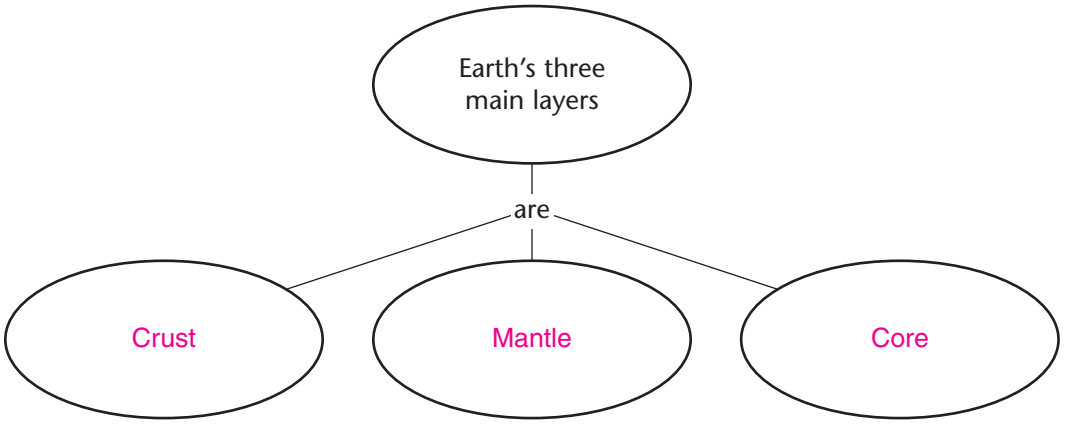
4. How is Earth like an onion? Like an onion, Earth is made up of several layers, each layer surrounding the layer beneath it.

▶ A Journey to the Center of the Earth (page 317)

5. Is the following sentence true or false? The temperature changes as you go from the surface toward the center of Earth. true

6. How does pressure change as you go from the surface toward the center of Earth? Pressure increases.

7. Complete the concept map.



▶ The Crust (page 318)

8. The crust is a layer of rock that forms Earth's outer skin.

9. Is the following sentence true or false? The crust is thinnest under high mountains. false

10. The dark-colored rock that makes up most of the oceanic crust is basalt.

11. The light-colored rock that makes up most of the continental crust is granite.

▶ The Mantle (pages 318–319)

Match the name of each layer of Earth with its description.

Layer	Description
b 12. mantle	**a.** Rigid layer that includes the upper part of the mantle and the crust
a 13. lithosphere	**b.** Layer of hot rock between the crust and the core
c 14. asthenosphere	**c.** Soft layer just below the lithosphere

Name _____ Date _____ Class _____

15. Is the following sentence true or false? The asthenosphere floats on the lithosphere. false

16. Is the following sentence true or false? The mantle is nearly 3,000 kilometers thick. true

▶ The Core (pages 319–321)

17. Circle the letter of each sentence that is true about Earth's outer core.

a. It makes up about 25 percent of Earth's total volume.

b. It is made of solid metal.

c. It contains iron and nickel.

d. It behaves like a solid.

18. Circle the letter of each sentence that is true about Earth's inner core.

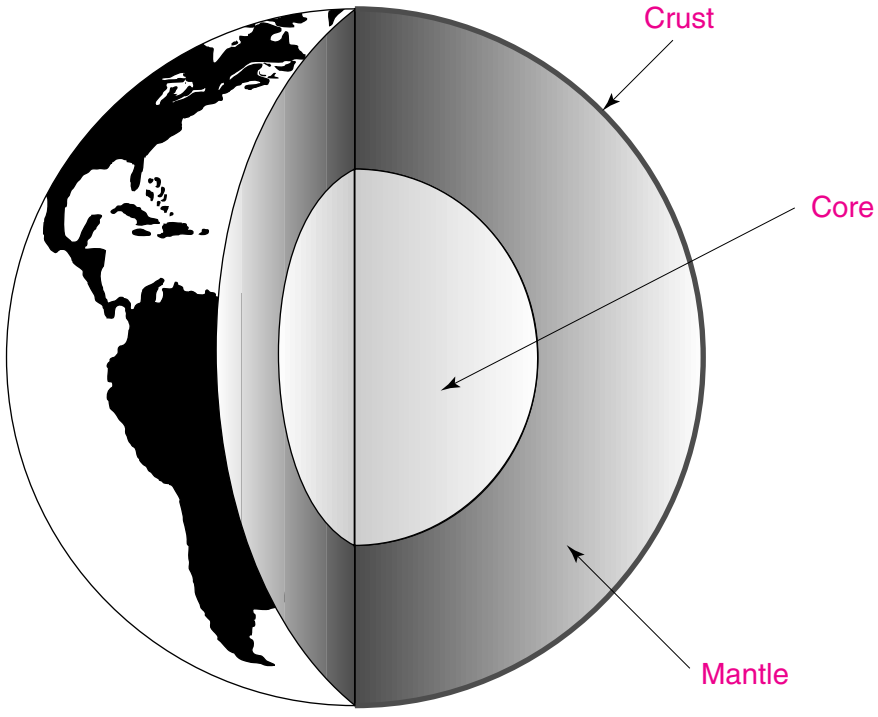
a. It consists of molten metal.

b. It behaves like a thick liquid.

c. It is not very dense.

d. It is under extreme pressure.

19. In the drawing, label the three main layers of Earth.



▶ Earth's Magnetic Field (page 322)

20. What creates Earth's magnetic field? Earth's magnetic field is created by convection currents in the liquid outer core.

SECTION 9–2 Convection Currents and the Mantle (pages 323-325)

This section describes how heat is transferred from Earth's hot core through the mantle.

▶ Introduction (page 323)

1. The movement of energy from a warmer object to a cooler object is called heat transfer.

2. List the three types of heat transfer.

a. radiation **b.** conduction **c.** convection

▶ Radiation (page 323)

3. What is radiation? Radiation is the transfer of energy by electromagnetic waves.

4. What are two forms of radiation? Forms of radiation include the heat you feel from sunlight and the heat you feel around a flame or open fire.

▶ Conduction (page 324)

5. What is conduction? Conduction is heat transfer by direct contact of particles of matter.

6. What is an example of conduction? An example is a spoon heating up in a pot of hot soup or the skin of your hand heating up when you touch a hot spoon.

Name _____ Date _____ Class _____

▶ Convection (pages 324–325)

7. What is convection? Convection is heat transfer by the movement of a heated fluid.

8. Heat transfer by convection is caused by differences of temperature and density within a fluid.

9. A measure of how much mass there is in a volume of a substance is density.

10. Circle the letter of the sentence that describes what happens to a fluid when its temperature increases.

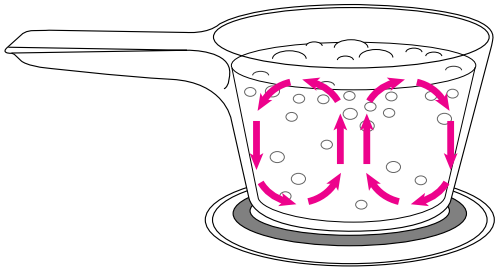
a. Its particles occupy less space.

b. Its density decreases.

c. Its particles move more slowly.

d. Its particles settle together more closely.

11. Use arrows to show the convection currents that would flow if the pot of soup in the drawing was heated.



12. If the pot is no longer heated, when will the convection currents stop flowing? They will stop flowing when all the soup has reached the same temperature.

▶ Convection in Earth's Mantle (page 325)

13. Is the following sentence true or false? Convection currents flow in the asthenosphere. true

14. Is the following sentence true or false? The heat source for the convection currents in the mantle is from the crust. false

SECTION 9–3 Drifting Continents
(pages 326–330)

This section describes a theory of how the continents came to be located where they are today. The section also gives evidence for the theory and explains why the theory was not accepted for many years.

▶ Continental Drift (pages 327–329)

1. State Alfred Wegener's hypothesis about how Earth's continents have moved.

Wegener's hypothesis was that all the continents had once been joined together in a single landmass and have since drifted apart.

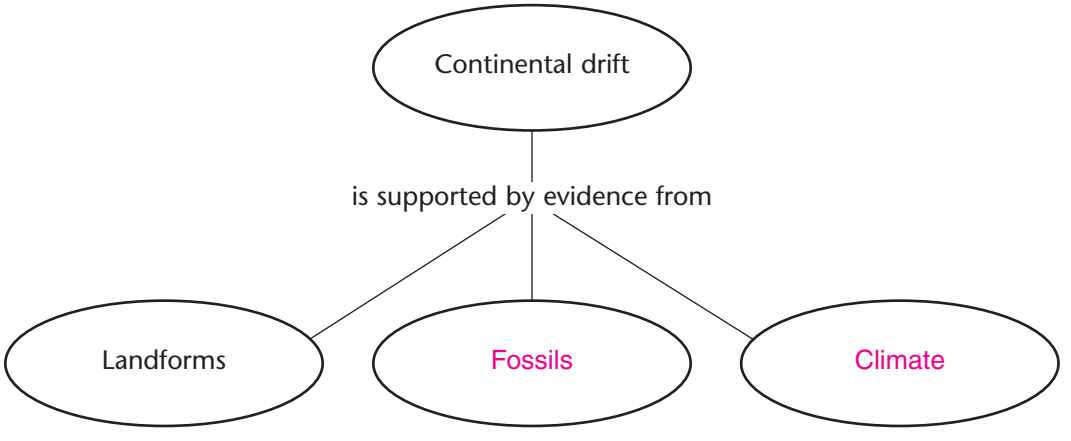
2. Wegener named his supercontinent Pangaea.

3. What did Wegener think had happened to this supercontinent?

Wegener thought that this supercontinent had broken apart and that the pieces had slowly moved to become the continents as they are today.

4. Wegener's idea that the continents slowly moved over Earth's surface became known as continental drift.

5. Complete the concept map.



Name _____ Date _____ Class _____

6. Give an example of evidence from landforms that supported Wegener's idea of continental drift. An example is mountains in South Africa that line up with mountains in Argentina or coal fields in Europe that match up with coal fields in North America.

7. Any trace of an ancient organism preserved in rock is called a(n) fossil.

8. How did Wegener explain similar fossils on different continents? Wegener explained it as evidence that the continents had once been united.

9. Is the following sentence true or false? Wegener believed that Earth's climate had changed. false

▶ Scientists Reject Wegener's Hypothesis (page 330)

10. How did Wegener think that mountains formed? He thought they formed when drifting continents collided, causing their edges to crumple and fold.

11. How do the locations of mountains support Wegener's idea about how mountains form? Mountains usually occur in narrow bands along the edges of continents, as you would expect if the collision of continents forms mountains.

Reading Skill Practice

When you read about a complex subject, taking notes can help you to identify the most important information. Take notes on Section 9–3 by writing down the headings in the order they occur. Then, under each heading, list the main points. Do your work on a separate sheet of paper.

Students should make note of the main points under each heading in the section, including a brief description of the hypothesis about continental drift and the evidence that supports it, as well as a concise statement about how the hypothesis was first rejected.

SECTION 9–4 Sea-Floor Spreading (pages 331-337)

This section explains sea-floor spreading and describes evidence that it happens. The section also explains subduction and describes how subduction affects Earth's oceans.

▶ Mapping the Mid-Ocean Ridge (page 332)

1. Circle the letter of each sentence that is true about the mid-ocean ridge.

a. The mid-ocean ridge is the longest chain of mountains in the world.

b. The mid-ocean ridge is found only below the Pacific Ocean.

c. The mid-ocean ridge lies completely under water.

d. The top of the mid-ocean ridge is split by a steep-sided valley.

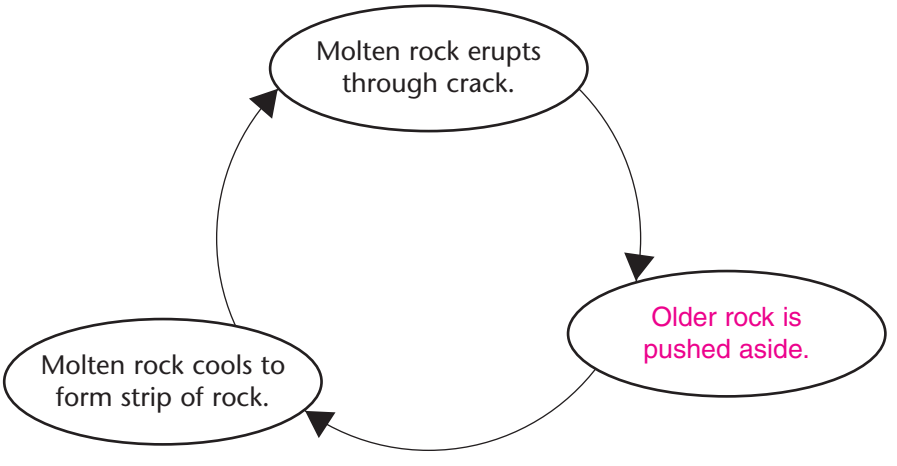
2. A device that bounces sound waves off underwater objects is called sonar.

3. What is sonar used for? Sonar is used to determine the distance to an object. It has been used to map the mid-ocean ridge.

▶ Evidence for Sea-Floor Spreading (pages 333–335)

4. The process that continually adds new material to the ocean floor is called sea-floor spreading.

5. Complete the cycle diagram of sea-floor spreading.



Name _____ Date _____ Class _____

6. List three types of evidence for sea-floor spreading.

a. molten material b. magnetic stripes c. drilling samples

7. Circle the letter of each sentence that is true about Earth's magnetism.

(a.) At times in the past, a compass needle on Earth would have pointed south.

(b.) Rock that makes up the ocean floor lies in a pattern of magnetized stripes.

c. The pattern of stripes is different on both sides of the mid-ocean ridge.

(d.) Rocks that harden at the same time have the same "magnetic memory."

8. How did drilling samples show that sea-floor spreading really has taken place? The farther away from the ridge that the samples were taken, the older they were, and the youngest samples were always in the center of the ridge.

▶ Subduction at Deep-Ocean Trenches (page 336)

9. Deep underwater canyons are called deep-ocean trenches.

10. What is subduction? Subduction is the process by which the ocean floor sinks beneath a deep-ocean trench.

11. Is the following sentence true or false? At the mid-ocean ridge, subduction allows oceanic crust to sink back into the mantle.

false

▶ Subduction and Earth's Oceans (page 337)

12. Is the following statement true or false? The Pacific Ocean is shrinking.

true

13. Why is the Atlantic Ocean expanding? The Atlantic Ocean is expanding because it has only a few short deep-ocean trenches, and the spreading ocean floor has virtually nowhere to go.

SECTION 9–5 The Theory of Plate Tectonics
(pages 340-345)

This section explains how the lithosphere is broken into separate sections that move.

▶ Introduction (page 340)

1. The lithosphere is broken into separate sections called plates.

2. Is the following sentence true or false? Plates can carry continents or parts of the ocean floor but not both. false

▶ A Theory of Plate Motion (page 340–341)

3. State the theory of plate tectonics. Pieces of Earth's lithosphere are in constant, slow motion, driven by convection currents in the mantle.

4. Is the following sentence true or false? The theory of plate tectonics explains the formation, movement, and subduction of Earth's plates. true

5. The plates of the lithosphere float on top of the asthenosphere.

▶ Plate Boundaries (pages 342–344)

Match the term with its definition.

	Term	Definition
b	6. plate boundary	**a.** Deep valley that forms where two plates pull apart
c	7. fault	**b.** Line where different pieces of the lithosphere meet
a	8. rift valley	**c.** Break in Earth's crust where rocks have slipped past each other

Name _____ Date _____ Class _____

9. Complete the table.

Plate Movement	
Type of Plate Boundary	**How Plates Move**
Transform boundary	The plates move past each other in opposite directions.
Divergent boundary	The plates move apart.
Convergent boundary	The plates move together.

10. Is the following sentence true or false? Crust is neither created nor destroyed along a transform boundary. true

11. Most divergent boundaries occur at the mid-ocean ridge.

12. When two plates converge, the result is called a(n) collision.

13. When two plates collide, what determines which plate comes out on top?

The density of the plates determines which plate comes out on top.

14. Complete the table.

Convergent Boundaries	
Types of Plates Converging	**Result**
Oceanic/oceanic	Subduction occurs.
Oceanic/continental	Oceanic plate sinks.
Continental/continental	Mountain ranges form.

▶ The Continents' Slow Dance (page 345)

15. About how fast do plates move? Plates move from about one to ten centimeters per year.

16. Is the following sentence true or false? The pieces of the super continent Pangea began to drift apart about 225 million years ago.

true

SECTION 9–6 Changing Earth's Surface
(pages 346–353)

This section describes how forces in Earth's surface cause changes in the lithosphere, such as mountain building, land subsidence, and volcanoes.

▶ Forces in the Lithosphere (pages 346–347)

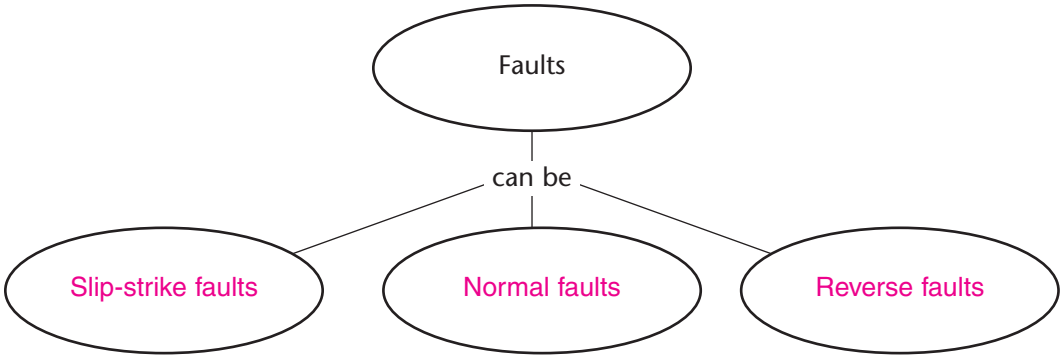
1. Is the following sentence true or false? Plate movement can alter Earth systems and produce changes in Earth's surface. true
2. A force that adds potential energy to rock until the rock changes shape or breaks is called stress.
3. What is deformation? Deformation is a change in rock's shape or volume.
4. Is the following sentence true or false? Deformation takes place quickly. false
5. Where deformation causes the lithosphere to break, a(n) fault forms.
6. What causes an earthquake? During plate movement, stress builds up along a fault, storing potential energy in the rock. Eventually, the rock along the fault suddenly breaks and slides, causing an earthquake.

▶ Faults and Fault Movements (pages 348–349)

7. What is a fault? A fault is a break in Earth's crust where slabs of crust slip past each other.
8. Is the following sentence true or false? Faults usually occur along plate boundaries. true
9. The forces of plate motion compress, pull, or shear the crust so much that the crust breaks.

Name _____ Date _____ Class _____

10. Complete the concept map.



11. The rocks on either side of the fault slip past each other sideways with little up and down motion at a(n) slip-strike fault.

12. The half of the fault that lies above a normal fault is called the hanging wall, and the half that lies below the fault is called the footwall.

13. Is the following sentence true or false? A reverse fault has the same structure as a slip-strike fault, but the blocks move in the opposite direction. false

14. Compression forces cause reverse faults.

▶ Mountain Building (pages 349–350)

15. Mountain building is the result of folding and faulting driven by plate movement.

16. What is a mountain? A mountain is a landform that rises high above the surrounding land.

17. Circle the letter of each sentence that is true about mountain building.

a. Collisions between plates cause folding.

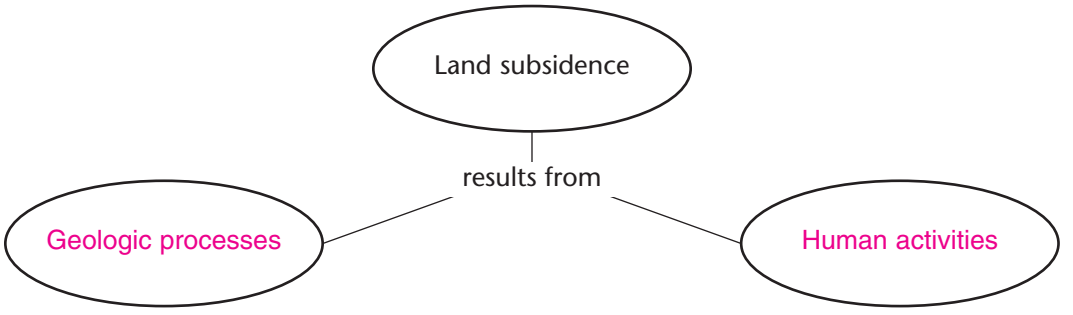
b. Folding formed the Teton range in Wyoming.

c. Tension in the crust causes the formation of fault-block mountains

d. Faulting formed the Appalachian Mountains.

▶ Land Subsidence (page 350)

18. Complete the concept map.



19. Plate movement along diverging plate boundaries causes subsidence that leads to the formation of rift valleys and ocean basins.

20. Is the following sentence true or false? Sometimes, as uplift raises one part of the crust, subsidence occurs in an adjoining area.

true

▶ Volcanic Mountains (page 351)

21. What is a volcano? A volcano is a weak spot in the crust where molten, rock-forming material called magma comes to the surface.

22. Volcanic activity builds mountains made of what two materials?

a. lava rock

b. other volcanic materials

23. Is the following sentence true or false? Plate movements determine where volcanoes develop on Earth's surface. true

Name _____ Date _____ Class _____

▶ Locating Volcanoes (pages 351–352)

24. Is the following sentence true or false? There are about 200 active volcanoes on land. false

25. What is the Ring of Fire? The Ring of Fire is a volcanic belt formed by the many volcanoes that rim the Pacific Ocean.

26. Why do volcanic belts form along the boundaries of Earth's plates? Here, the lithosphere is weak and fractured, allowing magma to reach the surface.

27. Most volcanoes occur along diverging plate boundaries or in subduction zones around the edges of oceans.

28. What are two examples of places where volcanoes form along diverging plate boundaries?

a. the mid-ocean ridge

b. rift valleys

29. Many volcanoes occur on islands, near boundaries where two oceanic plates collide.

30. Where two plates collide, the process of subduction occurs, which causes sinking crust to melt and form magma.

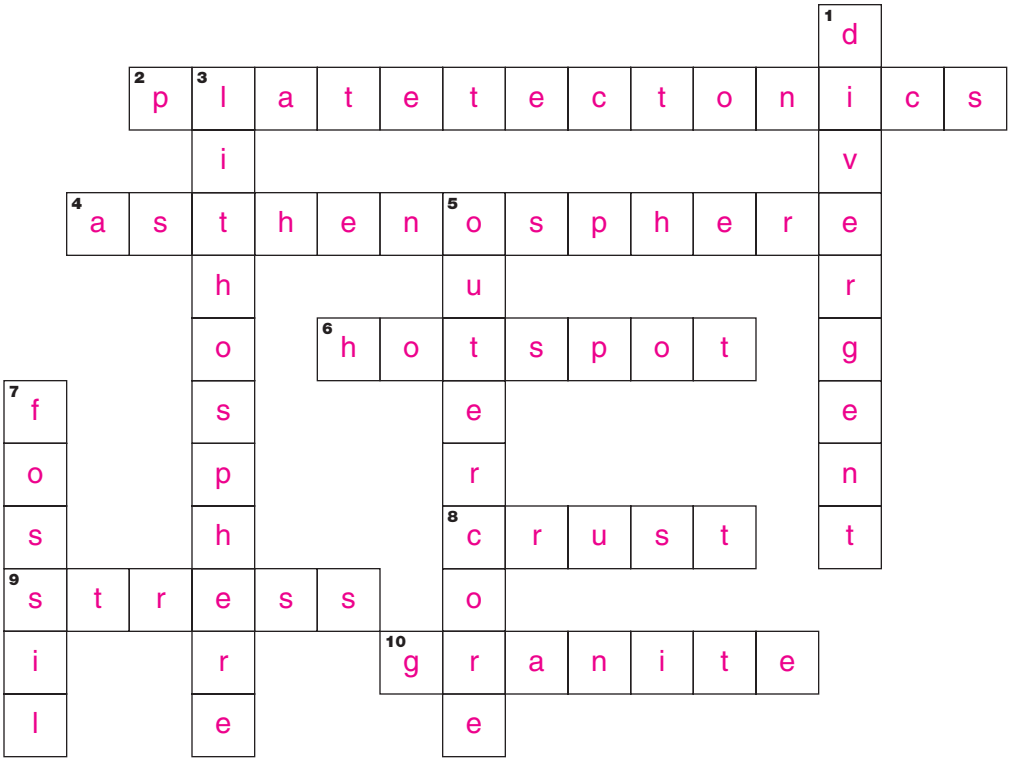
31. What is a hot spot? A hot spot is an area where magma from deep within the mantle melts through the crust like a blowtorch through steel.

32. Where is there a hot spot under the North American Plate? Yellowstone National Park in Wyoming

Name _____ Date _____ Class _____

WordWise

Use key terms from Chapter 9 to complete the crossword puzzle.



Clues Down

1. The type of boundary where two plates move apart
3. Rigid layer formed by the crust and the uppermost part of the mantle
5. Layer of molten metal that surrounds Earth's inner core
7. Trace of an organism that has been preserved in rock

Clues Across

2. Geological theory that Earth's plates are in constant, slow motion
4. Part of the mantle just beneath the lithosphere
6. Area where magma from deep within the mantle melts through the crust
8. Layer of rock that forms Earth's outer skin
9. Force that adds potential energy to rock until the rock changes shape or breaks
10. Kind of rock that makes up most of the continental crust

Name _____ Date _____ Class _____

CHAPTER 10

MINERALS

SECTION 10–1 Properties of Minerals (pages 360-368)

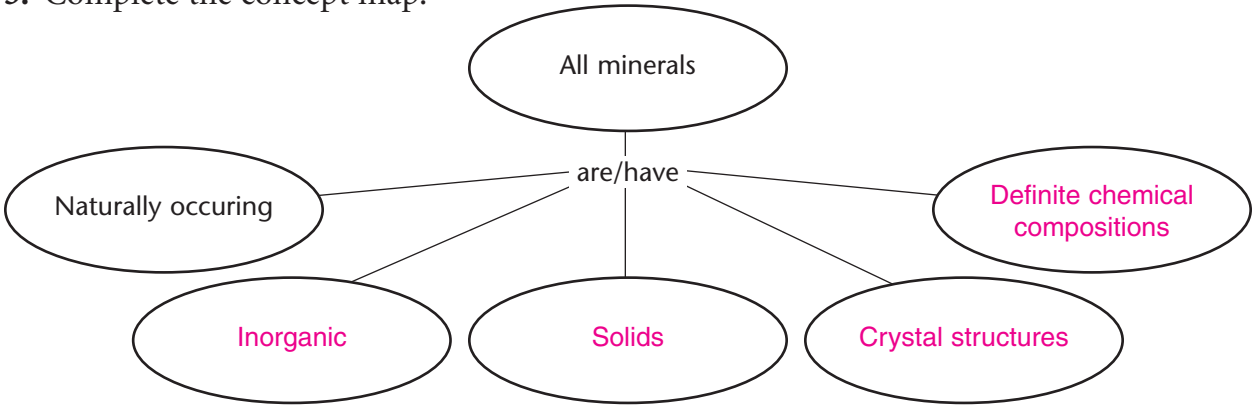
This section explains what minerals are and how they can be identified.

▶ What Is a Mineral? (pages 361–363)

1. Is the following sentence true or false? Geologists have identified about 300 minerals. false

2. Is the following sentence true or false? About 20 minerals make up most of the rocks of Earth's crust. true

3. Complete the concept map.



4. Because minerals do not come from living things, they are said to be inorganic.

5. A substance that keeps its shape because its particles can't flow freely is a(n) solid.

6. A solid with flat sides that meet at sharp edges and corners is called a(n) crystal.

7. Is the following sentence true or false? A mineral always contains certain elements in definite proportions. true

8. A substance composed of a single kind of atom is called a(n) element.

9. A substance formed when two or more elements combine and lose their distinct properties is a(n) compound.

10. Is the following sentence true or false? Very few minerals are compounds. false

11. What are some examples of minerals that occur as elements instead of compounds? Examples include copper, silver, and gold.

▶ Identifying Minerals (pages 363–368)

12. Is the following sentence true or false? Each mineral has its own specific properties. true

13. What is the Mohs hardness scale? It's a scale that ranks ten minerals from softest to hardest.

14. The softest known mineral is talc. The hardest known mineral is diamond.

15. Is the following sentence true or false? A mineral can scratch any mineral harder than itself. false

16. Why can't color alone be used to identify most minerals? Color alone can't be used because most minerals occur in a variety of colors.

17. The color of a mineral's powder is its streak.

Name _____ Date _____ Class _____

18. The term that describes how a mineral reflects light from its surface is _____luster_____.

19. Is the following sentence true or false? Minerals containing metals often have a shiny luster. _____true_____

20. Circle the letter of each sentence that is true about the density of a mineral.

a. A given mineral can have varying densities.

b. The larger the sample of a mineral, the greater its density.

(**c.**) Each mineral has a characteristic density.

(**d.**) The density of a mineral is its mass divided by its volume.

21. Is the following sentence true or false? Each piece of a mineral has the same crystal structure. _____true_____

22. How do geologists classify crystal structures? Geologists classify crystal structures into six groups based on the number and angle of the crystal faces.

Match the term with its definition.

	Term	Definition
a	**23.** cleavage	**a.** A mineral's ability to split easily along flat surfaces
c	**24.** fracture	**b.** A mineral's ability to glow under ultraviolet light
b	**25.** fluorescence	**c.** The way a mineral looks when it breaks

Reading Skill Practice

Studying a compare/contrast table can help you remember detailed information. Use the chart in Figure 8 of Section 10-1 to compare and contrast the properties of quartz and sulfur. Then write a summary of their similarities and differences. Do your work on a separate sheet of paper. For more information about compare/contrast tables, see page 686 in the Skills Handbook of your textbook.

Students should describe the similarities and differences between quartz and sulfur in terms of their hardness, color, streak, crystal shape, luster, special properties, and density, using the information in the chart in Figure 8 on page 366.

SECTION 10–2 How Minerals Form (pages 370–374)

This section describes how minerals form and where minerals are found.

▶ Processes That Form Minerals (page 371)

1. In what two ways do minerals form? Minerals form through crystallization of melted materials and through crystallization of materials dissolved in water.

2. The process by which atoms are arranged to form a material with a crystal structure is referred to as crystallization.

▶ Minerals From Magma (page 371)

3. Molten material from the mantle that hardens to form rock is magma.

4. What affects the size of crystals formed from magma? The size of crystals is affected by the rate at which the magma cools, the amount of gas the magma contains, and the chemical composition of the magma.

5. Magma that reaches the surface is called lava.

6. Why does magma that cools deep below the surface have large crystals? Magma that cools deep below the surface cools slowly, leading to the formation of large crystals.

▶ Minerals From Hot Water Solutions (pages 372–373)

7. A mixture in which one substance dissolves in another is called a(n) solution.

Name _____ Date _____ Class _____

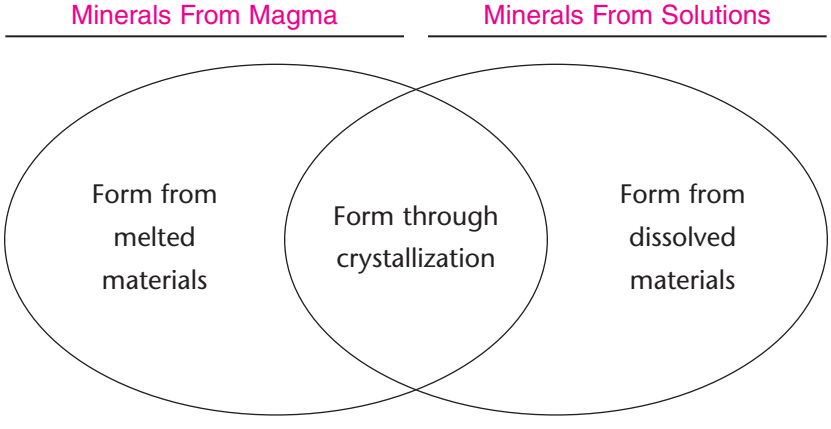
8. How do minerals form from a hot water solution? When a hot water solution begins to cool, the elements and compounds leave the solution and crystallize as minerals.

9. A narrow channel or slab of a mineral that is much different from the surrounding rock is called a(n) vein.

10. How do veins form? Deep underground, solutions of hot water and metals follow cracks within the rock. Then the metals crystallize into veins.

11. Explain how minerals form from solutions along the mid-ocean ridge. Ocean water seeps down through cracks in the crust, where it is heated by magma and dissolves minerals. Then the hot solution rushes upward, and the minerals crystallize when the hot solution hits the cold sea.

12. Complete the Venn diagram by labeling the circles with the type of minerals they represent.



▶ Minerals Formed by Evaporation (page 373)

13. Is the following sentence true or false? Minerals can form when solutions evaporate. true

14. Circle the letter of each sentence that is true about halite deposits in the United States.

a. Deposits are found in the Midwest and Southwest.

b. Deposits are found along the Gulf Coast.

c. Deposits formed only during the past thousand years.

d. Deposits formed when ancient seas evaporated.

▶ Where Minerals Are Found (page 374)

15. What is Earth's crust mostly made up of? Earth's crust is mostly made up of the common rock-forming minerals combined in various types of rock.

16. Is the following sentence true or false? Uncommon minerals are distributed evenly throughout Earth's crust. false

17. Is the following sentence true or false? Many valuable minerals are found in or near areas of volcanic activity and mountain building. true

SECTION 10–3 Mineral Resources (pages 376–381)

This section describes the uses of minerals and how minerals are obtained.

▶ The Uses of Minerals (pages 376–377)

1. Any hard, colorful mineral that has a brilliant or glassy luster is called a(n) gemstone.

2. A gemstone that has been cut and polished is called a(n) gem.

Name _____ Date _____ Class _____

3. Circle the letter of each choice that is a way gems are used.

a. jewelry **b.** fuel

c. mechanical parts **d.** grinding and polishing

4. List four examples of metals.

a. aluminum **b.** iron **c.** copper **d.** silver

5. Why are metals useful? Metals are useful because they can be stretched into wire, flattened into sheets, and hammered or molded without breaking.

6. What are some uses of metals? Uses of metals include metal tools and machinery, metal filaments in lightbulbs, and steel girders in buildings.

Match each mineral with the product in which it is found.

	Mineral	Product
d	7. talc	**a.** cement
e	8. kaolin	**b.** microscopes
b	9. calcite	**c.** watches
c	10. quartz	**d.** powder
a	11. gypsum	**e.** pottery

▶ Ores (page 377)

12. A rock that contains a metal or economically useful mineral is called a(n) ore.

13. Is the following sentence true or false? Most metals occur in a pure form. false

14. Much of the world's copper is contained in the mineral ore chalcopyrite.

▶ Prospecting (page 378)

15. Anyone who searches for an ore deposit is called a(n) prospector.

16. What features do geologists look for when they prospect for ores?

Geologists look for the kinds of rocks and the types of plants in an area.

They also look for the presence of certain chemicals in stream water.

▶ Mining (pages 378–379)

17. Is the following sentence true or false? The map of an ore deposit helps miners decide how to mine the ore. true

18. Complete the compare/contrast table.

How Ores Are Mined	
Kind of Ore Deposit	**Type of Mine Used**
Starts near the surface and extends deep underground	Open pit mine
Occurs in veins	Shaft mine
Is exposed on the surface	Strip mine

19. Describe strip mining. Miners use earthmoving equipment to scrape away soil and expose ore deposits.

20. Describe open pit mining. Miners use giant earthmoving equipment to dig a tremendous pit and remove ore deposits.

21. Describe a shaft mine. A shaft mine has a network of tunnels that extend deep into the ground, following the veins of ore.

Name _____ Date _____ Class _____

22. How can mining harm the environment? Strip mining and pit mining leave scars on the land. Waste materials from mining can pollute rivers and lakes.

23. What do mine operators do to restore land damaged by strip mining? Mine operators grade the surface and replace the soil.

▶ Smelting (pages 380–381)

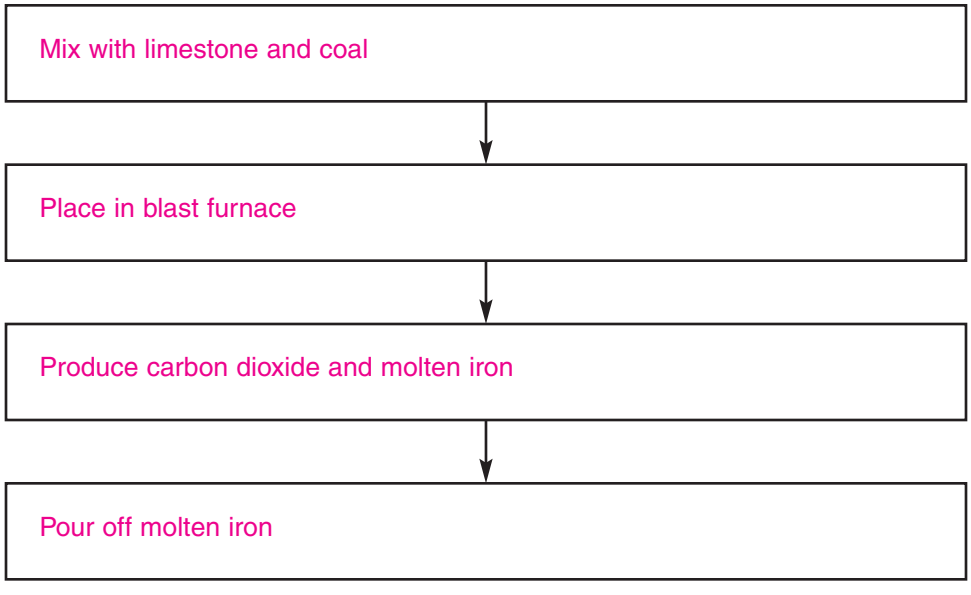
24. The process in which an ore is melted to separate the useful metal from other elements is smelting.

25. Is the following sentence true or false? People first developed smelting in the 1800s. false

26. A solid mixture of two or more metals is called a(n) alloy.

27. Fill in the flowchart with the following steps in the correct sequence: produce carbon dioxide and molten iron, pour off molten iron, mix with limestone and coal, place in blast furnace.

Smelting Iron Ore



Name _____ Date _____ Class _____

WordWise

Use the clues to help you unscramble the key terms from Chapter 10. Then put the numbered letters in order to find the answer to the riddle.

Clues	Key Terms	
It's how it looks when it breaks.	tarfceur	f r a c t u r e (1)
It contains two or more metals.	ylaol	a l l o y (2)
It could be shiny or pearly.	rutels	l u s t e r (3)
It was never alive.	rincanoig	i n o r g a n i c (4)
It's the color of the powder.	rsaekt	s t r e a k (5)
It includes melting.	temsilgn	s m e l t i n g (6)
It has a repeating pattern.	ratlycs	c r y s t a l (7)
It contains two or more elements.	pucnoodm	c o m p o u n d (8)
It's valued because it's beautiful and rare.	nsgoteem	g e m s t o n e (9)
It's a mixture.	situnloo	s o l u t i o n (10)
It's how it splits.	elagveac	c l e a v a g e (11)
It's composed of a single kind of atom.	teemlen	e l e m e n t (12)

Riddle: Why do some minerals glow?

Answer: f l u o r e s c e n c e
(1 2 3 4 5 6 7 8 9 10 11 12)

Name _____ Date _____ Class _____

CHAPTER 11

Rocks

SECTION 11–1 Classifying Rocks (pages 388–391)

This section explains how geologists classify rocks.

▶ How Geologists Classify Rocks (pages 388–389)

1. Earth's crust is made of rock.

2. What are rocks made of? Rocks are made of mixtures of minerals and other materials.

3. Circle the letter of each mineral that is found in granite.

   (a) quartz (b) feldspar (c) mica (d) hornblende

4. Circle the letter of each characteristic that geologists use to classify rocks.

   (a) texture (b) mineral composition

   c. hardness (d) color

▶ Texture (pages 389–390)

5. Is the following sentence true or false? Most rocks can be identified by color alone. false

6. The look and feel of a rock's surface is its texture.

7. Particles of minerals and other rocks that make up a rock are called grains.

8. Is the following sentence true or false? A rock's grains give the rock its texture. true

9. Circle the letter of each sentence that is true about the grain size in rock.

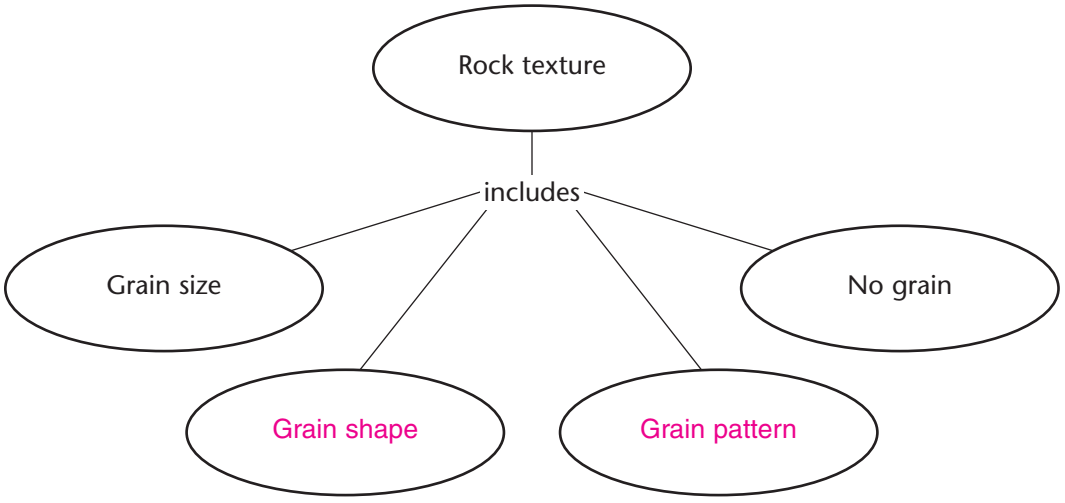
a. An example of a coarse-grained rock is diorite.

b. An example of a fine-grained rock is slate.

c. Grains in fine-grained rock are easy to see.

d. Grains in coarse-grained rock are microscopic.

10. Complete the concept map.



11. Circle the letter of the choice that determines the grain shape of a rock such as granite.

a. Shape of the rock's crystals

b. Size of the rock's crystals

c. Shape of fragments of other rock

d. Coarseness of the rock's grains

12. Circle the letter of the choice that determines the grain shape of a rock such as conglomerate.

a. Shape of fragments of other rock

b. Size of the rock's grains

c. Shape of the rock's crystals

d. Fineness of the rock's grains

13. Circle the letter of the description of the grain pattern of gneiss.

a. It looks like rows of beads.

b. It looks like a stack of pancakes.

c. It looks like waves.

d. It looks like rows of squares and rectangles.

Name _____ Date _____ Class _____

14. Circle the letter of each sentence that is true about rocks with no visible grain.

a. Some rocks have no visible grain even under a microscope.

b. Some rocks without crystal grains cooled very quickly.

c. Rocks without crystal grains look rough and coarse.

d. An example of a rock with a glassy texture is slate.

▶ Mineral Composition (page 391)

15. How do geologists identify the minerals in a rock? To identify the minerals in a rock, geologists look at a small sliver of the rock under a microscope and observe the shape and size of the rock's crystals.

16. To prepare a rock for viewing under the microscope, why must geologists cut the rock very thin? The rock must be very thin so light can shine through its crystals.

17. Circle the letter of each element that could make a rock attract a magnet.

a. sulphur **b.** nitrogen **c.** iron **d.** nickel

▶ Origin (page 391)

18. List the three major groups of rock.

a. igneous **b.** sedimentary **c.** metamorphic

19. Complete the compare/contrast table.

How Rocks Form	
Type of Rock	**How It Forms**
Igneous	Molten rock cools.
Sedimentary	Particles are pressed and cemented.
Metamorphic	Existing rock is changed.

20. The type of rock that forms from magma or lava is igneous rock.

21. The type of rock that forms in layers is sedimentary rock.

22. Is the following sentence true or false? Most metamorphic rocks form close to the surface. false

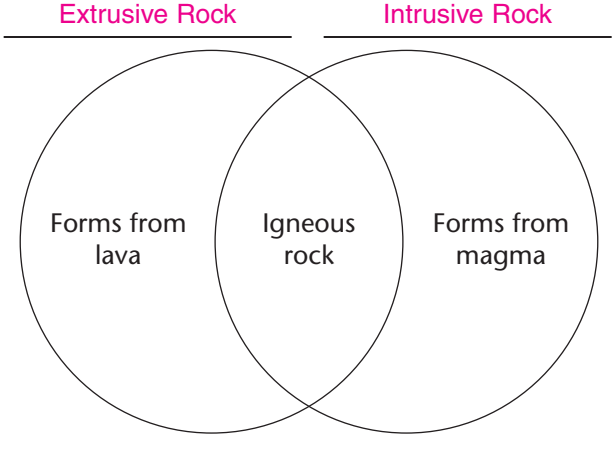
SECTION 11–2 Igneous Rocks (pages 392–395)

This section describes the characteristics and uses of igneous rocks.

▶ Characteristics of Igneous Rock (pages 393–394)

1. Circle the letter of the definition of igneous rock.
   - **a.** Rock that forms from minerals
   - **b.** Rock that contains iron
   - **c.** Rock that forms from magma or lava
   - **d.** Rock that contains crystals

2. Complete the Venn diagram by labeling each circle with the type of rock it represents.



3. Is the following sentence true or false? Extrusive rock forms beneath Earth's surface. false

4. Circle the letter of each sentence that is true about basalt.
   - **a.** It forms much of the crust.
   - **b.** It is the most common intrusive rock.
   - **c.** It forms from lava.
   - **d.** It forms beneath Earth's surface.

Name _____ Date _____ Class _____

5. Circle the letter of each sentence that is true about granite.

a. It is the most abundant intrusive rock in continental crust.

b. It forms the core of many mountain ranges.

c. It forms from magma.

d. It forms on top of the crust.

6. The texture of an igneous rock depends on the size and shape of its crystals.

7. Is the following sentence true or false? Igneous rocks with similar mineral compositions always have the same textures. false

Match the type of texture of igneous rocks with how rocks of that texture form.

Texture	How Rocks of That Texture Form
b **8.** fine-grained	**a.** Magma cools in two stages.
c **9.** coarse-grained	**b.** Lava cools rapidly.
a **10.** porphyritic	**c.** Magma cools slowly.

11. Is the following sentence true or false? Intrusive rocks have smaller crystals than extrusive rocks. false

12. A rock with large crystals scattered on a background of much smaller crystals has a(n) porphyritic texture.

13. What type of texture do extrusive rocks such as basalt have?

Extrusive rocks such as basalt have a fine-grained or glassy texture.

14. Circle the letter of each sentence that is true about the silica composition of igneous rocks.

a. Igneous rocks low in silica are usually dark colored.

b. An example of an igneous rock low in silica is granite.

c. Igneous rocks high in silica are usually light colored.

d. An example of an igneous rock high in silica is basalt.

▶ Uses of Igneous Rocks (page 395)

15. Why have people throughout history used igneous rocks for tools and building materials? People have used igneous rocks for these purposes because they are hard, dense, and durable.

16. Complete the table.

How Some Igneous Rocks Are Used	
Type of Igneous Rock	**Way It Is Used**
Basalt	Gravel for construction
Pumice	Cleaning and polishing
Perlite	Soil mixes

Reading Skill Practice

When you read about new or difficult concepts, making a concept map can help you better understand and remember the ideas. Make a concept map that shows how igneous rocks are classified, based on the material in Section 11-2. For more information on concept maps, see page 688 of the Skills Handbook in your text. Do your work on a separate sheet of paper.

Students' concept maps should show that igneous rocks are classified on the basis of their origin, texture, and mineral composition.

SECTION 11–3 Sedimentary Rocks (pages 396–401)

This section describes how sedimentary rocks form and how they are classified and used.

▶ From Sediment to Rock (pages 396–397)

1. Is the following sentence true or false? Sedimentary rocks form from particles deposited by water and wind. true

Name _____ Date _____ Class _____

2. Small, solid pieces of material that come from rocks or living things are called sediment.

3. List three forces that can carry sediment.

a. water **b.** wind **c.** ice

Match the process with its description.

	Process	Description
c	**4.** erosion	**a.** Dissolved minerals glue sediments together.
d	**5.** deposition	**b.** Sediments are pressed together in layers.
b	**6.** compaction	**c.** Water or wind loosen and carry away fragments of rock.
a	**7.** cementation	**d.** Sediments settle out of water or wind.

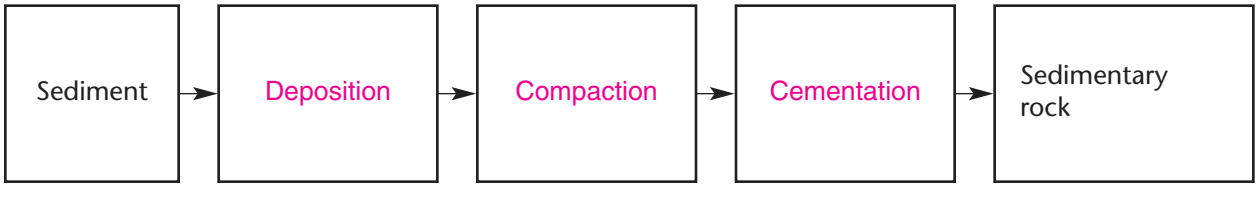
8. What remains of living things may sediment include? Sediment may include shells, bones, leaves, stems, and other remains of living things.

9. What happens to the remains of living things in sediment? The remains slowly harden and change into fossils trapped in rock.

10. The process in which thick layers of sediment press down on the layers beneath them is called compaction.

11. Complete the flowchart to show how sediment is turned into sedimentary rock.

Sedimentary Rock Formation



12. Is the following sentence true or false? It takes millions of years for sedimentary rock to form. true

▶ Types of Sedimentary Rock (page 398)

13. How do geologists classify sedimentary rock? Geologists classify sedimentary rock according to the type of sediments that make up the rock.

14. List the three major groups of sedimentary rock.

a. clastic **b.** organic **c.** chemical

15. Is the following sentence true or false? The same process forms all types of sedimentary rock. false

▶ Clastic Rocks (page 398)

16. Is the following sentence true or false? Clastic rocks form when rock fragments are squeezed together. true

17. How are clastic rocks classified? They are classified based on the size of the rock particles they contain.

18. Complete the table.

How Clastic Rock Forms	
Type of Clastic Rock	**Material From Which It Forms**
Shale	Tiny particles of clay
Sandstone	Small particles of sand
Conglomerate or breccia	Different-sized rock fragments

▶ Organic Rocks (page 399)

19. The type of rocks that form where the remains of plants and animals are deposited in thick layers is called organic rock.

Name _____ Date _____ Class _____

20. List two important organic rocks.

a. coal **b.** limestone

21. Organic rock that forms from the remains of swamp plants buried in water is coal.

22. How does organic limestone form? Shells pile up on the ocean floor where they are compacted by the pressure of overlying layers. Calcite from dissolved shells seeps into the spaces between the shell fragments and cements them together.

23. What sediments form chalk? Chalk forms from sediments containing skeletons of microscopic living things found in the oceans.

▶ Chemical Rocks (page 400)

24. List two ways that chemical rocks can form.

a. Minerals that are dissolved in a solution crystallize.

b. Mineral deposits form when seas or lakes evaporate.

25. Is the following sentence true or false? Some limestone is considered to be a chemical rock. true

26. Large deposits of rocks formed by evaporation form only in dry climates.

▶ Limestone Deposits From Coral Reefs (pages 400–401)

27. Skeletons of living coral grow together to form a structure called a(n) coral reef.

28. Coral animals absorb the element calcium from ocean water.

29. The protective outer shells of coral animals are formed from calcite.

30. Circle the letter of each sentence that is true about the growth of coral reefs.

a. Coral reefs may grow to be hundreds of kilometers long.

b. Coral reefs may grow to be hundreds of kilometers thick.

c. Coral reefs usually grow inward away from the open ocean.

d. Coral reefs may grow for thousands of years.

31. The barrier reef that lies along the coast of Australia is named the Great Barrier Reef.

32. A ring-shaped coral island is called a(n) atoll.

33. Where is limestone that began as coral found on continents?

It is found in places where uplift has raised ancient sea floors above sea level.

▶ Uses of Sedimentary Rocks (page 86)

34. Why have sandstone and limestone been used as building materials for thousands of years? These rocks have been used because they are soft enough to be easily cut into blocks or slabs.

35. What are some ways that builders today use sandstone and limestone?

Today they are used for decorating or for covering the outside walls of buildings.

36. Is the following sentence true or false? Limestone is used for smelting iron ore and making cement. true

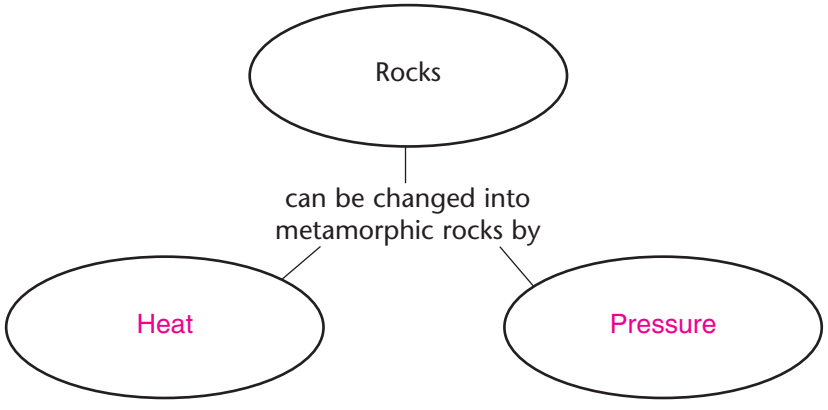
Name _____ Date _____ Class _____

SECTION 11–4 Metamorphic Rocks
(pages 402-404)

This section explains how metamorphic rocks form, how they are classified, and how they are used.

▶ How Metamorphic Rocks Form (page 402)

1. List the two forces that can change rock into metamorphic rocks



2. Is the following sentence true or false? Metamorphic rocks form deep beneath Earth's surface. true

3. How do rocks change when they become metamorphic rocks?

They change in appearance, texture, crystal structure, and mineral content.

4. What kinds of rocks can be changed into metamorphic rock?

Igneous, sedimentary, and other metamorphic rocks can be changed into metamorphic rock.

5. Is the following sentence true or false? The deeper a rock is buried in the crust, the less pressure there is on that rock. false

▶ Classifying Metamorphic Rocks (page 403)

6. Is the following sentence true or false? Geologists classify metamorphic rocks by the arrangement of grains making up the rocks.

true

7. Metamorphic rocks with grains arranged in parallel layers or bands are said to be foliated.

8. Circle the letter of each type of metamorphic rock that is foliated.

(a.) slate (b.) schist
(c.) gneiss d. marble

9. Metamorphic rocks with grains arranged randomly are said to be nonfoliated.

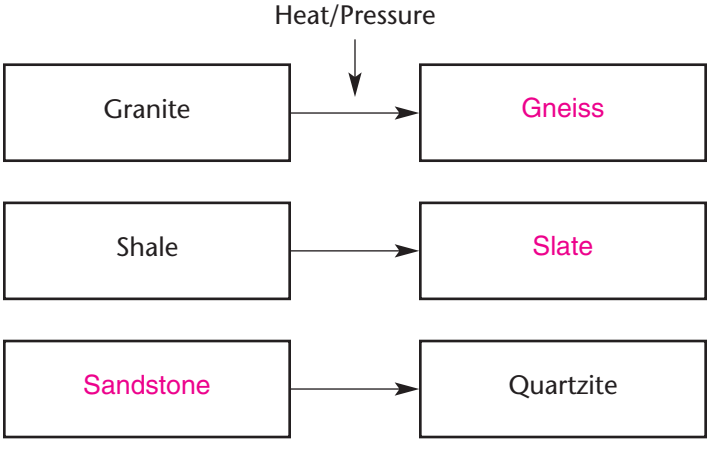
10. List two examples of nonfoliated metamorphic rocks.

a. marble

b. quartzite

11. Complete the flowchart.

How Some Metamorphic Rocks Form



Name _____ Date _____ Class _____

▶ Uses of Metamorphic Rock (page 404)

12. Why is marble useful for buildings and statues? Marble is useful because it can easily be cut into thin slabs and polished.

13. What are some of the ways that slate is used? Slate is used for flooring, roofing, outdoor walkways, chalkboards, and trim for stone buildings.

Reading Skill Practice

Taking notes while you read is a very helpful way to remember what you have read. To take notes, write down the headings in the section. Under each heading, write the main idea and important details that you read about. You should also include the key terms and their definitions in your notes. Reread Section 11-4. As you read, take notes about what you are reading. Do your work on a separate sheet of paper.

Notes should be organized under the headings in this section and include information from pages 402-404.

SECTION 11–5

The Rock Cycle

(pages 406-409)

This section describes the cycle that builds, destroys, and changes rocks in Earth's crust. The section also explains how this cycle is related to movements in Earth's crust.

▶ A Cycle of Many Pathways (pages 406)

1. The series of processes that slowly change rocks from one kind to another is referred to as the rock cycle.

2. Is the following sentence true or false? The rock cycle is produced by forces inside Earth and at the surface. true

3. What drives the rock cycle? Earth's constructive and destructive forces move rocks through the rock cycle.

4. Is the following sentence true or false? All rocks follow the same pathway through the rock cycle. false

▶ One Pathway Through the Rock Cycle (pages 407–408)

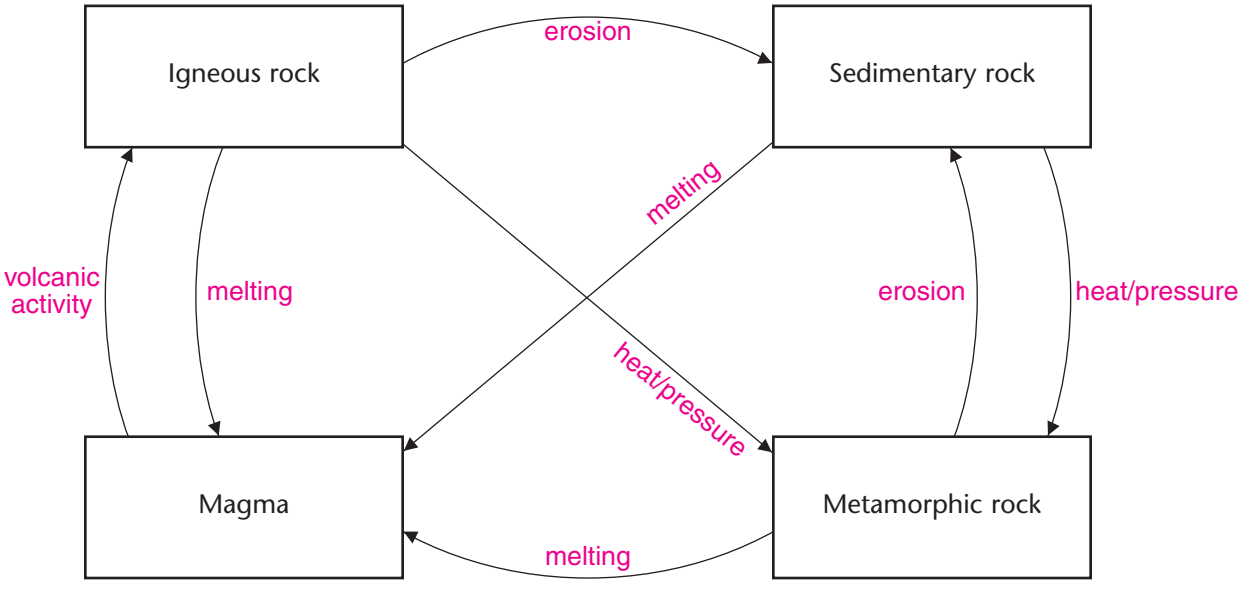
5. How does igneous rock such as a granite batholith formed beneath Earth's surface become exposed to weather? Forces of mountain building slowly push the granite upward.

6. How does granite change into sandstone? Granite weathers away to become sand, which is carried by streams to the ocean. Here it is deposited, compacted, and cemented into sandstone.

7. How does sandstone change into quartzite? As more sediment is piled up on the sandstone, the heat and pressure increase and change the rock's texture. After millions of years, the sandstone is changed into quartzite.

8. Label the arrows in the cycle diagram, using the following terms: erosion, melting, heat/pressure, volcanic activity. Some of the terms may be used more than once.

The Rock Cycle



Name _____ Date _____ Class _____

▶ The Rock Cycle and Plate Tectonics (page 409)

9. What are plates? Plates are sections of Earth's lithosphere.

10. How do plate movements drive the rock cycle? Plate movements push rocks back into the mantle, where they melt and become magma. Plate movements also cause folding, faulting, and uplift of the crust.

11. What are two types of plate movements that advance the rock cycle?

a. collision between subducting oceanic plates

b. collision between continental plates

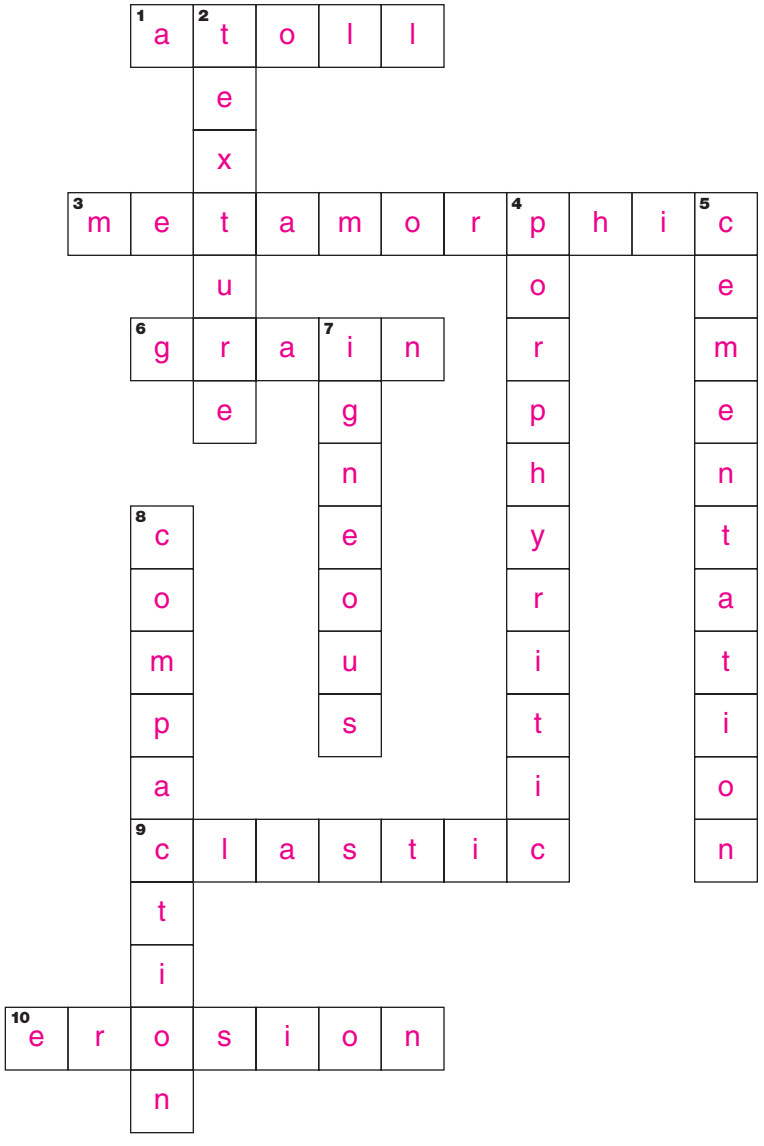
12. What could happen to sandstone that is part of oceanic crust? The oceanic crust carrying the sandstone drifts toward a deep-ocean trench. At the trench, subduction returns some of the sandstone to the mantle. There it melts and forms magma, which eventually becomes igneous rock.

13. What could happen to sandstone on continental plates that collide?

The collision could squeeze the sandstone, changing it to quartzite. The collision could form a mountain range or plateau containing the quartzite.

WordWise

Test your knowledge of rocks by using key terms from Chapter 11 to solve the crossword puzzle.



Clues across

1. Ring-shaped coral island
3. Rock formed by heat or pressure
6. Particle that gives rock texture
9. Sedimentary rock formed under pressure
10. Movement of fragments of rock

Clues down

2. Look and feel of a rock's surface
4. Igneous rock with big and small crystals
5. Process of gluing sediments
7. Rock formed from molten rock
8. Process of pressing sediments

Name _____ Date _____ Class _____

CHAPTER 12

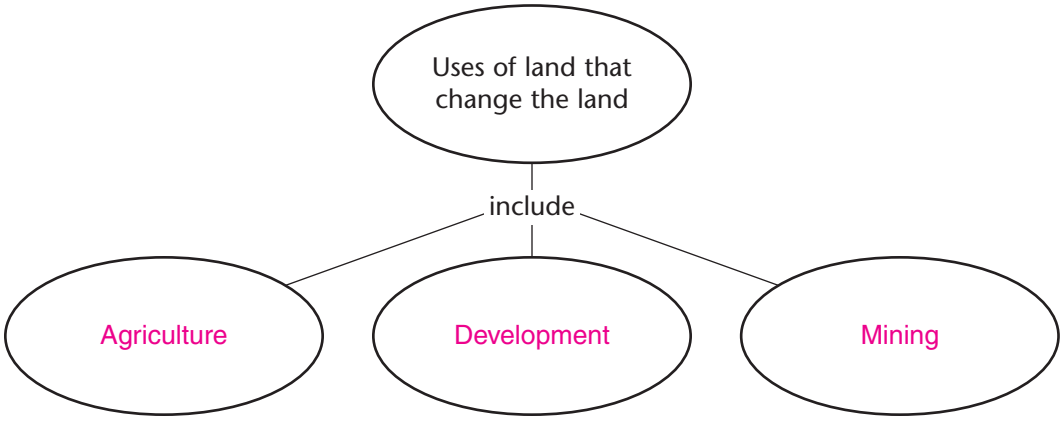
Land and Soil Resources

SECTION 12–1 Conserving Land and Soil (pages 420–427)

This section describes ways that land is used and how the land is changed when it is used in these ways. The section also explains how soil can be protected and how damaged land can be restored.

▶ Types of Land Use (pages 420–421)

1. Complete the concept map.



2. Why can less than a third of Earth's land be farmed? The rest is too dry, wet, salty, or mountainous.

3. List three ways that new farmland can be created.

a. clearing forests **b.** draining wetlands

c. irrigating deserts

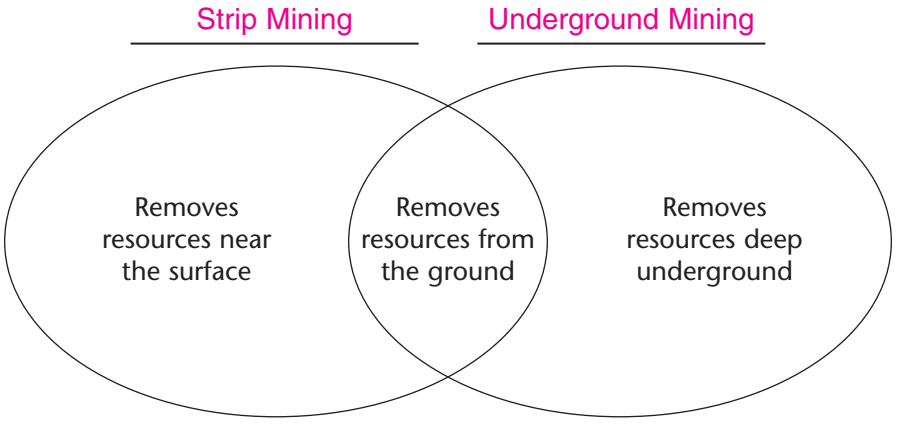
4. The construction of buildings, roads, bridges, dams, and other structures is called development.

5. Circle the letter of each choice that is a result of development.

(a.) Decrease in farmland
b. Increase in wilderness areas
(c.) Decrease in wildlife habitats
d. Increase in cropland

6. The removal of nonrenewable resources such as iron, copper, and coal from the land is called mining.

7. Complete the Venn diagram.



▶ Restoring the Land (page 422)

8. The process of restoring land to a more natural, productive state is called land reclamation.

9. Is the following sentence true or false? Land reclamation is currently underway all over the world. true

10. Is the following sentence true or false? It is easier to restore damaged land and soil than it is to protect them. false

11. How can an open mine be restored to agricultural land? The mining cuts are smoothed out, then the subsoil and topsoil that had been removed before mining is replaced. Finally, grass is planted.

Name _____ Date _____ Class _____

▶ Protecting the Soil (pages 422–426)

12. Circle the letter of each choice that is a way people depend on soil.

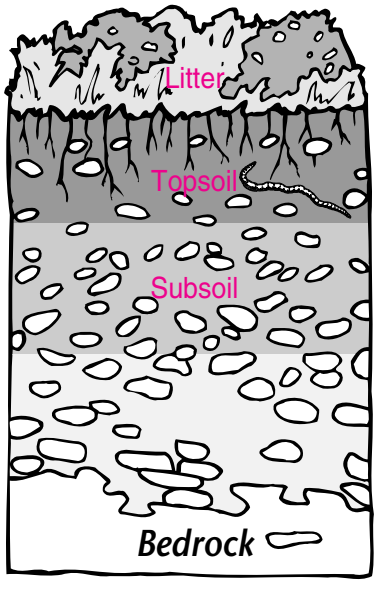
(a.) To provide plants with nutrients

(b.) To store and filter water

(c.) To break down wastes

(d.) To recycle chemical substances needed for life

13. Label each of the soil layers in the drawing.



Match the soil layer with what it contains.

Soil Layer	Contents
b **14.** litter	**a.** Rock fragments, water, and air
c **15.** topsoil	**b.** Dead leaves and grass
a **16.** subsoil	**c.** Rock fragments, nutrients, water, air, and decaying animal and plant matter

17. The rock that makes up Earth's crust is called bedrock.

18. How is bedrock broken down to form soil? Freezing and thawing break apart the bedrock. Both plant roots wedged between rocks and chemicals released by lichens break the rock into smaller pieces. Animals such as earthworms and moles help grind the rock into even smaller particles.

CHAPTER 12, Land and Soil Resources *(continued)*

19. List three problems that can result from poor soil management.

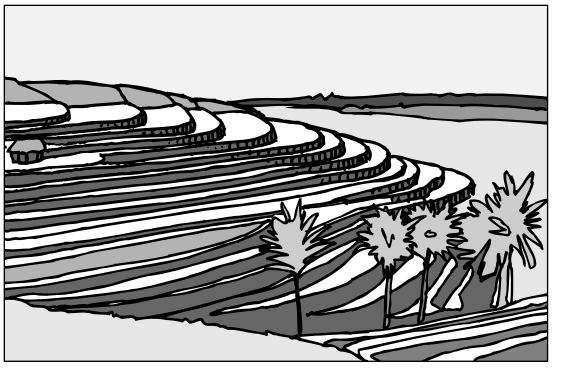
a. erosion **b.** nutrient depletion **c.** desertification

20. The process by which water, wind, or ice moves particles of rocks or soil is erosion.

21. What are some causes of erosion? Logging, mining, and farming are some causes of erosion.

22. List the three soil conservation practices that are shown in the drawings.

strip cropping



terracing

contour plowing

23. What is desertification? Desertification is the advance of desertlike conditions into areas that previously were fertile.

24. Is the following sentence true or false? In the past 50 years, a large amount of land has undergone desertification. true

Name _____ Date _____ Class _____

25. Complete the flowchart to show how climate can cause desertification.

Desertification

26. The process of soil becoming less fertile is called nutrient depletion.

Match each soil conservation practice with its description.

	Soil Conservation Practice	Description
c	**27.** leaving fields fallow	**a.** Using machines that break up only the subsoil
a	**28.** conservation plowing	**b.** Planting different crops in a field each year
b	**29.** crop rotation	**c.** Leaving fields unplanted

▶ The Nitrogen Cycle (pages 426–427)

30. Is the following sentence true of false? Most organisms can use the "free" nitrogen gas in the air. false

31. What is nitrogen fixation? The process of changing free nitrogen gas into a usable form

32. Most nitrogen fixation is performed by certain kinds of bacteria, which live in the roots of plants called legumes.

33. Once nitrogen has fixed into compounds, it can be used by organisms to make proteins and other complex compounds.

34. Decomposers are organisms that break down complex compounds and return simple nitrogen compounds to the soil.

SECTION 12–2 Solid Waste (pages 429–435)

This section explains what solid waste is and where it comes from. The section also describes how solid waste is managed and how individuals can help control solid waste.

▶ The Problem of Waste Disposal (pages 430–431)

1. What is municipal solid waste? Municipal solid waste is the waste produced in homes, businesses, schools, and other places in a community.

2. What are other sources of solid waste? Other sources include construction debris and certain agricultural and industrial wastes.

3. List three methods of handling solid waste.
   a. bury it b. burn it c. recycle it

4. A place where solid waste is buried is called a(n) landfill.

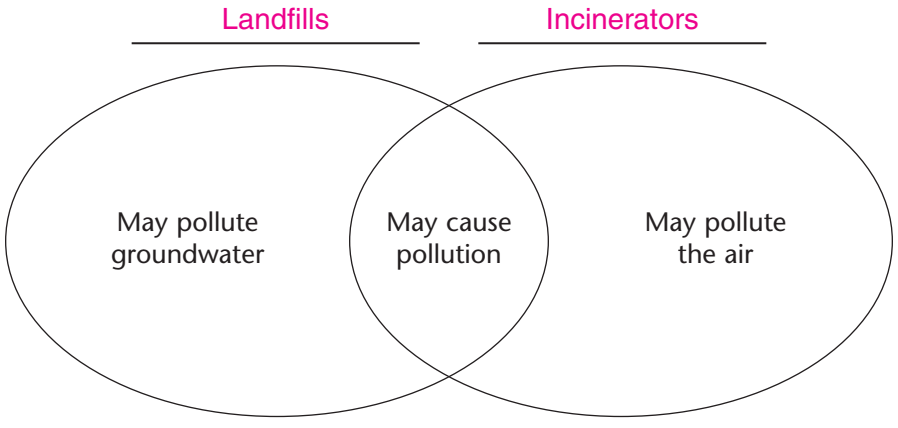
5. A polluted liquid that forms when rainwater dissolves chemicals in landfill waste is referred to as leachate.

6. How does a sanitary landfill differ from an open dump? Unlike an open dump, a sanitary landfill is constructed to safely hold solid wastes.

7. Circle the letter of each sentence that is true about incineration.
   a. It refers to the burning of solid waste.
   b. It can be used to generate electricity.
   c. It gets rid of solid waste completely.
   d. It is a cheap way to handle solid waste.

Name _____ Date _____ Class _____

8. Label each circle in the Venn diagram with the method of solid waste management it represents.



▶ Recycling (pages 432–434)

9. What is recycling? Recycling is the process of reclaiming raw materials and reusing them.

10. Is the following sentence true or false? Recycling reduces the volume of solid waste. true

11. A substance that can be broken down and recycled by bacteria and other decomposers is said to be biodegradable.

12. List the four major categories of products that are recycled.

a. metal **b.** glass

c. paper **d.** plastic

13. What are some common metal objects that can be recycled? Objects include metal desks, scissors, staples, paper clips, soda cans, house siding, and window screens.

14. Is the following sentence true or false? Glass is one of the most difficult products to recycle. false

15. Why can paper be recycled only a few times? Each time paper is recycled, the new paper is rougher, weaker, and darker.

16. What products can be made from recycled plastic milk jugs and soda bottles? Products include fiber filling for sleeping bags and jackets, carpeting, park benches, shower stalls, floor tiles, trash cans, and dock pilings.

17. Circle the letter of each sentence that is true about recycling.

(a.) It conserves resources. **b.** It creates no pollution.

(c.) It saves energy. **d.** It can be used for all types of solid waste.

▶ Solid Waste Management (pages 434–435)

18. Circle the letter of each sentence that is true about solid waste management in the United States.

(a.) People have become more aware of the solid waste problem.

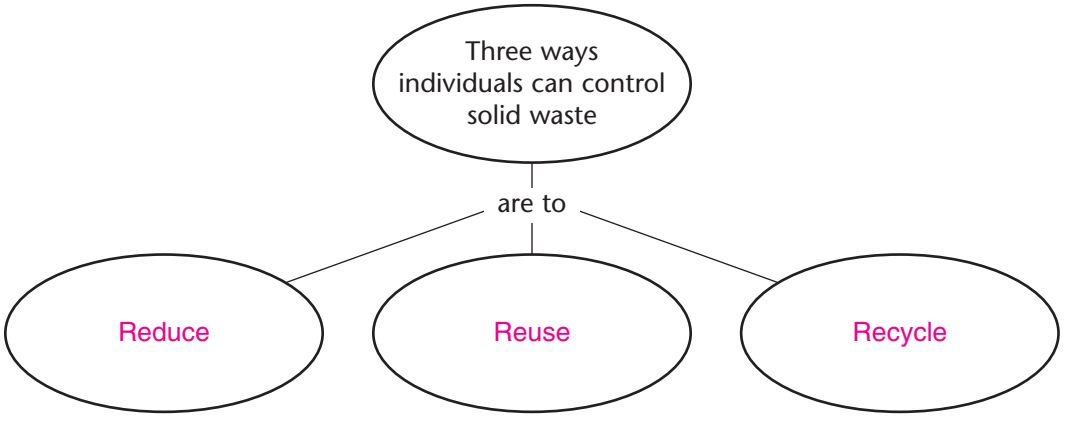
b. The amount of solid waste that is recycled has decreased.

c. Little solid waste goes to landfills.

d. Most solid waste is incinerated.

▶ What Can You Do? (page 435)

19. Complete the concept map.



Name _____ Date _____ Class _____

20. Helping natural decomposition processes break down waste is called composting.

21. How can compost be used? Compost can be used as a natural fertilizer for plants.

Reading Skill Practice

Taking notes as you read can help you remember the most important points. Take notes on Section 12–2 by writing each heading and then listing the main points under each heading. Do your work on a separate sheet of paper.

Students should make note of the main points about waste disposal, recycling, solid waste management, and ways individuals can help control solid waste. They should include enough details to make their notes clear and informative.

SECTION 12–3 Hazardous Wastes (pages 438–442)

This section describes types of hazardous wastes and their health effects. The section also explains how hazardous wastes are disposed of and how they can be reduced.

▶ Types of Hazardous Wastes (page 439)

1. Is the following sentence true or false? Hazardous waste is any material that can harm human health or the environment. true

Match the category of hazardous waste with its definition.

	Category of Hazardous Waste	Definition
c	**2.** toxic	**a.** Waste that reacts very quickly
a	**3.** explosive	**b.** Waste that dissolves many materials
d	**4.** flammable	**c.** Waste that is poisonous
b	**5.** corrosive	**d.** Waste that easily catches fire

6. Wastes that contain unstable atoms are called radioactive wastes.

7. How can radioactive wastes affect human health? They can give off radiation, which can cause cancer and other diseases.

8. What are some sources of radioactive wastes? Sources include the used fuel from nuclear reactors, the mining of radioactive minerals such as uranium, and some types of medical and scientific research.

9. Is the following sentence true or false? Radioactive waste can remain dangerous for thousands of years. true

▶ Health Effects of Hazardous Wastes (page 440)

10. Is the following sentence true or false? A person can be exposed to hazardous wastes only by eating or drinking them. false

11. Circle the letter of each factor that may determine the effects of a hazardous substance on a person.
   - (a.) How harmful the substance is
   - (b.) How much of the substance the person is exposed to
   - (c.) How long the exposure lasts
   - (d.) The person's age, weight, and health

12. Is the following sentence true or false? Long-term exposure to hazardous wastes can be life threatening. true

▶ Disposal of Hazardous Wastes (pages 440–441)

13. List the methods of hazardous waste disposal.

   a. burial in landfills
   b. incineration
   c. breakdown by living organisms
   d. storage in deep rock layers

Name _____ Date _____ Class _____

14. Circle the letter of each sentence that is true about hazardous waste disposal.

a. Hazardous wastes are most often disposed of in landfills.

b. Hazardous wastes can be incinerated at very low temperatures.

c. Some hazardous wastes can be broken down by bacteria.

d. Hazardous wastes cannot be recycled.

15. Is the following sentence true or false? Scientists have been able to develop completely safe methods for disposing of radioactive wastes.

false

16. How are high-level radioactive wastes currently stored? They are stored in vaults dug hundreds of meters underground or in concrete and steel containers above ground.

▶ Locating Disposal Sites (pages 441–442)

17. Complete the compare/contrast table.

Costs and Benefits of Hazardous Waste Disposal Sites		
Type of Disposal Sites	**Costs**	**Benefits**
A few large sites	Transport of wastes is more dangerous.	Sites are easier to monitor.
Many small sites	Sites are harder to monitor.	Transport of wastes is safer.

▶ Reducing Hazardous Waste (page 442)

18. Is the following sentence true or false? The best way to manage hazardous wastes is to produce less of them in the first place.

true

19. What can you do at home to reduce hazardous wastes? You can find substitutes for some hazardous household chemicals such as insect sprays, and you can use biodegradable forms of household cleaners.

Name _____ Date _____ Class _____

WordWise

Use the clues to help you unscramble key terms from Chapter 12. Then put the numbered letters in order to answer the riddle.

Clues	Key Terms	
Solid materials that are left over when oil is refined	enissr	r(1) e(2) s i n s
Construction of buildings, roads, and other structures	endlovepmet	d(3) e v e l o p m e n t
Layer of soil below topsoil	ouslibs	s u(4) b s o i l
Polluted liquid that forms when rainwater falls on solid waste	ehcatale	l e a c(5) h a t e(6)
Containing unstable atoms	daraoiitcev	r(7) a d i o a c t i v e(8)
Kind of depletion that occurs when soil becomes less fertile	teruntin	n u(9) t r i e n t
Able to dissolve or eat through many materials	vesiroorc	c o r r o s(10) i v e(11)
Process by which water, wind, or ice moves particles of rocks or soil	roonise	e r(12) o s i o n
Process of reclaiming and reusing raw materials	gleccyrni	r e(13) c(14) y(15) c l i n g
Rock that makes up Earth's crust	dkbrcoe	b e d r o c(16) k
Upper layer of soil that contains decaying animal and plant matter	poolsit	t o p s o i l(17)
The burning of solid waste	rationenniic	i n c i n e(18) r a t i o n

Riddle: What are the "three R's"?

Answer:

r(1) e(2) d u c e(6) , r(7) e u s e(11) , r(12) e(13) c(14) y(15) c(16) l(17) e(18)

Name _____ Date _____ Class _____

CHAPTER 13

Air and Water Resources

SECTION 13–1 Air Pollution (pages 448–453)

This section describes how air becomes polluted and explains how air pollution causes acid rain, destroys the ozone layer, and contributes to global warming.

▶ What's in the Air? (pages 448–449)

1. A change to the atmosphere that has harmful effects is called air pollution.

2. What are pollutants? Pollutants are substances that cause pollution.

3. Circle the letter of each sentence that is true about air pollution.
   (a.) It can be solid particles or gases. (b.) It can affect human health.
   (c.) It can impact the climate. d. It is caused only by human activities.

4. Solid particles and gases that are released into the air are called emissions.

5. What is the largest source of emissions that cause air pollution today?
   The largest source is motor vehicles.

6. Name one natural cause of air pollution. One natural cause is an erupting volcano.

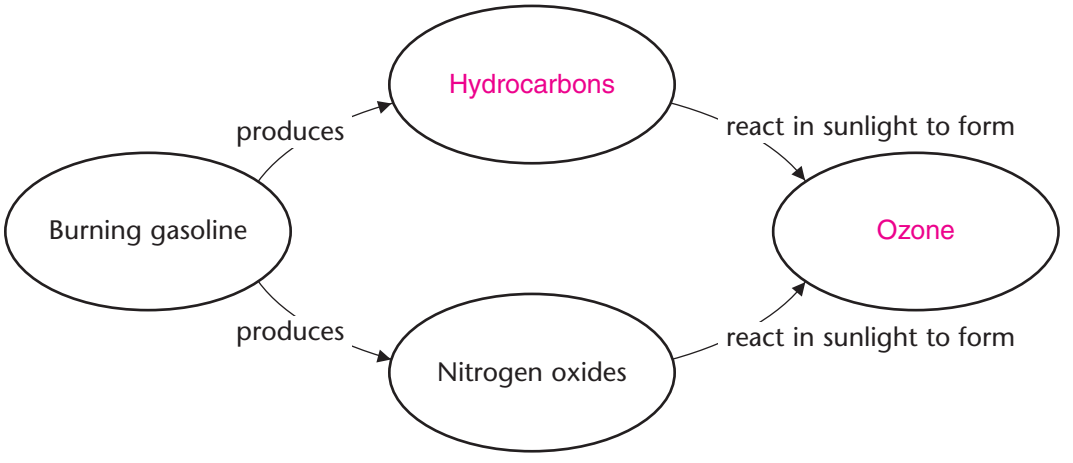
▶ Smog (pages 449–450)

7. A thick brownish haze formed when certain gases in the air react with sunlight is called photochemical smog.

8. Is the following sentence true or false? The major sources of photochemical smog are the gases emitted by factories. false

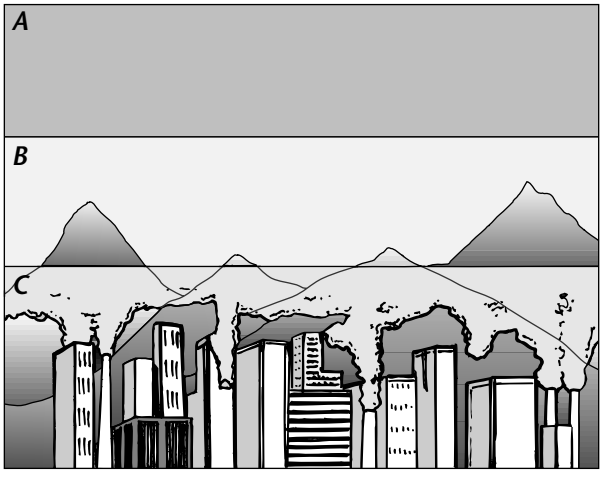
9. What is the major chemical found in smog? Ozone is the major chemical found in smog.

10. Complete the flowchart to show how smog forms.



11. What is a temperature inversion? It is a condition in which a layer of warm air prevents cooler rising air from escaping into higher parts of the atmosphere.

12. Which layer of air shown in the drawing below is the warmest during a temperature inversion? Layer B is the warmest.



Name _____ Date _____ Class _____

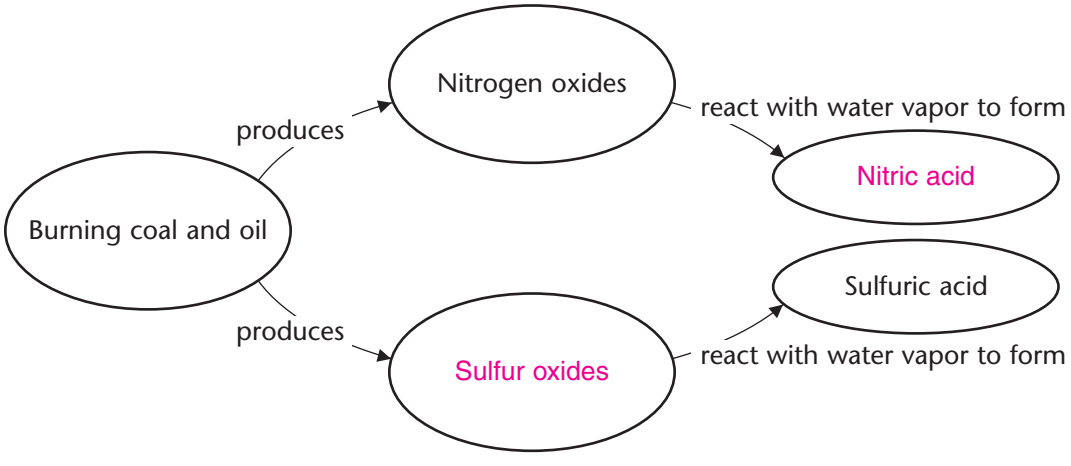
13. Why does a temperature inversion make smog more concentrated and dangerous? A temperature inversion traps polluted air and holds it close to Earth's surface.

14. What are the health effects of smog? Smog can irritate people's eyes and throats, cause lung problems, and harm the body's defenses against infection.

▶ Acid Rain (pages 450–451)

15. Precipitation that is more acidic than normal is called acid rain.

16. Complete the flowchart to show how acid rain forms.



17. What are the effects of acid rain? Acid rain kills many fish and their eggs, damages plants, and destroys forests.

▶ Indoor Air Pollution (pages 451–452)

18. What substances cause indoor air pollution? It is caused by dust, pet hair, air fresheners, asbestos, oil-based paints, glues, cleaning supplies, and cigarette smoke.

19. Circle the letter of each sentence that is true about radon.

(a.) It is colorless and odorless. **b.** It is caused by incomplete burning.

(c.) It may cause cancer. (d.) It is radioactive.

20. Circle the letter of each sentence that is true about carbon monoxide.

(a.) It is colorless and odorless. **b.** It forms in rocks underground.

c. It is harmless to people. **d.** It cannot be detected.

▶ The Ozone Layer (pages 452–453)

21. A layer of the upper atmosphere that protects people from the effects of too much ultraviolet radiation is the ozone layer.

22. What products contain chlorofluorocarbons? Products include refrigerators, air conditioners, and aerosol spray cans.

Reading Skill Practice

When you read statements that seem contradictory, such as ozone being both harmful and helpful, making a compare/contrast table can help you organize the information and avoid confusion. Make a table comparing and contrasting ozone in the upper atmosphere with ozone close to Earth's surface. Compare the two types of ozone in terms of their roles in the atmosphere and their effects on health. For more information about compare/contrast tables, see page 688 in the Skills Handbook of your textbook. Do your work on a separate sheet of paper.

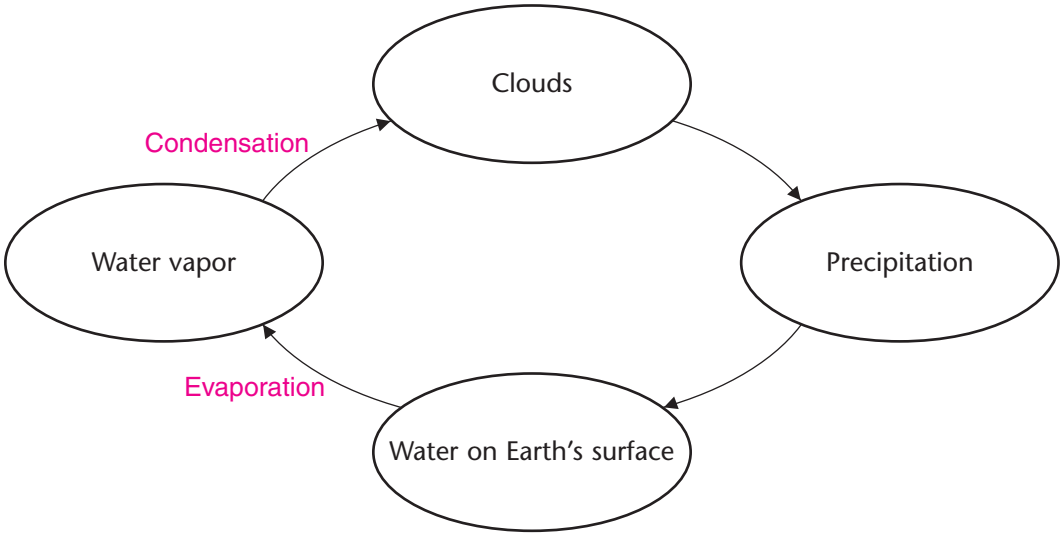
In their tables, students should compare and contrast ozone in the upper atmosphere with ozone close to Earth's surface to show that the former absorbs sunlight and protects health whereas the latter forms smog and harms health.

SECTION 13–2 The Water Supply (pages 445-461)

▶ The Water Cycle (pages 455–456)

1. The process of evaporation condensation, and precipitation make up the water cycle.

2. Label the cycle diagram to show the processes involved in the water cycle.



3. Rain, snow, sleet, and hail are forms of precipitation.

▶ The Water Cycle as a System (page 457)

4. Is the following sentence true or false? Presently, the water cycle is in balance worldwide true.

5. Cutting down a forest increases the flow of streams or rivers in the area.

6. Circle the letter of each sentence that is true about Earth's water supply.

a. Water is a scarce resource.

b. About half the water on Earth is in the form of fresh water.

c. Salt water cannot be used for drinking or watering crops.

d. About three quarters of Earth's fresh water is in the form of ice.

7. Water stored in layers of soil and rock beneath Earth's surface is called groundwater.

8. How does the water cycle purify water? During the water cycle, water evaporates from oceans, lakes, and rivers. As it evaporates, any dissolved substances are left behind. The pure water vapor condenses into droplets that fall as precipitation.

9. What is a drought? It is a period when less rain than normal falls in an area.

▶ Water Pollution (pages 458–461)

10. Any change to water that has a harmful effect on people or other living things is called water pollution.

11. Is the following sentence true or false? Most pollution is the result of human activities. true

12. List four human activities that produce wastes that can end up in water.
    a. agriculture
    b. industry
    c. construction
    d. mining

13. How can pollution affect water in areas far from its source? Pollutants dissolve and move throughout a body of water.

14. The water and human wastes that are washed down sinks, toilets, and showers are called sewage.

Name _____ Date _____ Class _____

15. Complete the compare/contrast table.

Farm Chemicals		
Types of Chemicals	**Their Role in Farming**	**How They Pollute**
Fertilizers	Provide nutrients to crops	Cause algae to grow in ponds
Pesticides	Kill crop-destroying organisms	Harm animals that feed in the fields

16. What are some sources of metal wastes that can pollute water?

Sources include chemical plants, paper and textile mills, factories, and mining sites.

17. Particles of rock, silt, and sand in water are called sediments.

18. How do sediments affect organisms in water? They cover up food sources, nesting sites, and eggs of organisms. They also block sunlight, which prevents algae and plants from growing.

▶ Land Subsidence and Groundwater Withdrawal (page 461)

19. How does removal of groundwater cause land subsidence?

As water is removed, particles of soil and rock settle closer together and occupy less space. This causes the land to sink.

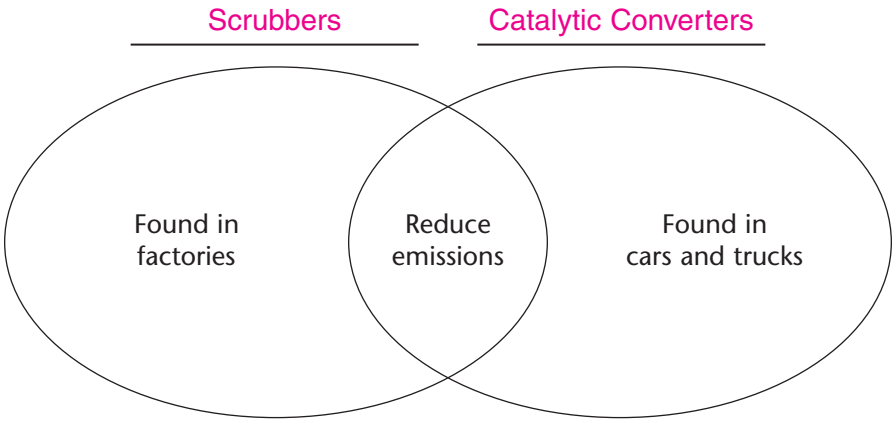
SECTION 13–3 Finding Pollution Solutions (pages 463-466)

This section describes ways that air and water pollution can be controlled.

▶ Reducing Air Pollution (page 464)

1. The major role of technology in controlling air pollution is to reduce emissions.

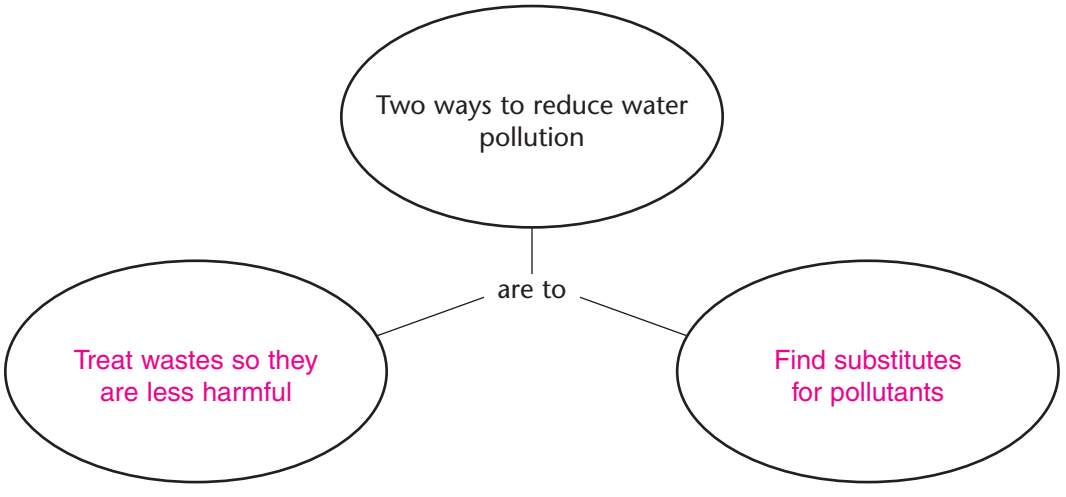
2. Complete the Venn diagram.



3. Why should fewer CFCs enter the atmosphere after the year 2000 than in the past? Many nations agreed to stop using most CFCs by the year 2000, and researchers developed CFC substitutes.

▶ Cleaning Up the Water (pages 465–466)

4. Complete the concept map.



5. Is the following sentence true or false? Few communities treat waste water before returning it to the environment. false

Name _____ Date _____ Class _____

Match each major step in sewage treatment with its description.

	Step	Description
b	**6.** primary treatment	**a.** Using bacteria to break down wastes
a	**7.** secondary treatment	**b.** Using filters to remove solid materials

8. Is the following sentence true or false? Oil is a pollutant that nature can handle in small amounts. true

9. How do bacteria break down oil in the ocean? When oil is present, the bacteria multiply quickly and feed on the oil.

10. Is the following sentence true or false? Gasoline or oil that leaks from an underground tank is easy to clean up. false

11. How can polluted groundwater be cleaned up? Groundwater can be pumped to the surface, treated, and then returned underground.

12. What are two ways industries can reduce pollution? They can recycle wastes to recover useful materials, and they can change their processes to produce less waste or less harmful waste.

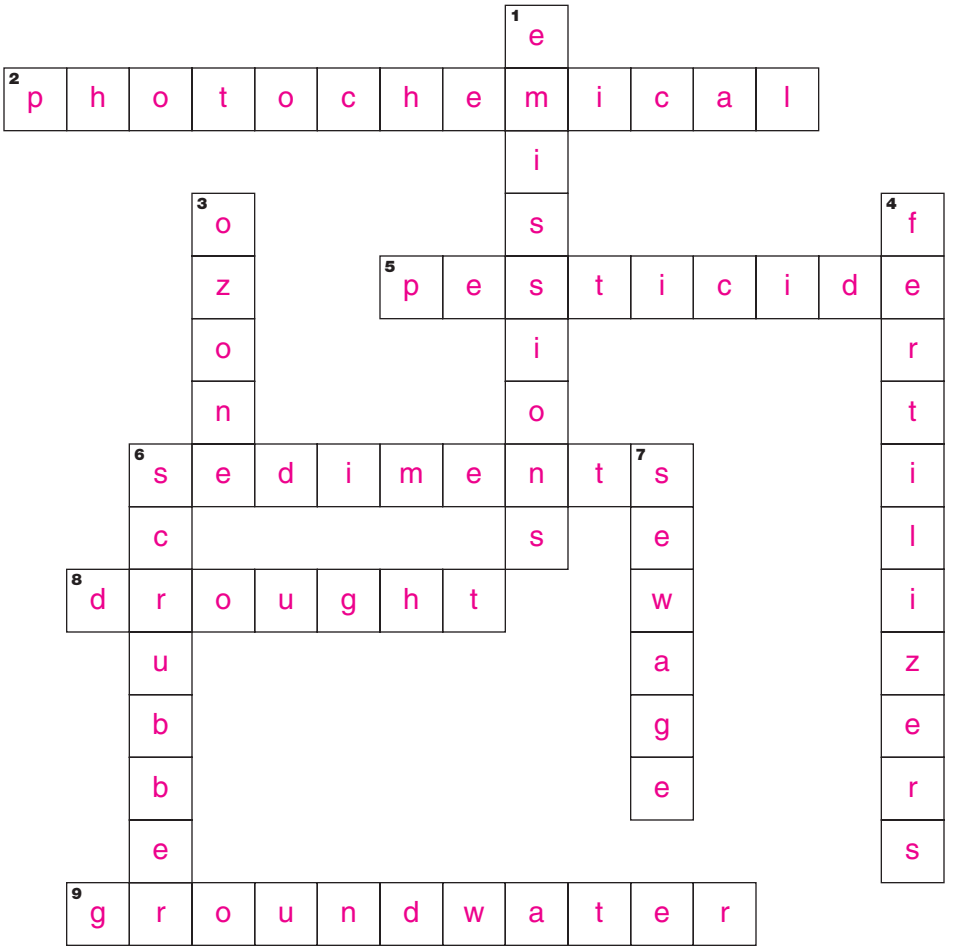
▶ What Can You Do? (page 466)

13. Why does using less energy reduce air pollution? Using less energy reduces the amount of fuels that are burned, and this reduces air pollution.

14. How can individuals prevent water pollution at home? They can prevent water pollution by not pouring household chemicals, such as paint thinners, motor oil, and garden chemicals down the drain.

WordWise

Review key terms from Chapter 13 by solving this crossword puzzle.



Clues across

2. Type of smog formed when certain gases react with sunlight

5. Chemical that kills crop-destroying organisms

6. Particles of rock, silt, and sand carried by water

8. Period when less rain than normal falls in an area

9. Water stored in layers of soil and rock beneath Earth's surface

Clues down

1. Solid particles and gases that are released into the air

3. Toxic form of oxygen that is found in smog

4. Chemicals that provide nutrients to help crops grow better

6. Device that removes pollutants from emissions in a smokestack

7. Water and human wastes from sinks, toilets, and showers

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CHAPTER 14

The Oceans

SECTION 14–1 Exploring the Ocean (pages 472–478)

This section describes how the ocean has been explored over the past several thousand years. The section also describes features of the ocean floor.

▶ Voyages of Discovery (page 473)

1. Circle the letter of the sentence that is true about the Phoenicians.
   - **a.** They were one of the earliest cultures to explore the oceans.
   - **b.** They sailed to Hawaii.
   - **c.** They established sea routes for trade by 2000 B.C.
   - **d.** They lived on islands in the Indian Ocean.

2. Circle the letter of the sentence that is true about the Polynesians.
   - **a.** They sailed the Atlantic Ocean around 1,200 B.C.
   - **b.** They had no way to make maps.
   - **c.** They settled on the islands of Hawaii and New Zealand.
   - **d.** They lived along the Mediterranean Sea.

3. Is the following sentence true or false? Captain Cook's voyages of exploration marked the beginning of the modern science of oceanography. false

▶ Exploring the Ocean Floor (pages 473–475)

4. Why has the deep ocean floor been explored only recently? It has been explored only recently because the lack of light, cold temperatures, and extreme pressure on the ocean floor required scientists to develop technology before they could study there.

5. Is the following sentence true or false? To study the deep ocean floor, scientists have had to rely on direct methods of gathering information.

false

6. How did the *Challenger's* crew measure the depth of the Atlantic Ocean?

The crew lowered a weight on a long line into the water until the weight touched the bottom. The length of line that got wet was approximately equal to the water's depth at that location.

7. Circle the letter of each sentence that is true about sonar.

a. It measures distance.

b. It uses sound waves.

c. It was invented during World War II.

d. It uses X rays.

▶ Features of the Ocean Floor (pages 476–478)

8. Circle the letter of each sentence that is true about the ocean floor.

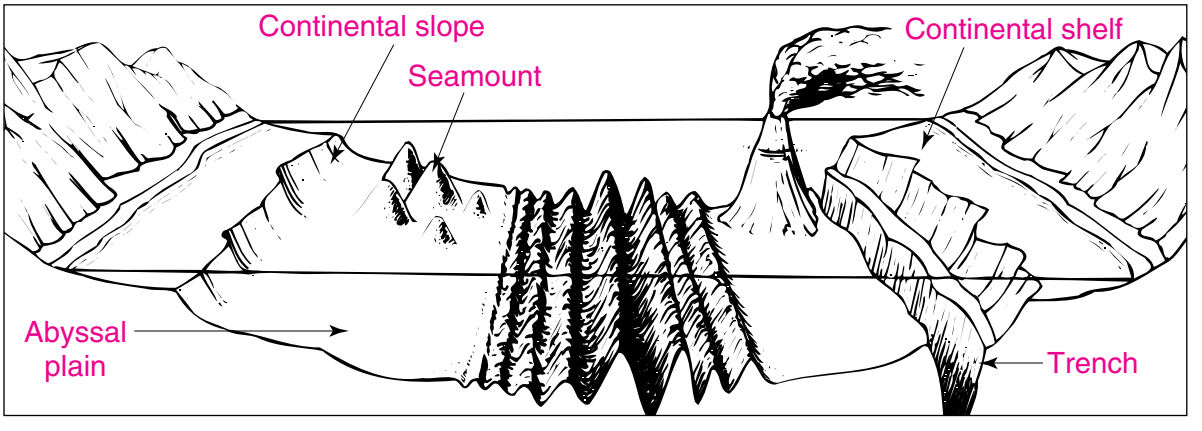
a. It is completely flat and sandy.

b. It is rocky and uneven.

c. It has the biggest mountains on Earth.

d. It has deep canyons.

9. Find and label each of the following ocean floor features in the drawing: continental shelf, continental slope, seamount, abyssal plain, and trench.



Name _____ Date _____ Class _____

10. Is the following sentence true or false? The average depth of the ocean is 11 kilometers. false

11. Is the following sentence true or false? The continental slope is where the rock that makes up the continent stops and the rock of the ocean floor begins. true

Match each feature of the ocean floor with its description.

	Feature	Description
f	**12.** continental shelf	**a.** Smooth and nearly flat region of the ocean floor
d	**13.** continental slope	**b.** Mountain on the ocean floor that is completely under water
b	**14.** seamount	**c.** Continuous range of mountains on the ocean floor
a	**15.** abyssal plain	**d.** Incline at the edge of the continental shelf
c	**16.** mid-ocean ridge	**e.** Steep-sided canyon in the ocean floor
e	**17.** trench	**f.** Shallow area of the ocean floor extending outward from land

18. Circle the letter of each sentence that is true about the mid-ocean ridge.

(**a.**) It passes through all of Earth's oceans.

b. It is about 800 kilometers long.

(**c.**) It is the longest mountain range on Earth.

(**d.**) It is divided by a central valley.

Reading Skill Practice

When you read a long section, writing a summary can help you identify and remember the main ideas. Write a concise paragraph summing up the main ideas under each heading in Section 14-1. Each paragraph should be shorter than the text under that heading in your book. Include each of the boldfaced terms in your summary. Do your work on a separate sheet of paper.

In their summaries, students should correctly use the boldfaced terms as they briefly describe exploration and features of the ocean floor.

SECTION 14–2 Tides and the Lunar Cycle
(pages 480–485)

This section explains what causes tides and describes the daily and monthly cycles of tides. The section also explains how energy in tides can be harnessed.

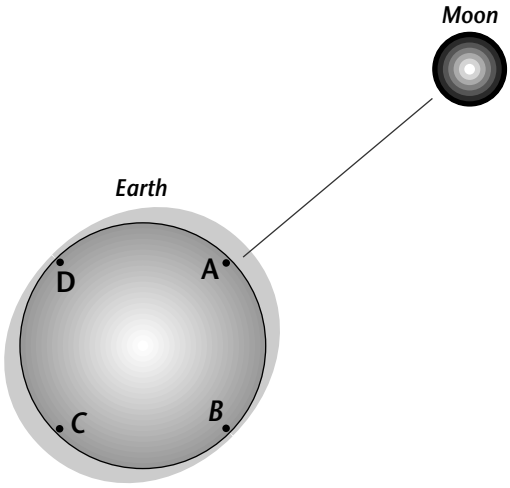
▶ Introduction (page 480)

1. The daily rise and fall of Earth's water on its coastlines are called tides.

2. What is the difference between high tide and low tide? High tide is when the water reaches its highest point; low tide is when the water reaches its lowest point.

▶ What Causes Tides? (page 481)

3. At which two points are tidal bulges occurring when Earth and the moon are in the positions shown in the drawing? Tidal bulges are occurring at points A and C.



4. At which two points are low tides occuring? Low tides are occurring at points B and D.

▶ The Lunar Cycle (page 481–483)

5. The lunar cycle produces the phases of the moon.

6. At new moon, the side of the moon facing Earth also faces directly away from the sun.

7. At the full moon phase, the moon's Earth-facing side is completely lit.

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8. List, in order, the three phases that follow the full moon.

   a. waning gibbous

   b. third quarter

   c. waning crescent

9. The time from one new moon to the next new moon is 29.5 days.

▶ The Daily Tide Cycle (page 483)

10. Circle the letter of each sentence that is true about high tides.

   a. They usually occur twice a day.

   b. They occur later in the west.

   c. They occur six hours apart.

   d. They occur more often than low tides.

11. Circle the letter of the sentence that is true about daily tides.

   a. Daily high and low tides are always easy to tell apart.

   b. Some places appear to have just one high and one low tide a day.

   c. There is a greater difference between high and low tides where the ocean floor slopes gradually.

   d. The coast of Texas has a dramatic range between high and low tides.

12. Is the following sentence true or false? Low tides occur about twelve and a half hours apart. true

13. What factors affect the height of the tide in any particular location?

Factors include landforms such as capes, peninsulas, and islands.

▶ The Monthly Tide Cycle (pages 483–484)

14. Is the following sentence true or false? The sun's gravity affects Earth's tides. true

15. Complete the compare/contrast table with the following terms: least, greatest, neap tide, spring tide.

Monthly Tide Cycle		
Type of Tide	**Position of Sun and Moon**	**Difference Between High and Low Tides**
Spring tide	Sun and moon in straight line	Greatest
Neap tide	Sun and moon at right angles	Least

16. Circle the letter of each sentence that is true about spring tides.

(a.) They occur twice a month.

b. They occur only in spring.

(c.) They occur during a new moon.

(d.) They occur during a full moon.

17. Who needs to know the times and heights of tides? Sailors, marine scientists, people who fish, and others who live along a coast need to know about tides.

▶ Energy From Tides (page 485)

18. Is the following sentence true or false? The energy stored in tides is potential energy. true

19. Describe how a tidal power plant captures tidal energy. The energy of tide water moving back to sea due to gravity powers generators that produce electricity.

20. Circle the letter of the sentence that is true about tidal energy.

(a.) It is clean.

b. It is nonrenewable.

c. It can be used on any coast.

d. It cannot be harnessed.

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SECTION 14–3 Life at the Ocean's Edge
(pages 486-493)

This section describes living conditions and types of organisms found in water at the ocean's edge, including along rocky shores and in inlets and bays. The section also describes beach erosion and what can be done to reduce it.

▶ Living Conditions (pages 486–488)

1. List physical factors that determine where marine organisms can live.

a. salinity **b.** water temperature **c.** light

d. dissolved gases **e.** nutrients **f.** wave action

2. Circle the letter of the sentence that is true about how conditions in ocean water vary.

a. Salinity is higher where rivers flow into the ocean.

b. Salinity is lower in warm, shallow water.

c. The level of dissolved gases is higher in cold water.

d. The level of oxygen in the water does not vary.

3. How do scientists classify marine organisms? They classify them according to where they live and how they move.

4. Complete the compare/contrast table.

Types of Marine Organisms		
Type of Organism	**Where It Lives**	**How It Moves**
Plankton	Near the surface	Floats
Nekton	Throughout the water column	Swims freely
Benthos	On the ocean floor	Crawls or stays in place

5. Is the following sentence true or false? Many plankton and benthos are algae. true

6. Circle the letter of each sentence that is true about nekton.

(a.) They are animals. (b.) They include fish and whales.

(c.) They are consumers. **d.** They include algae.

7. Relationships among producers, consumers, and decomposers in a habitat make up a(n) food web.

▶ Rocky Shores (pages 488–489)

8. The zone between the highest high-tide line and lowest low-tide line is called the intertidal zone.

9. What special conditions must organisms tolerate in the rocky intertidal zone? They must tolerate the pounding of waves, changes in salinity and temperature, and being underwater as well as being exposed to air.

10. What adaptations do algae have for living in the intertidal zone?

Algae have rootlike structures that anchor them firmly to rock, and some are covered with slime that keeps them from drying out during low tide.

11. Depressions among the rocks that remain filled with water after the tide goes out are called tide pools.

12. Circle the letter of each type of organism you might see in a tide pool.

(a.) sea stars (b.) sea urchins (c.) sponges **d.** blackline algae

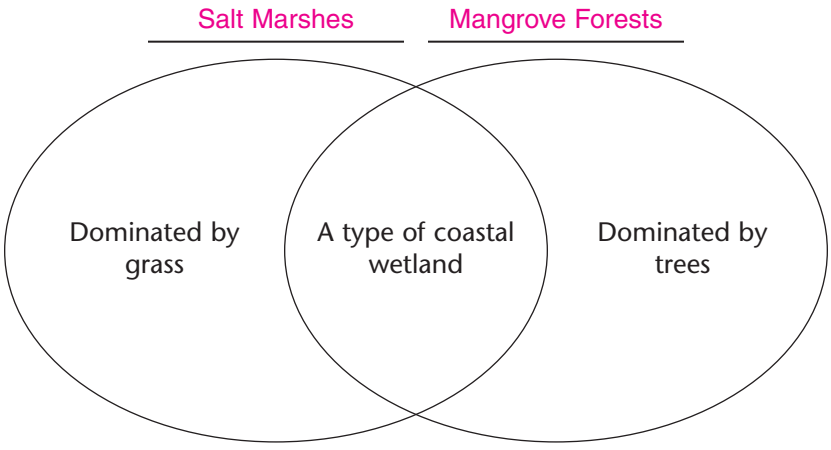
▶ Where River Meets Ocean (pages 490–491)

13. Coastal inlets or bays where fresh water from rivers mixes with the salty ocean water are called estuaries.

14. Water that is partly salty and partly fresh is referred to as brackish.

Name _____ Date _____ Class _____

15. Complete the Venn diagram.



16. How do pollutants enter estuaries, and how are they flushed out?

Pollutants enter estuaries in river water, and they are flushed out by ocean tides.

▶ Waves and Beach Erosion (pages 491–492)

17. The boundary beween land and ocean is always changing shape because of the energy in ocean waves.

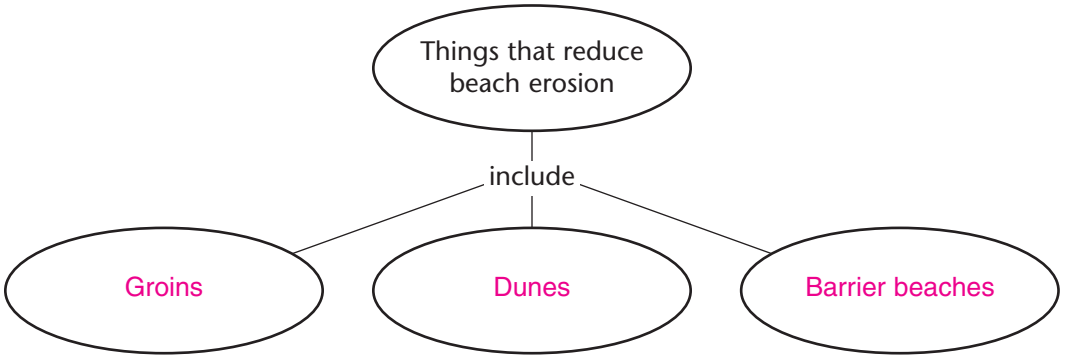
18. How do waves shape a beach? Waves shape a beach by eroding the shore in some places and building it up in others.

19. Waves pick up sand at one point, carry it back along the coast, and deposit the sand elsewhere in a process called longshore drift.

20. Waves deposit sand on the underwater slope and produce a long underwater ridge called a(n) sandbar.

▶ Reducing Erosion (pages 492–493)

21. Complete the concept map.



22. The erosion of dunes is increased when cars, bicycles, or people destroy the plants growing there.

SECTION 14–4 The Neritic Zone and Open Ocean (pages 494-500)

This section describes living conditions and types of organisms found in water over the continental shelf and in the open ocean.

▶ Introduction (pages 494–495)

1. The part of the ocean that extends from the low-tide line out to the edge of the continental shelf is called the neritic zone. The part of the ocean that extends beyond the edge of the continental shelf is called the open-ocean zone.

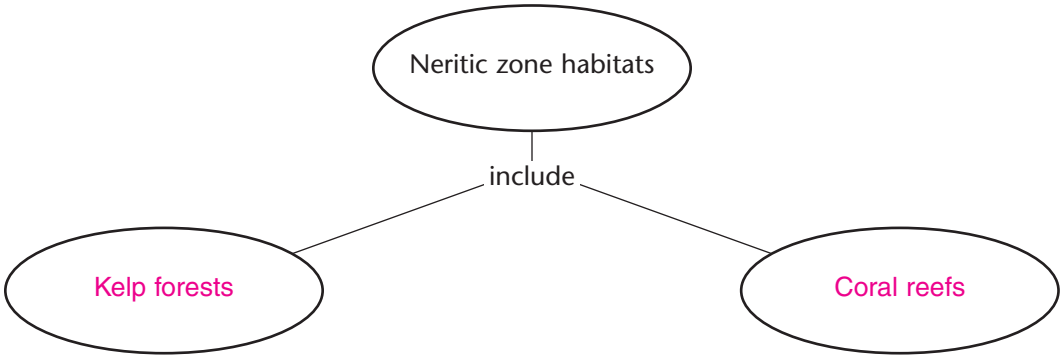
▶ Conditions in the Neritic Zone (page 495)

2. Circle the letter of each sentence that helps explain why there is so much life in the neritic zone.

(a.) The water is shallow.
(b.) The water is high in nutrients.
(c.) Large plantlike algae grow there.
d. Upwelling never occurs there.

Name _____ Date _____ Class _____

3. Complete the concept map.



▶ Life in a Kelp Forest (page 496)

4. Circle the letter of each sentence that is true about kelp.

a. They are algae.
b. They produce their own food.
c. They provide food for sea otters.
d. They provide a home for slugs.

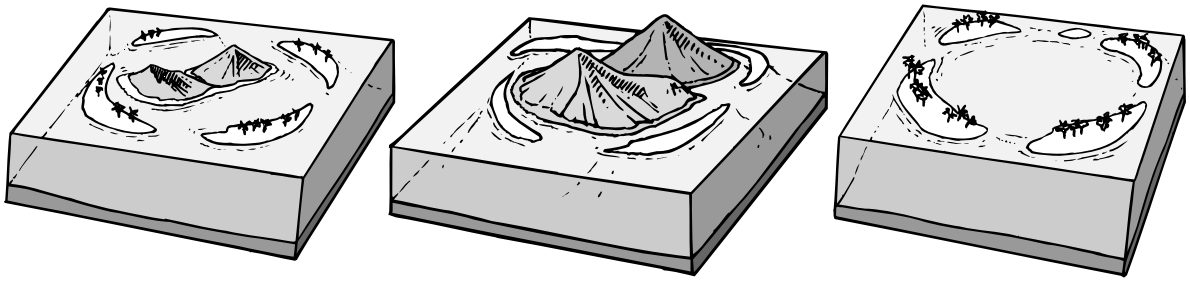
5. What important role do sea otters play in a kelp forest? They eat sea urchins, which eat the kelp.

▶ Coral Reefs (pages 496–497)

6. Is the following sentence true or false? A coral reef is made of living things.

true

7. Number the drawings to show the correct sequence of steps in the formation of an atoll.



2 1 3

Match the type of coral reef with its description.

	Type of Reef	Description
b	**8.** atoll	**a.** Reef that is separated from land by a lagoon
c	**9.** fringing reef	**b.** Ring-shaped reef that surrounds a shallow lagoon
a	**10.** barrier reef	**c.** Reef that closely surrounds the edges of an island

11. Is the following sentence true or false? Reefs protect coastlines during violent storms. true

▶ Conditions in the Open Ocean (pages 498–499)

12. Is the following sentence true or false? The open ocean supports fewer organisms than the neritic zone. true

13. Is the following sentence true or false? The surface zone is the only part of the open ocean that receives enough sunlight to support the growth of algae. true

14. How is the deep zone like a desert? Like a desert, the deep zone has harsh conditions and few organisms.

15. The production of light by living things is called bioluminescence.

▶ Hydrothermal Vents (pages 499–500)

16. An area where heated ocean water rises through cracks in the ocean floor is a(n) hydrothermal vent.

17. Circle the letter of each sentence that is true about organisms around hydrothermal vents.

(a.) Bacteria produce food from chemicals in the hot water.

(b.) Tube worms get their food from the bacteria inside them.

c. Algae form the base of the food web.

d. Giant clams feed on algae.

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SECTION 14–5 Resources From the Ocean
(pages 501-506)

This section describes living resources, such as fish, and nonliving resources, such as fuels, that are obtained from the ocean and the ocean floor. The section also explains how the ocean becomes polluted and why Earth's oceans should be protected.

▶ Living Resources (pages 501–503)

1. Is the following sentence true or false? Foods from the ocean make up about 10 percent of the world's total food supply. false

2. List the six species of fish that make up the majority of fishes harvested for eating.

   a. herring b. sardines c. anchovy

   d. cod e. pollock f. mackerel

3. Where are nearly all fishes caught? Nearly all fishes are caught in coastal water or areas of upwelling.

4. Is the following sentence true or false? If used wisely, fisheries naturally renew themselves. true.

5. The farming of saltwater and freshwater organisms is called aquaculture.

▶ Mineral Resources (pages 503–504)

6. How is magnesium obtained from seawater? Magnesium is obtained from seawater by removing the fresh water and leaving the salts behind.

7. What are some nonliving resources from the ocean floor? Nonliving resources include gravel, sand, gold, diamonds, and metals such as manganese.

8. When metals concentrate around pieces of shell on the ocean floor, they form black lumps called nodules.

9. Is the following sentence true or false? The technology to gather nodules was developed in the mid-1900s. false

10. Circle the letter of the sentence that is true about resources on the deep ocean floor.
    - **a.** All nations agree on who owns the rights to the resources.
    - **b.** Everyone agrees that whoever finds the resources should own them.
    - **c.** All nations have the technology to obtain a share of the resources.
    - **d.** Only some nations can afford the technology to obtain the resources.

▶ Fuels From the Ocean Floor (page 504)

11. Is the following sentence true or false? Fuels on the ocean floor come from the remains of dead marine organisms. true

12. Two fuels that are found on the ocean floor are oil and natural gas.

13. Why are the richest deposits of oil and gas often located on the continental shelves? The richest deposits are located on the continental shelves because that is where many organisms in the ocean live, die, and become buried in sediment.

▶ Ocean Pollution and Water Quality (pages 504–506)

14. Circle the letter of each sentence that is true about ocean pollution.
    - **a.** The ocean is so vast that it cannot become polluted.
    - **b.** Most ocean pollution comes from the land.
    - **c.** The ocean is a self-cleaning system.
    - **d.** Most ocean pollution is due to natural causes.

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15. Is the following sentence true or false? Some ocean pollution is the result of weather. true

16. How can a sudden surge of fresh water from an estuary pollute the ocean?
The sudden change in salinity may kill ocean animals that are unable to adjust to it.

17. List three ocean pollutants related to human activities.
a. sewage **b.** chemicals **c.** trash

18. Circle the letter of the sentence that is true about oil from oil spills.
a. It is a minor threat to ocean life.
b. It is harmful to only a few organisms.
c. It can destroy an animal's natural insulation.
d. It is harmful only to animals that swallow it.

19. What is the natural cleaning process that slowly takes place after oil spills?
Certain bacteria that live in the ocean feed on the oil and multiply, eventually cleaning up the oil that was spilled.

▶ Protecting Earth's Oceans (page 506)

20. Why is it difficult to determine who, if anyone, should control portions of the ocean? It is difficult because the world ocean is a continuous body of water that has no boundaries.

21. Is the following sentence true or false? Approximately three quarters of the ocean's surface waters are owned by no nation. false

22. Is the following sentence true or false? Ownership of the ocean floor beneath the high seas is no longer under debate. false

WordWise

Use the clues to make a list of key terms from Chapter 14. Then find and circle each of the key terms in the hidden-word puzzle. The terms may be written across, down, or diagonally.

Clues	Key Terms
Bundle of rootlike strands that attaches algae to rocks	holdfast
Device that uses sound waves to measure distance	sonar
Deep canyon in the ocean floor	trench
Tiny algae and animals that float in water	plankton
Organisms that live on the bottom of the ocean	benthos
The daily rise and fall of Earth's waters on its coastlines	tides
The practice of raising fish and other water organisms for food	aquaculture
Ring-shaped coral island found far from land	atoll
Mountain on the ocean floor that is completely under water	seamount
A long underwater ridge of sand	sandbar
Free-swimming ocean animals	nekton

a c h o l d f a s t r
d e s o n a r e f a r
t r e n c h t n b h n
a m a i m a o d e o b
t w m e n t n c t m l
o a o p l a n k t o n
l l u v s l e n t v l
l z n b e n t h o s l
e s t i d e s h y d o
a q u a c u l t u r e

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CHAPTER 15

Climate and Climate Change

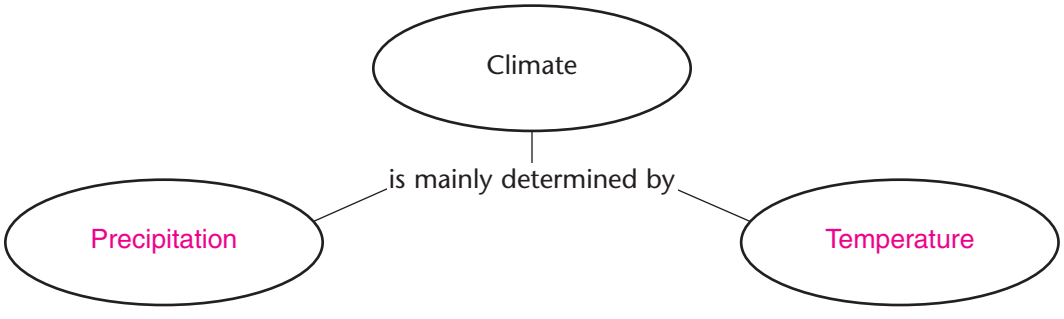
SECTION 15–1 What Causes Climate? (pages 514–521)

This section describes factors that determine climate, or the average weather conditions in an area. The section also explains what causes the seasons.

▶ Introduction (page 514)

1. The average, year-after-year conditions of temperature, precipitation, winds, and clouds in an area is the climate.

2. Complete the concept map.



▶ Factors Affecting Precipitation (pages 514–515)

3. List the main factors that affect precipitation.

   a. prevailing winds b. presence of mountains

4. Why does precipitation occur when warm air rises? Warm air cools as it rises. Because cool air cannot hold as much water vapor as warm air, water comes out of the air as precipitation.

5. Is the following sentence true or false? Winds blowing inland from oceans carry less water than winds blowing from land. false

6. Circle the letter of each sentence that is true about the effect of mountain ranges on precipitation.

   a. Precipitation falls on the leeward side of mountains.

   b. The windward side of mountains is in a rain shadow.

   c. Air that flows over the mountains absorbs a lot of water vapor as it rises.

   d. Precipitation falls on the side of the mountains that the oncoming wind hits.

▶ Factors Affecting Temperature (pages 516–518)

7. What are the main factors that influence temperature? The main factors are latitude, altitude, distance from large bodies of water, and ocean currents.

8. It is warmer near the equator because the sun's rays strike Earth's surface most directly there.

9. List the three temperature zones on Earth's surface that are based on latitude.

   a. tropical zone **b.** polar zone **c.** temperate zone

10. Is the following sentence true or false? Areas at high altitudes have cool climates no matter what their latitude. true

Match the type of climate with its description.

	Type of Climate	Description
a	11. marine climate	**a.** Relatively warm winters and cool summers
b	12. continental climate	**b.** Cold winters and warm or hot summers

▶ Oceans and Climate Changes (page 519)

13. The abnormal climate event that occurs every two to seven years in the Pacific Ocean is called El Niño.

Name _____ Date _____ Class _____

14. El Nino causes a vast sheet of water to move across the Pacific Ocean toward the coast of South America.

▶ Microclimates (page 519)

15. The climate characteristic of a small specific area is a(n) microclimate.

16. What are some natural features than can result in a microclimate?

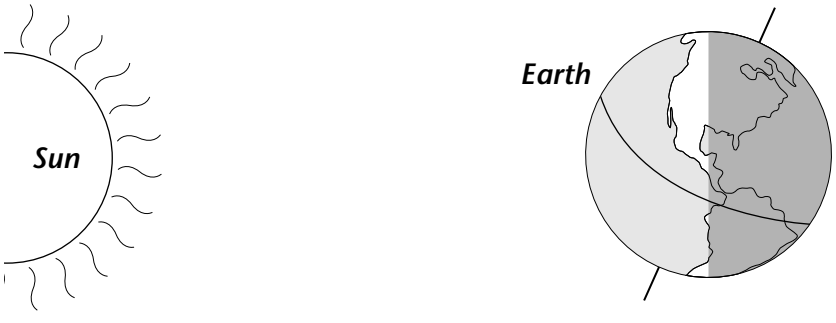
Inland mountains, lakes, forests, and other natural features can influence climate nearby and result in a microclimate.

▶ The Seasons (pages 520–521)

17. Is the following sentence true or false? It is colder in the winter in the Northern Hemisphere because Earth is farther from the sun then.

false

18. When Earth is in the position shown in the drawing, what season is it in the Northern Hemisphere? It is winter in the Northern Hemisphere.



19. Circle the letter of each sentence that is true about Earth's axis.

(a.) The axis always points in the same direction.

b. The north end of the axis is tilted away from the sun all year.

(c.) When it is summer in the Southern Hemisphere, the south end of the axis is tilted toward the sun.

d. In March and November, neither end of the axis is tilted toward the sun.

20. Why is Earth's surface warmer in the Northern Hemisphere when it is summer there? Earth's surface is warmer then because the Northern Hemisphere receives more direct rays from the sun and the days are longer than the nights.

Reading Skill Practice

When you read a section with difficult material, turning the headings into questions and then trying to find the answers can help you focus on the most important points. For each heading in Section 15-1, first turn the heading into a question, and then try to find the answer. Do your work on a separate sheet of paper.

A sample question for the heading *The Seasons* might be: "What causes the seasons?" The answer might be: "The seasons are caused by the tilt of Earth's axis as Earth travels around the sun."

SECTION 15–2

Climate Regions

(pages 524–533)

This section explains how scientists classify climates and describes five major climate regions.

▶ Classifying Climates (pages 524–525)

1. What are the two major factors that scientists use to classify climates?

The two major factors are temperature and precipitation.

2. List the five major climate regions.

a. tropical rainy **b.** dry **c.** temperate marine

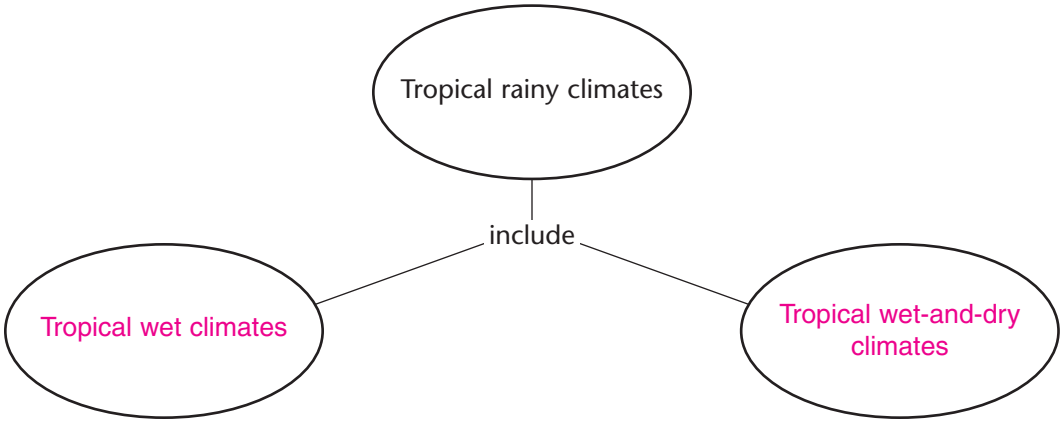
d. temperate continental **e.** polar

3. Is the following sentence true or false? A highland climate can occur within any of the other climate regions. true

Name _____ Date _____ Class _____

▶ Tropical Rainy Climates (pages 525–528)

4. Complete the concept map.



5. Circle the letter of each sentence that is true about a tropical wet climate.

a. It has heavy rainfall year-round.

b. It is hot year-round.

c. Rain forests grow in this type of climate.

d. Florida has this type of climate.

6. Circle the letter of each sentence that is true about a tropical wet-and-dry climate.

a. It has a wet season and a dry season.

b. It is hot year-round.

c. Tropical grasslands grow in this type of climate.

d. Hawaii has this type of climate.

▶ Dry Climates (pages 528–529)

7. Arid regions, which get less than 25 centimeters of rain every year, are also called deserts.

8. Where are there arid climates in the United States? There are arid climates in portions of California, the Great Basin, and the southwest.

9. An area that is dry but gets enough rainfall for short grasses and low bushes to grow is called a(n) steppe.

10. The steppe region of the United States is the Great Plains.

▶ Temperate Marine Climates (pages 529–530)

11. Complete the compare/contrast table.

Temperate Marine Climates		
Type of Climate	**Characteristics**	**Region Where It Is Found**
Marine west coast	Cool and wet	Pacific Northwest
Mediterranean	Warm and dry	Southern coast of California
Humid subtropical	Warm and wet	Southeastern United States

▶ Temperate Continental Climates (page 531)

12. Circle the letter of each sentence that is true about temperate continental climates.

a. They are found in both Northern and Southern hemispheres.

b. They are greatly influenced by oceans.

c. They have extremes of temperature.

d. They are found in the northeastern United States.

13. Is the following sentence true or false? Humid continental climates receive less precipitation in summer than in winter. false

14. What are summers and winters like in subarctic climates? Summers are short and cool, and winters are long and bitterly cold.

▶ Polar Climates (page 532)

15. Is the following sentence true or false? The polar climate is the coldest climate region. true

Name _____ Date _____ Class _____

16. Complete the compare/contrast table.

Polar Climates		
Type of Climate	**Warmest Temperature**	**Organisms Found There**
Ice cap	0° C (freezing)	Only lichens and a few low plants
Tundra	10° C	Many kinds of plants and animals

▶ Highlands (page 533)

17. How do highland climates differ from climates of the regions that surround them? Highland climates are colder than climates of the regions that surround them.

18. The climate above the tree line is like that of the tundra.

SECTION 15–3 Long-Term Changes in Climate (pages 536-540)

This section explains how scientists learn about past climates and describes a time in the past when ice covered large parts of Earth. The section also gives some possible reasons why climates have changed.

▶ Studying Climate Change (page 537)

1. Circle the letter of each choice that provides evidence of ancient climates.

(a.) fossils (b.) tree rings (c.) pollen records **d.** weather maps

2. Why do scientists think that Greenland's climate was warm and moist 80 million years ago? They have found fossils from this time period of trees related to magnolias and palms, which grow only in warm, moist climates.

3. Is the following sentence true or false? A thin tree ring indicates that the year was warm or wet. false

▶ Ice Ages (page 538)

4. Circle the letter of the sentence that is true about the ice ages.

a. When they occurred, glaciers covered all of Earth's surface.

b. There have been at least six major ice ages in the past two million years.

c. Each of the major ice ages lasted 100,000 years or longer.

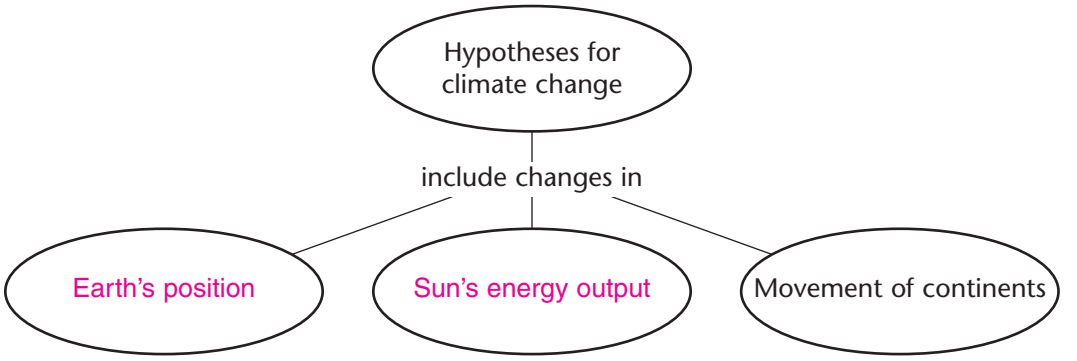
d. The most recent major ice age ended about 105,000 years ago.

5. Is the following sentence true or false? Some scientists think that we are now in a warm period between ice ages. true

6. Why was the sea level lower during the ice ages? The sea level was lower because so much water was frozen in the ice sheets.

▶ Causes of Climate Change (pages 539–540)

7. Complete the concept map.



8. What changes in Earth's position may have affected climates? The time of year when Earth is closest to the sun, the angle at which Earth's axis tilts, and the shape of Earth's orbit all change slightly over long periods of time and may have affected climates.

Name _____ Date _____ Class _____

9. Circle the letter of each sentence that is true about sunspots.

a. They are dark, cooler regions on the surface of the sun.

b. They increase and decrease in 100-year cycles.

c. They could be caused by changes in the sun's energy output.

d. They are known to be the chief cause of the ice ages.

10. Is the following sentence true or false? Satellite measurements have shown that the amount of energy the sun produces increases and decreases slightly from year to year. true

11. Circle the letter of each sentence that is true about the movement of Earth's continents.

a. Earth's continents have always been located where they are now.

b. Most of the land on Earth was once part of a single continent.

c. Continents now near the poles were once near the equator.

d. The movement of continents has had no effect on climates.

Reading Skill Practice

Outlining is a way to help yourself understand and remember what you have read. Write an outline of this section on long-term changes in climate. In an outline, copy the headings in the textbook. Under each heading, write the main idea of that part of the lesson. Then list the details that support that main idea.

Outlines should be organized under the headings *Studying Climate Change, Ice Ages,* and *Causes of Climate Change* and include information from pages 536–540.

SECTION 15–4

Global Changes in the Atmosphere (pages 541-546)

This section describes the carbon cycle and explains how human activities may be increasing Earth's temperature by changing the atmosphere.

▶ The Carbon Cycle (pages 541–543)

1. The carbon cycle is a(n) system that transfers matter from one part of the environment to another.

2. Where can nonliving matter be found in the carbon cycle?

The crust, oceans, and atmosphere

3. List four ways carbon dioxide is added to the atmosphere.

a. From volcanoes

b. From decaying organic material

c. From the burning of fossil fuels

d. From limestone exposed to weathering and erosion

4. How does photosynthesis change carbon in the carbon cycle?

Photosynthesis takes carbon from carbon dioxide and makes it part of the structure of plants and other living things.

5. Is the following sentence true or false? The trees that make up Earth's forests contain a small amount of carbon. false

6. Circle the letter of each sentence that is true about calcite.

a. Corals build skeletons made of calcite.

b. Calcite is a compound that is also called calcium oxide.

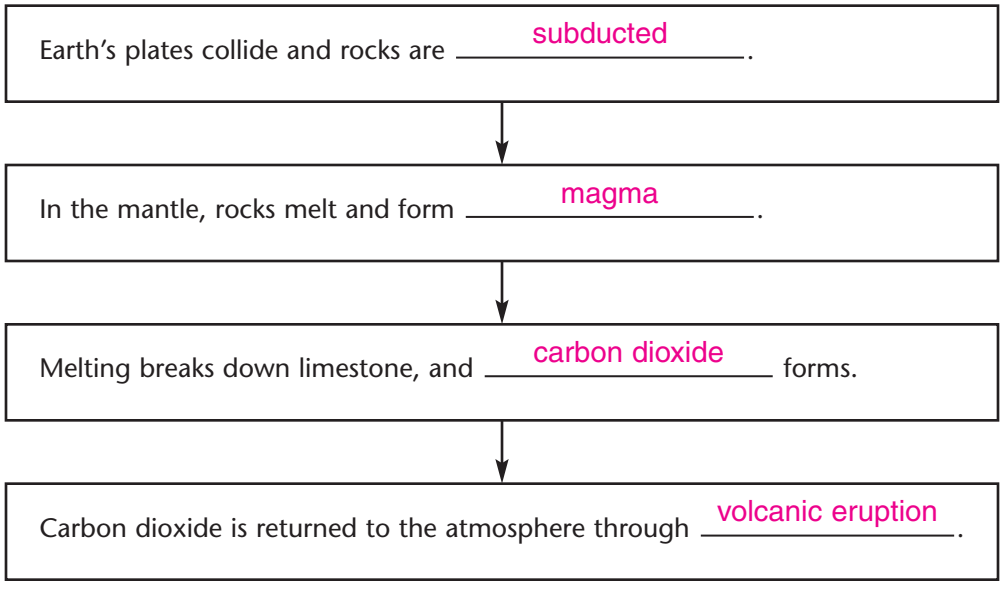
c. Calcite is the mineral that makes up the sedimentary rock limestone.

d. The weathering of calcite returns carbon to the atmosphere.

Name _____ Date _____ Class _____

7. Complete the flowchart.

Carbon in Limestone



8. Humans add carbon dioxide to the atmosphere by burning fossil fuels.

▶ Global Warming (pages 544–545)

1. Is the following sentence true or false? Over the last 120 years, the average temperature of the troposphere has risen by about 5 Celsius degrees false

Match the term with its definition.

	Term	Definition
a	2. greenhouse effect	**a.** Process by which Earth's atmosphere traps solar energy
b	3. global warming	**b.** Gradual increase in the temperature of Earth's atmosphere

4. Gases in the atmosphere that trap solar energy are called greenhouse gases.

CHAPTER 15, Climate and Climate Change *(continued)*

5. What are some greenhouse gases? Greenhouse gases include water vapor, carbon dioxide, and methane.

6. How may human activities be warming Earth's atmosphere? Human activities may be warming Earth's atmosphere by adding greenhouse gases to the atmosphere.

7. Circle the letter of the choice that is the outcome of burning wood, coal, oil, and natural gas.

   a. Carbon dioxide is added to the air.

   b. Global warming is prevented.

   c. Less heat is trapped by Earth's atmosphere.

   d. The amount of carbon dioxide in the air decreases.

8. Is the following sentence true or false? The amount of carbon dioxide in the air has been steadily increasing. true

9. Is the following sentence true or false? Everyone agrees about the causes of global warming. false

10. How might changes in solar energy affect Earth's climate? Changes in solar energy might cause periods of warmer and cooler climates.

11. Circle the letter of each choice that is a possible effect of global warming.

    a. Places too cold for farming today could become farmland.

    b. The ocean could become warmer.

    c. The number of hurricanes might decrease.

    d. Low-lying coastal areas might be flooded.

Name _____ Date _____ Class _____

▶ Ozone Depletion (pages 545–546)

12. How is ozone different from the usual form of oxygen? Ozone has three oxygen atoms in each molecule instead of the usual two.

13. Is the following sentence true or false? Ozone in the stratosphere filters out much of the harmful ultraviolet radiation from the sun.

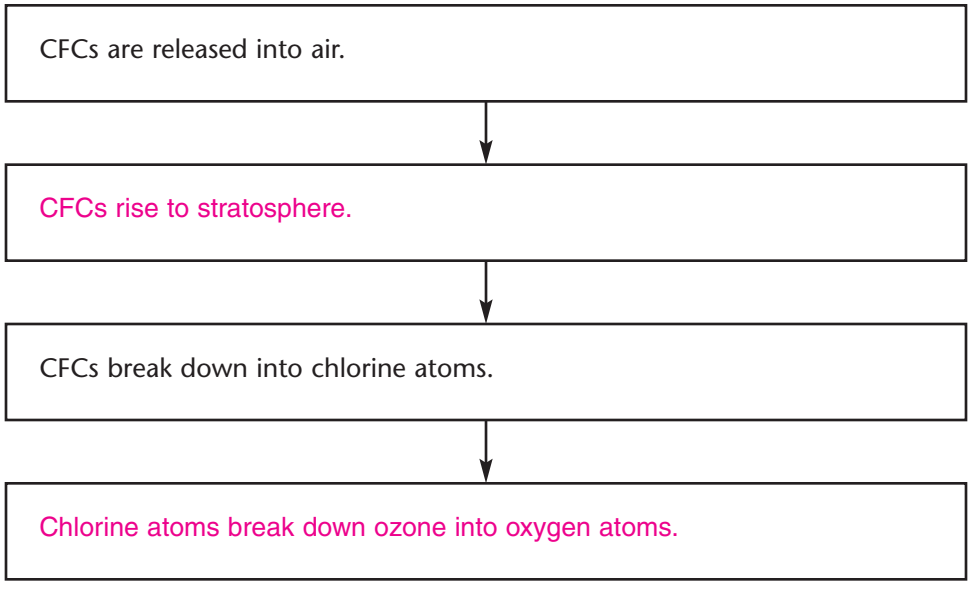
true

14. Is the following sentence true or false? The ozone layer over Antarctica is growing thinner. true

15. What are chlorofluorocarbons, or CFCs? CFCs are a group of chlorine compounds that were used in air conditioners, refrigerators, electronics cleaners, and spray cans.

16. Complete the flowchart.

CFCs and Ozone Depletion



17. With a decrease in ozone, the amount of ultraviolet radiation reaching Earth's surface would increase.

WordWise

Use the clues to help you unscramble the key terms from Chapter 15. Then put the numbered letters in order to find the answer to the riddle.

Clues	Key Terms
Climate characteristic of a small, specific area	m i c r(1) o c l i m a t e
Downwind side of mountains	l e(2) e w a r d
The process by which plants use the energy of sunlight to change carbon dioxide and water into food and oxygen	p h o t o s y n t h e s i(3) s
Permanently frozen soil found in the tundra climate region	p e r m(4) a f r o s t
Tropical grassland found in the tropical wet-and-dry climate	s a v a n n a(5)
Polar climate region with short, cool summers and bitterly cold winters	t(6) u n d r a
Region that receives less than 25 centimeters of rain a year	d e(7) s e r t

Riddle: What is determined by temperature and precipitation?

Answer: c(1) l(2) i(3) m(4) a(5) t(6) e(7)

Name _____ Date _____ Class _____

CHAPTER 16

GENETICS: THE SCIENCE OF HEREDITY

SECTION 16–1 Mendel's Work (pages 556-561)

This section describes how Gregor Mendel identified the method by which characteristics are passed from parents to their offspring.

▶ Introduction (page 556)

1. Gregor Mendel experimented with thousands of pea plants to understand the process of heredity.

Match the term with its definition.

	Term	Definition
c	**2.** heredity	**a.** The scientific study of heredity
a	**3.** genetics	**b.** Characteristics that parents pass to offspring
b	**4.** traits	**c.** The passing of traits from parents to offspring

▶ Mendel's Peas (pages 556–557)

5. Circle the letter of the characteristic in pea plants that make them good for studying the passing of traits from parent to offspring.

a. Peas produce small numbers of offspring.

b. Peas readily cross-pollinate in nature.

c. Peas have many traits that exist in only two forms.

d. Peas do not have stamens.

6. In a flower, the female sex cells, or eggs, are produced by the pistil. The male sex cells are produced by the stamens.

▶ Mendel's Experiments (pages 557–558)

7. Why did Mendel use purebred plants in his experiments? He knew that the offspring would always have the same form of the trait as the parents.

8. Complete the flowchart below, which summarizes Mendel's first experiment with pea plants.

Mendel's Experiment

Purebred tall plants are crossed with purebred **short** plants.

↓

F_1 offspring are all **tall**.

↓

F_1 offspring are allowed to self-pollinate.

↓

F_2 offspring are **tall** and **short**.

▶ Other Inherited Characteristics (page 558)

9. Circle the letter of other traits in garden peas that Mendel studied. Look at Figure 3 on page 559.

a. seed size, seed shape, seed color

b. seed color, pod color, flower color

c. flower size, pod shape, seed coat color

d. pod color, seed shape, flower position

Name _____ Date _____ Class _____

10. Two forms of the trait of seed shape in pea plants are round and wrinkled.

▶ Dominant and Recessive Alleles (page 559)

11. Circle the letter of each sentence that is true about alleles.

a. Genes are factors that control traits.

b. Alleles are different forms of a gene.

c. Dominant alleles always show up in the organism when the allele is present.

d. Recessive alleles mask dominant alleles.

12. Is the following sentence true or false? Only pea plants that have two recessive alleles for short stems will be short. true

▶ Understanding Mendel's Crosses (page 560)

Match the pea plant with its combination of alleles.

Pea Plant	Combination of Alleles
c **13.** purebred short	**a.** Two alleles for tall stems
a **14.** purebred tall	**b.** One allele for tall stems and one allele for short stems
b **15.** hybrid tall	**c.** Two alleles for short stems

▶ Using Symbols in Genetics (pages 560–561)

16. A dominant allele is represented by a(n) capital letter.

17. A recessive allele is represented by a(n) lowercase letter.

18. How would a geneticist write the alleles to show that a tall pea plant has one allele for tall stems and one allele for short stems? Tt

▶ Mendel's Contribution (page 561)

19. Is the following sentence true or false? Some scientists during Mendel's time thought Mendel should be called the Father of Genetics.

false

20. Is the following sentence true or false? The importance of Mendel's work was not recognized until 34 years after he presented his results to a scientific society. true

Reading Skill Practice

Concept maps can help you organize the terms and ideas in a chapter. Make a concept map to show the relationships among the key terms *genes, alleles, recessive alleles,* and *dominant alleles.* For more information about concept maps, see page 688 in the Skills Handbook of your textbook. Do your work on a separate sheet of paper.

Students should show that genes have different alleles and some of the alleles are recessive and some are dominant.

SECTION 16–2 Probability and Genetics (pages 564–569)

This section explains what probability is and how the laws of probability can be used in the study of genetics.

▶ Introduction (page 564)

1. The likelihood that a particular event will occur is called probability.

▶ Principles of Probability (page 565)

2. Circle the letter of each answer that equals the probability that a tossed coin will land heads up.

(a.) 1 in 2

(b.) $\frac{1}{2}$

(c.) 50 percent

d. 20 percent

Name _____ Date _____ Class _____

3. Is the following sentence true or false? When you toss a coin 20 times, you will always get 10 heads and 10 tails. false

4. If you toss a coin five times and it lands heads up each time, can you expect the coin to land heads up on the sixth toss? Explain.

No, the results of the first five tosses do not affect the results of the sixth toss.

▶ Mendel and Probability (page 566)

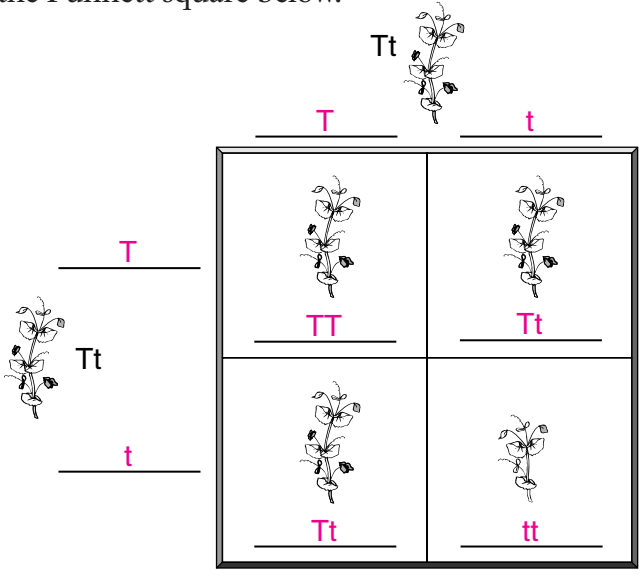
5. When Mendel crossed two hybrid plants for stem height (Tt), what results did he always get? He always found that three fourths of the plants had tall stems and one fourth of the plants had short stems.

6. Mendel realized that the principles of probability could be used to predict the results of genetic crosses.

▶ Predicting Genetice Outcomes (pages 566–567)

7. A chart that shows all the possible combinations of alleles that can result from a genetic cross is called a(n) Punnett square.

8. Write in the alleles of the parents and the possible allele combinations of the offspring in the Punnett square below.



9. Calculate the probability that an offspring in the Punnett square on page 209 will be *TT*. 1 in 4 or 25 percent

10. In the Punnett square on page 209, what possible allele combinations can a tall offspring have? *TT* and *Tt*

▶ Phenotypes and Genotypes (page 568)

Match the term with its definition.

	Term	Definition
b	**11.** phenotype	**a.** Describes an organism with two identical alleles for a trait
c	**12.** genotype	**b.** An organism's physical appearance, or observable traits
a	**13.** homozygous	**c.** An organism's genetic makeup, or allele combinations
d	**14.** heterozygous	**d.** Describes an organism that has two different alleles for a trait

15. Mendel used the term hybrid to describe heterozygous pea plants.

▶ Codominance (pages 568–569)

16. Is the following sentence true or false? In codominance, the alleles are neither dominant nor recessive. true

17. A black Erminette chicken is crossed with a white Erminette chicken. What color are the offspring? The offspring have both black and white feathers.

18. In cattle, red hair and white hair are codominant. Cattle with both white hair and red hair are heterozygous.

Name _____ Date _____ Class _____

SECTION 16–3 The Cell and Inheritance
(pages 572–576)

This section describes how one set of chromosomes from each parent is passed on to the offspring.

▶ Introduction (page 572)

1. The male sex cell is a(n) sperm. The female sex cell is a(n) egg.

▶ Chromosomes and Inherited Characteristics (page 573)

2. Circle the letter of each sentence that is true about what Sutton observed.

a. Grasshopper sex cells have half the number of chromosomes as body cells.

b. Grasshopper body cells have half the number of chromosomes as sex cells.

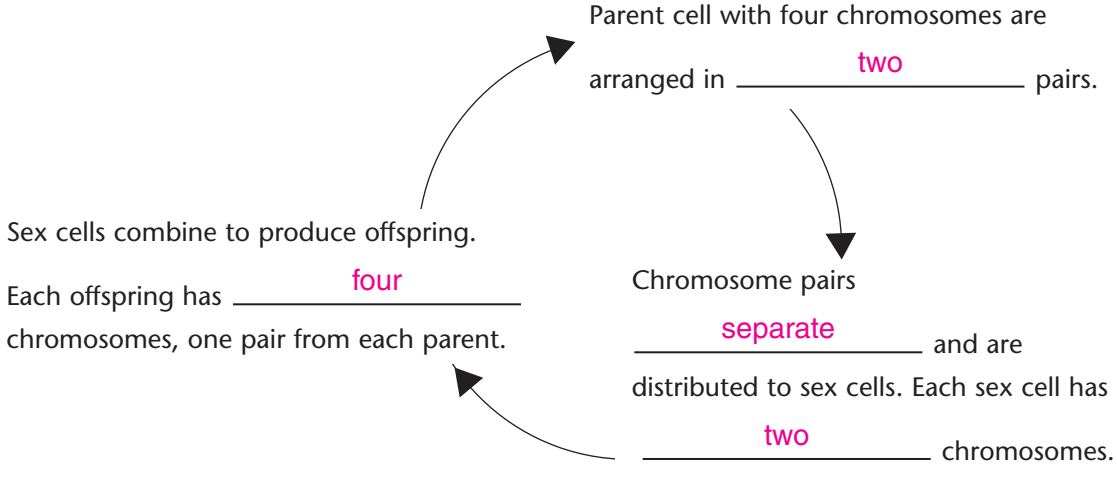
c. Grasshopper body cells and sex cells have the same number of chromosomes.

d. When grasshopper sex cells join, the fertilized egg has the same number of chromosomes as the body cells of the parents.

3. What is the chromosome theory of inheritance? Genes are carried from parents to their offspring on chromosomes.

▶ Meiosis (pages 574–575)

4. Complete the cycle diagram about meiosis.



5. What is meiosis? Meiosis is the process by which the number of chromosomes is reduced by half to form sex cells—sperm and eggs.

▶ Meiosis and Punnett Squares (page 574)

6. A Punnett square is a shorthand way to show the events that occur at meiosis.

7. Is the following sentence true or false? When chromosome pairs separate into different sex cells, the alleles of genes stay together. false

8. If the male parent cell is heterozygous for a trait, *Tt*, what alleles could the sperm cells possibly have? Half the sperm cells will have the *T* allele and the other half will have the t allele.

▶ Chromosomes (page 576)

9. Human body cells contain 23 pairs, or 46 chromosomes.

10. Is the following sentence true or false? Larger organisms always have more chromosomes in their body cells than smaller organisms. false

11. How are the genes lined up in a pair of chromosomes? Genes are lined up in the same order from one end of the chromosome to the other.

Reading Skill Practice

The photographs and illustrations in textbooks can help you better understand what you are reading. Look at Figure 14 on page 576. Describe the idea that this figure is showing. Do your work on a separate sheet of paper.

The figure shows that genes are lined up in order from one end to another on chromosome pairs. Each chromosome in the pair can have different alleles or the same alleles for a gene.

Name _____ Date _____ Class _____

SECTION 16–4 The DNA Connection (pages 577–582)

This section tells how the DNA molecule is related to genes, chromosomes, and the inheritance of traits.

▶ The Genetic Code (pages 577–578)

1. Circle the letter of each sentence that is true about genes, chromosomes, and proteins.

   a. Genes control the production of proteins in an organism's cells.

   b. Proteins help determine the size, shape, and other traits of an organism.

   c. Chromosomes are made up mostly of proteins.

   d. A single gene on a chromosome contains only one pair of nitrogen bases.

2. A DNA molecule is made up of these four nitrogen bases.

   a. adenine (A)

   b. thymine (T)

   c. guanine (G)

   d. cytosine (C)

3. What is the genetic code? The genetic code is the order of nitrogen bases along a gene that specifies what type of protein will be produced.

4. Protein molecules are made up of amino acids

5. One group of three nitrogen bases codes for one amino acid.

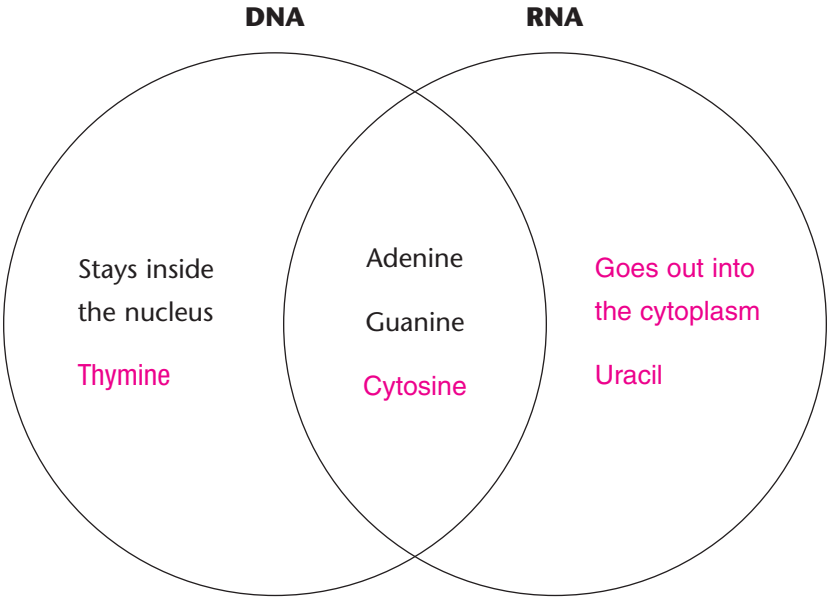
▶ How Cells Make Proteins (pages 578–581)

6. What happens during protein synthesis? During protein synthesis, the cell uses information from a gene on a chromosome to produce a specific protein.

CHAPTER 16, Genetics: The Science of Heredity *(continued)*

7. Proteins are made on ribosomes in the cytoplasm of the cell.

8. Complete this Venn diagram to show some of the similarities and differences between DNA and RNA.



9. List two kinds of RNA and tell their jobs.

a. Messenger RNA copies the coded message from the DNA in the nucleus and carries the message into the cytoplasm.

b. Transfer RNA carries amino acids and adds them to the growing protein.

10. Circle the letter of the first step in protein synthesis.

a. Transfer RNA carries amino acids to the ribosome.

b. The ribosome releases the completed protein chain.

c. Messenger RNA enters the cytoplasm and attaches to a ribosome.

d. DNA "unzips" to direct the production of a strand of messenger RNA.

Name _____ Date _____ Class _____

11. Circle the letter of the last step in protein synthesis.

a. Transfer RNA carries amino acids to the ribosome.

b. The ribosome releases the completed protein chain.

c. Messenger RNA enters the cytoplasm and attaches to a ribosome.

d. DNA "unzips" to direct the production of a strand of messenger RNA.

▶ Mutations (pages 580–582)

12. What is a mutation? A mutation is any change in a gene or chromosome.

13. How can mutations affect protein synthesis in cells? Mutations can cause a cell to produce an incorrect protein during protein synthesis.

14. Circle the letter of each sentence that is true about mutations.

a. Cells with mutations will always make normal proteins.

b. Some mutations occur when one nitrogen base is substituted for another.

c. Some mutations occur when chromosomes don't separate correctly during meiosis.

d. Mutations that occur in a body cell can be passed on to an offspring.

15. Mutations can be a source of genetic variety.

16. Is the following sentence true or false? All mutations are helpful.

false

17. Whether a mutation is harmful or not depends partly on an organism's environment.

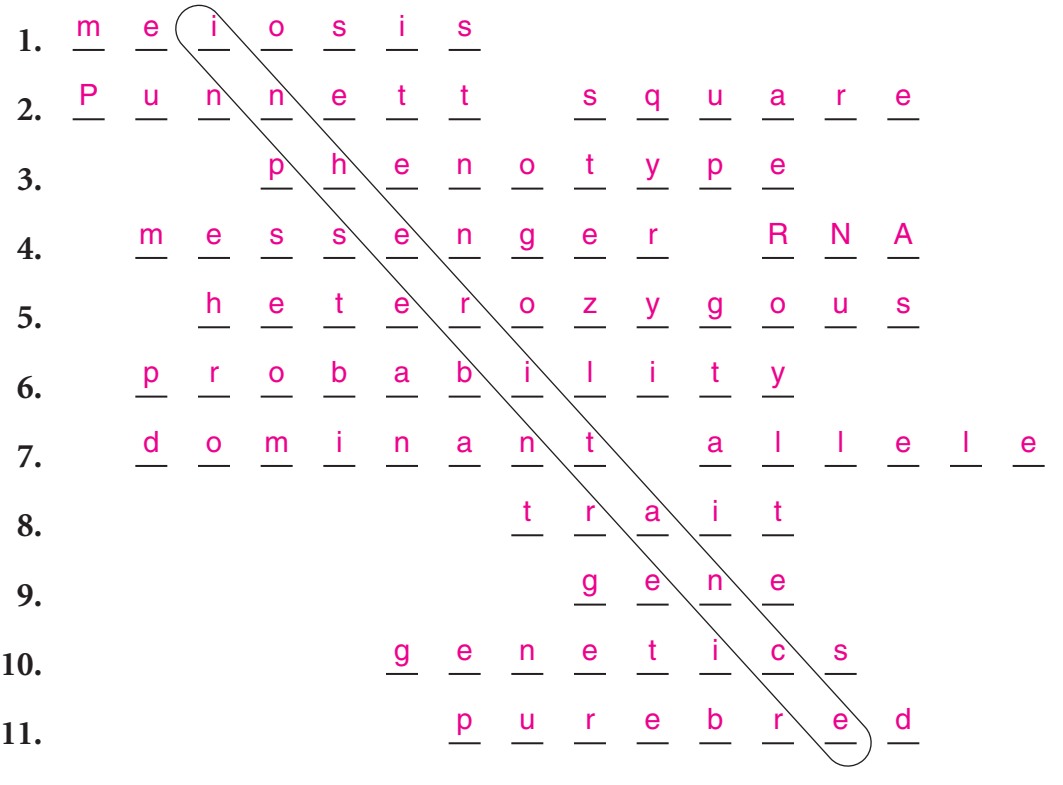
18. Mutations that are helpful improve an organism's chances for survival and reproduction.

WordWise

Use the clues below to identify key terms from Chapter 16. Write the terms below, putting one letter in each blank. When you finish, the word enclosed in the diagonal lines will reveal what Mendel studied.

Clues

1. The process by which the number of chromosomes is reduced by half in sex cells
2. A chart that shows all possible allele combinations resulting from a genetic cross
3. An organism's physical appearance
4. RNA that is a copy of the DNA message that can enter the cytoplasm
5. An organism that has two different alleles for a trait
6. Likelihood that a certain event will occur
7. An allele whose trait always shows up in the organism when the allele is present
8. Physical characteristic of an organism
9. A factor that controls a trait
10. The scientific study of heredity
11. One that always produces offspring with the same form of a trait as the parent



Name _____ Date _____ Class _____

CHAPTER 17

Modern Genetics

SECTION 17–1 Human Inheritance (pages 588–594)

This section tells why some traits in people have many possible phenotypes. It also describes the tools scientists use to learn how traits are inherited in families.

▶ Traits Controlled by Single Genes (pages 588–589)

1. The probability that two heterozygous parents for widow's peak will have a child with a straight hairline is 25 percent.
2. Is the following sentence true or false? Smile dimples are caused by the recessive allele of a gene. false

▶ Multiple Alleles (page 589)

3. A gene with three or more alleles for a single trait has multiple alleles.
4. Is the following sentence true or false? Even though a gene has multiple alleles, a person can carry only two of those alleles. true
5. Complete the table by writing all possible combinations of alleles for each blood type.

Blood Types	
Blood Type	**Combination of Alleles**
A	I^AI^A or I^Ai
B	I^BI^B or I^Bi
AB	I^AI^B
O	ii

Name _____ Date _____ Class _____

▶ Traits Controlled by Many Genes (page 590)

6. Why do some human traits, such as height and skin color, show a large number of phenotypes? These traits are controlled by more than one gene, and some of the genes have multiple alleles.

7. Is the following sentence true or false? Skin color is controlled by more than one gene. true

▶ The Effect of Environment (page 590)

8. The effects of genes are often altered by the environment.

9. What environmental factor contributes to the fact people have grown taller over time? Diets have become more healthful.

▶ Male or Female? (page 591)

10. Is the following sentence true or false? Genes on chromosomes determine whether a baby is a boy or a girl. true

11. Females have two X chromosomes. Males have one X chromosome and one Y chromosome.

12. Circle the letter of each sentence that is true about the sex chromosomes.

(a.) All eggs have one X chromosome.

(b.) Half of a male's sperm cells have an X chromosome.

c. None of a male's sperm cells have a Y chromosome.

d. The egg determines the sex of the child.

Name _____ Date _____ Class _____

▶ Sex-Linked Genes (pages 592–593)

13. Genes on the X and Y chromosomes are called sex-linked genes.

14. Why are males more likely than females to have a sex-linked trait that is recessive? Males have only one X chromosome.

15. Is the following question true or false? A carrier for colorblindness is colorblind. false

16. Why is a son who receives the allele for colorblindness from his mother always going to be colorblind? There is no allele on the Y chromosome that could mask the recessive allele for colorblindness on the X chromosome.

▶ Pedigrees (pages 593–594)

17. A chart or "family tree" that tracks which members of a family have a certain trait is called a(n) pedigree.

18. Is the following sentence true or false? On a pedigree, a circle represents a male. false

SECTION 17–2 Human Genetic Disorders (pages 595–599)

This section describes how changes in the DNA of some genes have affected certain traits in humans.

▶ Introduction (page 595)

1. An abnormal condition that a person inherits through genes or chromosomes is called a(n) genetic disorder.

2. What causes genetic disorders? Mutations, or changes in a person's DNA, cause genetic disorders.

▶ Cystic Fibrosis (page 596)

3. What is cystic fibrosis? Cystic fibrosis is a genetic disorder in which the body produces abnormally thick mucus in the lungs and intestines.

4. Is the following sentence true or false? Cystic fibrosis is caused by a mutation that is the dominant allele of a gene. false

▶ Sickle-Cell Disease (pages 596–597)

5. Circle the protein that is not normal in people with sickle-cell disease.
   a. mucus **b.** hemoglobin
   c. red blood cells **d.** clotting protein

6. The allele for the sickle-cell trait is codominant with the normal allele.

▶ Hemophilia (page 597)

7. Is the following sentence true or false? Hemophilia is caused by a dominant allele on the X chromosome. false

8. Hemophilia occurs more often in males.

9. How is hemophilia treated? People with hemophilia get regular doses of the missing clotting protein.

▶ Down Syndrome (page 598)

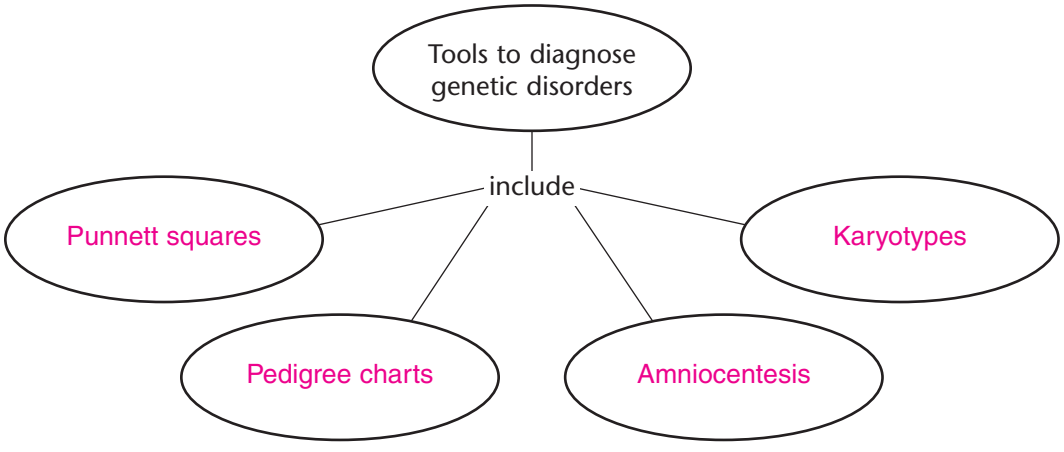
10. Circle the letter of the cause of Down syndrome.
    a. recessive allele **b.** dominant allele
    c. too many chromosomes **d.** too few chromosomes

11. Down syndrome most often occurs when chromosomes fail to separate properly during meiosis.

Name _____ Date _____ Class _____

▶ Diagnosing Genetic Disorders (pages 598–599)

12. Complete the concept map to show some tools used by doctors to detect genetic disorders.



13. What happens during amniocentesis? A doctor uses a very long needle to remove a small amount of the fluid that surrounds the developing baby to determine whether the baby will have some genetic disorder.

14. A picture of all the chromosomes in a cell is a(n) karyotype.

▶ Genetic Counseling (page 599)

15. How do genetic counselors help couples? They help couples understand their chances of having a child with a particular genetic disorder.

Reading Skill Practice

A compare/contrast table organizes information that you have read. Make a table to compare and contrast the four genetic disorders described in Section 17–2. The column headings should be the names of the genetic disorders. The row headings should include descriptions and causes of the disorders. For more information about compare/contrast tables, see page 688 in the Skills Handbook of your textbook. Do your work on a separate sheet of paper.

Students should make the table as described. Be sure students correctly identify the characteristics of each disorder, using pages 596–598 as a guide.

SECTION 17–3 Advances in Genetics (pages 602-608)

This section describes some of the research in genetic technology and how it can be used.

▶ Introduction (page 602)

1. List the three methods that people have used to develop organisms with desirable traits.

   a. selective breeding b. cloning c. genetic engineering

▶ Selective Breeding (pages 602–603)

2. The process of selecting a few organisms with the desired traits to serve as parents of the next generation is called selective breeding.

3. What is inbreeding? In inbreeding, breeders cross two individuals that have identical or similar sets of alleles.

4. Is the following sentence true or false? In hybridization, breeders cross two individuals that are genetically identical. false

5. What is commonly produced today by hybridization? Crops grown on farms and in gardens

▶ Cloning (page 604)

6. Circle the letter of each sentence that is true about cloning.

   (a.) A clone has exactly the same genes as the organism from which it was produced.

   b. A cutting is one way to make a clone of an animal.

   c. It's easier to clone an animal than it is to clone a plant.

   (d.) Dolly, the lamb, was the first clone of an adult mammal ever produced.

7. Is the following sentence true or false? Cloning can be done only in animals. false

Name _____ Date _____ Class _____

▶ Genetic Engineering (pages 604–607)

8. In genetic engineering, genes from one organism are transferred into the DNA of another organism.

9. Complete this flowchart about genetic engineering in bacteria.

Genetic Engineering in Bacteria

Human DNA is spliced into the plasmid, which is a small ring of DNA in bacteria.

↓

The bacterial cell takes up the plasmid. It now contains the human gene.

↓

The bacterial cell produces the protein that the human gene codes for.

10. What is gene therapy? Gene therapy is the process in which researchers insert working copies of a gene directly into the cells of a person with a genetic disorder.

▶ DNA Fingerprinting (page 607)

11. How are DNA samples similar to fingerprints? DNA samples can identify a person because no two people, except for identical twins, have the same DNA.

12. DNA fingerprinting is being used to help solve crimes.

▶ The Human Genome Project (page 608)

13. All the DNA in one cell of an organism is a(n) genome.

14. What is the goal of the Human Genome Project? Its goal is to identify the DNA sequence of every gene in the human genome.

WordWise

Use the clues to identify key terms from Chapter 17. Write the terms on the lines. Then find the words hidden in the puzzle and circle them. Words are across or up-and-down.

Clues	Key Terms
A procedure in which fluid surrounding a developing baby is removed	amniocentesis
A person with one recessive and one dominant allele for a trait	carrier
An organism that is genetically identical to the organism from which it was produced	clone
All the DNA in one cell of an organism	genome
Breeders cross two genetically different organisms	hybridization
Breeders cross two genetically identical organisms	inbreeding
A picture of all the chromosomes in a cell	karyotype
A chart that tracks which family member has a certain trait	pedigree

h k c i p a e g h r y x i n b r e e d i n g
k a e r g e n i e m i b h n c e t a c k h p
a r h y b r i d i z a t i o n b w s a t r e
d y o d i c i j a t w e g l h a g e r s c d
g o n k a l r e n t l d a l a m e i r d s i
o t e a p o d i w t k s a e r p n f i m c g
r y k r g n n i r i h r e w x p o n e s s r
h p l y p e l a g v p h y b s z m a r e w e
n e e a m n i o c e n t e s i s e k p y r e

Name _____ Date _____ Class _____

CHAPTER 18

Change Over Time

SECTION 18–1 Darwin's Voyage (pages 616–626)

This section discusses Charles Darwin and his theory of natural selection, which is based on what he saw during his trip around the world.

▶ Darwin's Observations (page 617)

1. Is the following sentence true or false? Charles Darwin was not surprised by the variety of living things he saw on his voyage around the world.

   false

2. A group of similar organisms that can mate with each other and produce fertile offspring is called a(n) species.

3. Is the following sentence true or false? Darwin observed a great diversity of organisms on the Galapagos Islands. true

▶ Similarities and Differences (page 618)

4. Circle the letter of each sentence that is true about Darwin's observations.

   (a.) Many Galapagos organisms were similar to organisms on mainland South America.

   b. Iguanas on the Galapagos Islands had small claws for climbing trees.

   (c.) Darwin thought Galapagos animals and plants came from mainland South America.

   d. All tortoises living in the Galapagos Islands looked exactly the same.

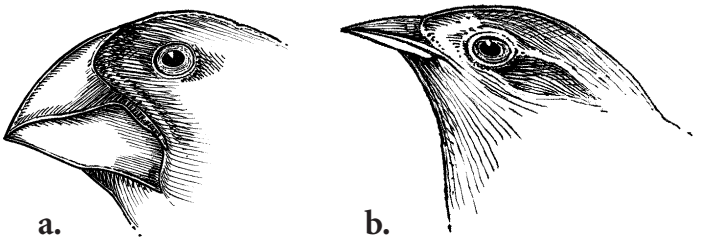
5. Darwin noticed many differences among similar organisms as he traveled from one Galapagos island to the next.

Name _____ Date _____ Class _____

▶ Adaptations (page 619)

Look at the bird beaks below. Match the bird beaks with the kind of food the bird eats.

	Kind of Food	Bird Beaks
b	6. insects	
a	7. seeds	



a. b.

8. A trait that helps an organism survive and reproduce is a(n) adaptation.

▶ Evolution (pages 619–620)

9. Circle the letter of each sentence that is true about Darwin's conclusions.
   - **a.** Darwin understood immediately why Galapagos organisms had many different adaptations.
   - **b.** Darwin thought that Galapagos organisms gradually changed over many generations.
   - **c.** Darwin believed that evolution had occurred on the Galapagos Islands.
   - **d.** Darwin knew how certain traits were selected for in nature.

10. Circle the letter of a well-tested concept that explains many observations.
    a. idea **b.** evolution **c.** scientific theory **d.** hypothesis

▶ Natural Selection (pages 620–621)

11. In his book, *The Origin of Species*, Darwin proposed that evolution occurs by means of natural selection.

12. Is the following sentence true or false? Individuals with variations that make them better adapted to their environment will not survive.
    false

Name _____ Date _____ Class _____

Match the factors that affect the process of natural selection with their definitions.

	Definitions	Factors
b	**13.** Caused by limited food and other resources	**a.** overproduction
c	**14.** Differences between individuals of the same species	**b.** competition
a	**15.** Species produce more offspring than can survive.	**c.** variations

▶ The Role of Genes in Natural Selection (page 624)

16. Is the following sentence true or false? Only traits that are controlled by genes can be acted upon by natural selection. true

17. Is the following sentence true or false? Darwin knew all about genes and mutations. false

▶ Natural Selection in Action (page 624)

18. During a drought on one of the Galapagos Islands in 1977, only finches with larger and stronger beaks were better able to survive.

19. Is the following sentence true or false? Natural selection can affect a group of organisms in as short a time as one year. true

▶ How Might New Species Form? (page 625)

20. When does a new species form? A new species might form when a group of individuals remains separated from the rest of its species long enough to develop different traits.

21. Give an example of how a group can be separated from the rest of its species. A group can be separated by a river, volcano, mountain range, or ocean wave that carries a few individuals to another shore.

▶ Continental Drift (page 626)

22. Pangaea gradually split apart in a process called continental drift.

23. What happened to plant and animal species during continental drift?

Species became isolated from one another and natural selection occurred.

Reading Skill Practice

The glossary on pages 712–738 of your textbook gives the definitions of all the key terms. You can use the glossary when you need to find the meaning of a key term. Find and write the definitions of the terms *adaptation, evolution, natural selection,* and *variation*. Do your work on a separate sheet of paper.

Check student answers with the glossary definitions in the textbook.

SECTION 18–2 The Fossil Record (pages 627-634)

This section explains what fossils are and how scientists determine a fossil's age. It also describes the geologic time scale, a calendar of Earth's history.

▶ Introduction (page 627)

1. Some of the most important clues to Earth's past are fossils.

2. Circle the letter of each item that can form a fossil.

(a.) bone (b.) shell (c.) footprint **d.** stone

▶ How Do Fossils Form? (pages 627–629)

3. Is the following sentence true or false? Only the soft parts of an animal remain to form a fossil. false

Name _____ Date _____ Class _____

4. What parts of plants are most often preserved as fossils? Leaves, stems, roots, and seeds are most often preserved as fossils.

5. In what conditions do most fossils form? Most fossils form when organisms that die become buried in sediments.

6. Particles of soil and rock are called sediments.

7. How does sedimentary rock form? When a river flows into a lake or ocean, the sediments carried by the river settle to the bottom. Over time, layers of sediment build up and harden to become sedimentary rock.

8. Remains of organisms that are actually changed to rock are called petrified fossils.

9. Circle the letter of each sentence that is true about molds and casts.
   - (a.) A mold forms when hard parts of an organism buried by sediments are gradually dissolved.
   - b. A cast is a hollow space in sediment in the shape of an organism.
   - (c.) A mold that becomes filled in with hardened materials is a cast.
   - (d.) A cast is a copy of the shape of an organism.

10. List three substances, other than sediments, in which organisms can be preserved.
    - a. ice
    - b. tar
    - c. amber, or hardened sap

▶ Determining a Fossil's Age (pages 629–630)

11. Is the following sentence true or false? By determining the age of fossils, scientists can reconstruct the history of life on Earth.

true

12. In what two ways can scientists determine the ages of fossils?

a. relative dating **b.** absolute dating

13. In layers of sedimentary rock, the oldest layer is at the bottom. Each higher layer is younger than the layers below it.

14. Is the following sentence true or false? Relative dating can only help scientists determine whether one fossil is older than another.

true

15. Scientists use radioactive elements, or unstable elements that decay, to determine the actual age of a fossil.

16. What is the half-life of a radioactive element? The half-life is the time it takes for half of the atoms in a sample to decay.

17. Potassium-40 breaks down into argon-40 over time.

18. How do scientists determine the age of a fossil? Scientists compare the amount of a radioactive element in a sample to the amount of the element into which it breaks down. This information is used to calculate the age of the fossil.

▶ What Do Fossils Reveal? (pages 630–631)

19. The millions of fossils that scientists have collected are called the fossil record.

20. How have scientists learned about extinct species? Scientists use fossils to learn about extinct species.

21. Circle the letter of the largest span of time in the Geologic Time Scale.

a. Precambrian Time **b.** eras **c.** periods **d.** years

22. Why do scientists know very little about the Precambrian? There are few fossils from this ancient time.

Name _____ Date _____ Class _____

23. Look at *Exploring Life's History* on pages 632–633. What are the names of the three eras? The three eras are the Paleozoic, the Mesozoic, and the Cenozoic.

▶ The Incomplete Fossil Record (page 631)

24. Complete the table below about the rate at which species may change.

How Fast Does Change Occur?	
Theory of Evolution	**What the Theory Says**
Gradualism	Evolution occurs slowly but steadily.
Punctuated Equilibria	Evolution occurs during short periods of rapid changes separated by long periods of little or no changes.

▶ Causes of Extinction (page 634)

25. What are the two causes of change in environmental conditions that can affect the survival of organisms?

a. natural events

b. human activities

26. A change in Earth's climate about 65 million years ago probably caused the extinction of half the species on Earth.

27. Is the following sentence true or false? The major cause of extinction today is habitat destruction. true

Reading Skill Practice

Outlines are useful tools to help you organize and remember what you have read. In outlines, the major headings of a section are listed in order. Under each heading, one or two important ideas about that topic are listed. Write an outline of the subsection, *Determining a Fossil's Age.* Do your work on a separate sheet of paper.

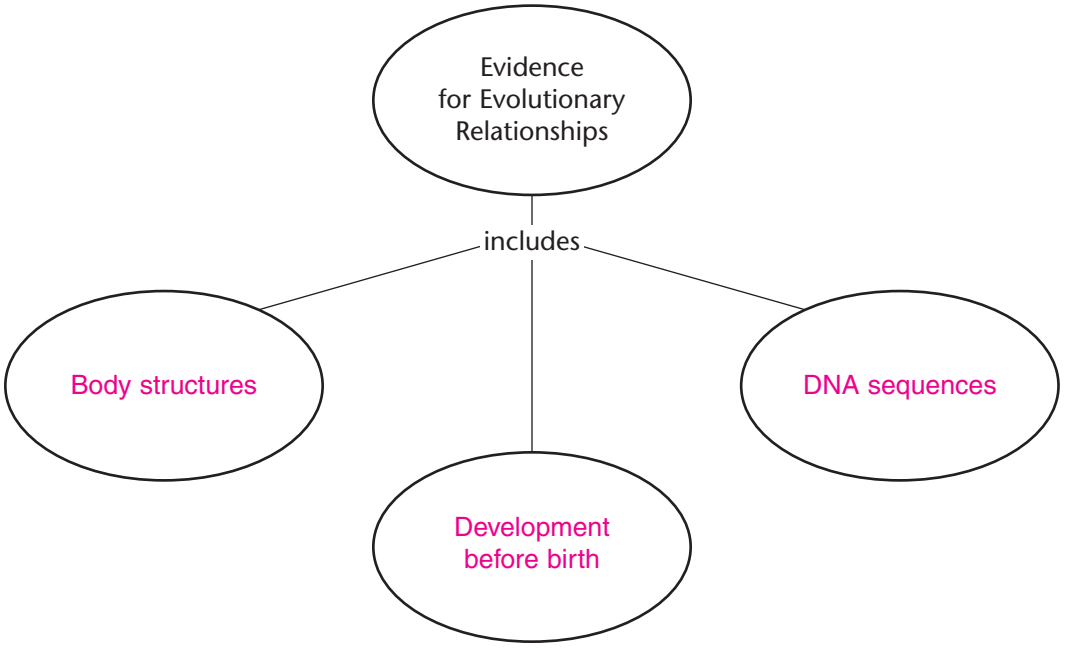
Outlines should be organized under the headings *Relative Dating* and *Absolute Dating* and include information from pages 629–630.

SECTION 18–3 Other Evidence of Change (pages 635–639)

This section tells how scientists infer which living things are related.

▶ Introduction (page 635)

1. Complete the concept map to show what kinds of evidence scientists use to infer whether organisms are related.



▶ Similarities in Body Structure (pages 635–636)

2. Why do scientists classify fish, amphibians, reptiles, birds, and mammals together in one group? These animal groups all have a similar body structure—an internal skeleton with a backbone.

3. Similar body structures that related species have inherited from a common ancestor are called homologous structures.

Name _____ Date _____ Class _____

▶ Similarities in Early Development (pages 636–637)

4. What similarities in development lead scientists to infer that turtles, chickens, and rats share a common ancestor? All three organisms have a tail and tiny gill slits in their throats during early stages of development.

5. Evidence supports the conclusion that turtles are more closely related to chickens than they are to rats.

▶ Similarities in DNA (pages 637–638)

6. Is the following sentence true or false? Scientists infer that more closely related species are, the more similar their DNA sequences.

true

7. What have scientists learned about the elephant shrew's DNA?

Scientists have learned that the elephant shrew's DNA is more similar to that of elephants than that of to rodents.

8. The DNA from fossils is providing scientists with new ways to compare fossils and today's organisms.

▶ Combining the Evidence (pages 638–639)

9. Circle the letter of each sentence that is true about evolutionary relationships of organisms.

a. DNA comparisons show that dogs are more similar to coyotes than to wolves.

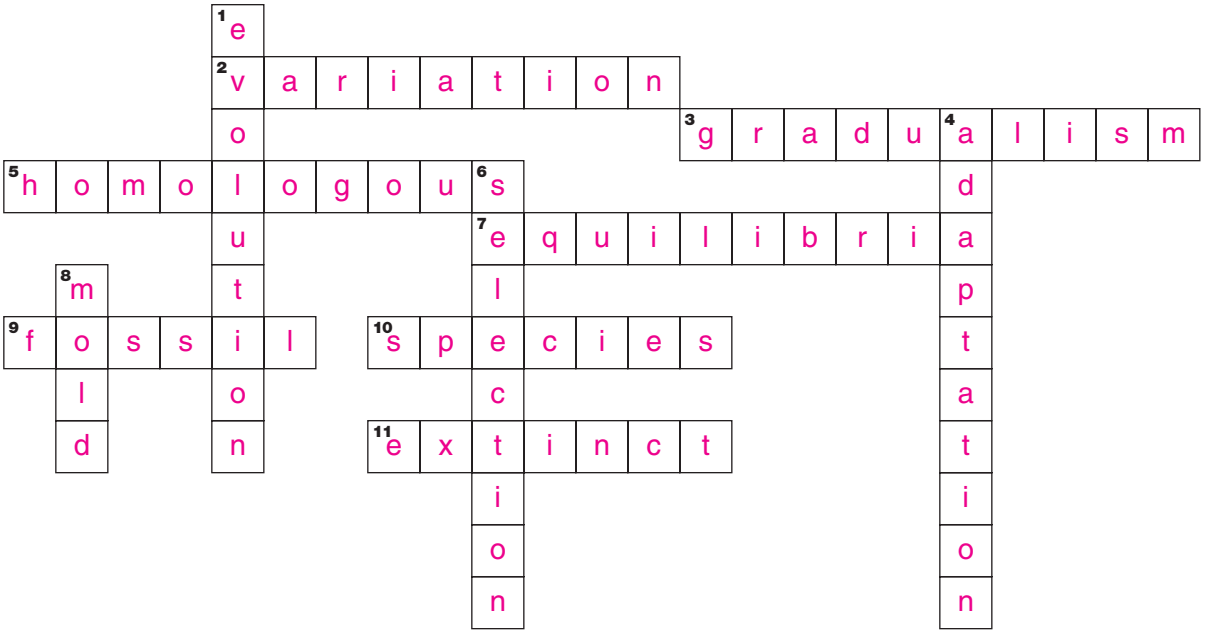
b. Scientists had already made inference about the relationships of dogs, wolves, and coyotes based on their similar structures and development.

c. A branching tree shows how scientists think different groups of organisms are related.

d. DNA evidence shows that giant pandas are more closely related to raccoons than to bears.

WordWise

Answer the clues to solve this crossword puzzle.



Clues down

1. The gradual change in a species over time
4. A trait that helps an organism survive and reproduce
6. The process by which individuals that are better adapted to their environment are more likely to survive is called natural _____.
8. A fossil formed when an organism buried in sediment dissolves, leaving a hollow area

Clues across

2. Any difference between individuals of the same species
3. The idea that evolution occurs slowly but steadily
5. Similar structures that related species inherited from a common ancestor are _____ structures.
7. The idea that evolution occurs during short periods of rapid change is punctuated _____.
9. The preserved remains of an organism
10. A group of similar organisms that can mate and produce fertile offspring
11. No members of a species are still alive

Name _____ Date _____ Class _____

CHAPTER 19

INTERDEPENDENCE IN LIVING SYSTEMS

SECTION 19–1 Interactions in the Human Body (pages 646–654)

This section describes the levels of organization in complex organisms. It also explains how body systems interact to carry out various functions.

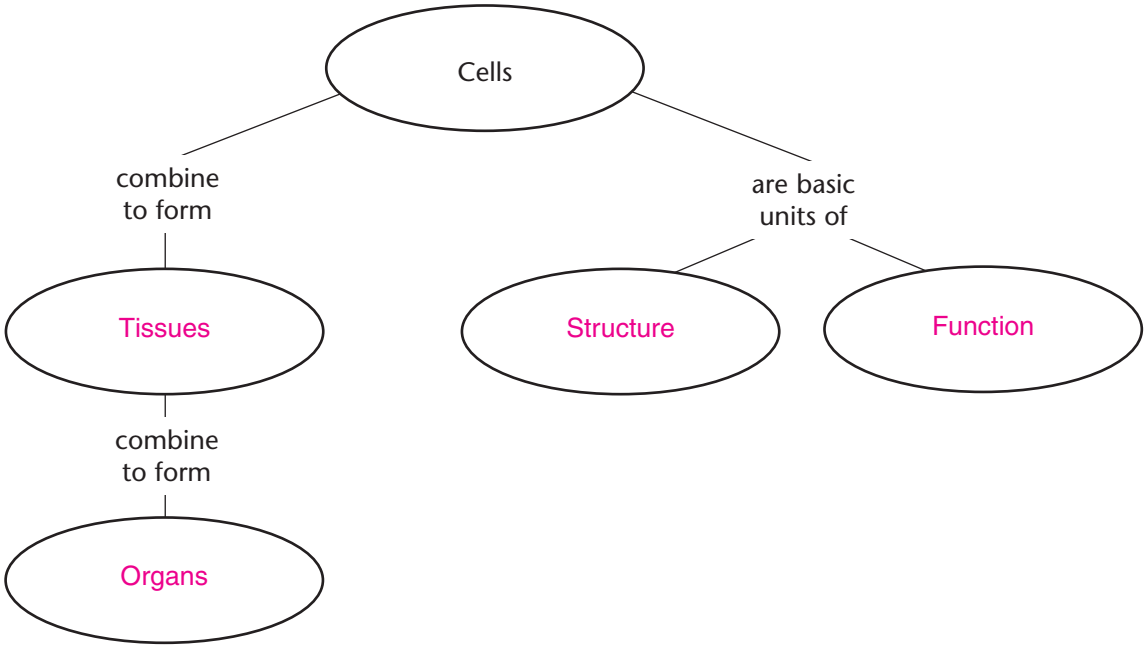
▶ What Is a System? (page 647)

1. Any group of parts that work together as a unit can be called a(n) system.

▶ How the Body Is Organized (pages 647–648)

2. The levels of organization in a many-celled organism begin with cells.

3. Complete the concept map.



4. List the four types of tissues

a. muscle tissue b. connective tissue

c. nerve tissue d. epithelial tissue

Match each body system with its function.

	Body System	Function
d	**5.** skeletal	**a.** Enables the body to move
a	**6.** muscular	**b.** Fights disease
f	**7.** digestive	**c.** Obtains and processes information
e	**8.** reproductive	**d.** Supports and protects the body
c	**9.** nervous	**e.** Creates offspring
d	**10.** immune	**f.** Breaks down and absorbs food

▶ Interactions Within the Human Body (page 649)

11. Is the following sentence true or false? Interdependence among body systems is necessary for the processes that keep humans alive and enable them to reproduce. true

12. How do a musician's muscular and skeletal systems work together?

Muscles make the musician's fingers move. These muscles attach to bones in the skeletal system.

▶ Blood—The Link to All Body Systems (page 650)

13. The main task of the cardiovascular system is transportation.

14. Why do all body systems interact with the cardiovascular system?

Every cell in the body depends on the cardiovascular system to deliver needed materials to it and to remove wastes.

Name _____ Date _____ Class _____

▶ Interactions in Transporting Oxygen (pages 650–652)

15. The respiratory system could not deliver oxygen to your body cells or remove carbon dioxide without the cardiovascular system and muscular system.

16. The main organs of the respiratory system are the lungs

17. What are alveoli? Alveoli are the structures in the lungs through which oxygen moves from the air into the blood.

18. Circle the letter of each sentence that is true about the cardiovascular system.

a. Capillaries are the largest blood vessels in the cardiovascular system.

b. In the capillaries around the alveoli, oxygen binds to red blood cells.

c. Oxygen-rich red blood cells release oxygen to body cells.

d. Carbon dioxide passes from the air in alveoli into the blood.

19. Is the following sentence true or false? The actions of the diaphragm and other muscles cause you to inhale and exhale. true

▶ Interactions in Digesting Food (pages 652–653)

20. The digestive, muscular, and cardiovascular systems interact to digest and absorb the food you eat and deliver nutrients to your cells.

21. The small intestine is lined with tiny finger-shaped projections called villi, which absorb nutrients into the body.

22. Food is pushed through the digestive system by waves of muscular contractions.

23. Nutrients are carried to cells by the cardiovascular system.

▶ Movement: Muscles, Bones, and Nerves (pages 653–654)

24. List three systems that are involved in voluntary movements.

a. muscular system

b. skeletal system

c. nervous system

25. Muscles that control voluntary motion are called skeletal muscles.

26. Parts of the body are moved when muscles contract and pull on bones.

27. Muscles are directed to contract by the brain and nerves.

Reading Skill Practice

Illustrations in textbooks can help you understand what you have read. Look at Figure 7 on page 654. What idea does this illustration communicate? Do your work on a separate sheet of paper.

The diagram shows that muscles contract or relax to cause movement in the body.

SECTION 19–2 Equilibrium and Feedback (pages 655-660)

This section describes the characteristics of a system in equilibrium and explains how feedback helps maintain equilibrium.

▶ Stability of Living Systems (pages 655–656)

1. A system that is stable is in equilibrium.

2. What is homeostasis? Homeostasis is the process by which the body's internal environment is kept stable in spite of changes in the external environment.

Name _____ Date _____ Class _____

▶ Negative Feedback (page 656)

3. Is the following sentence true or false? In negative feedback, a process is turned on by the condition it produces. false

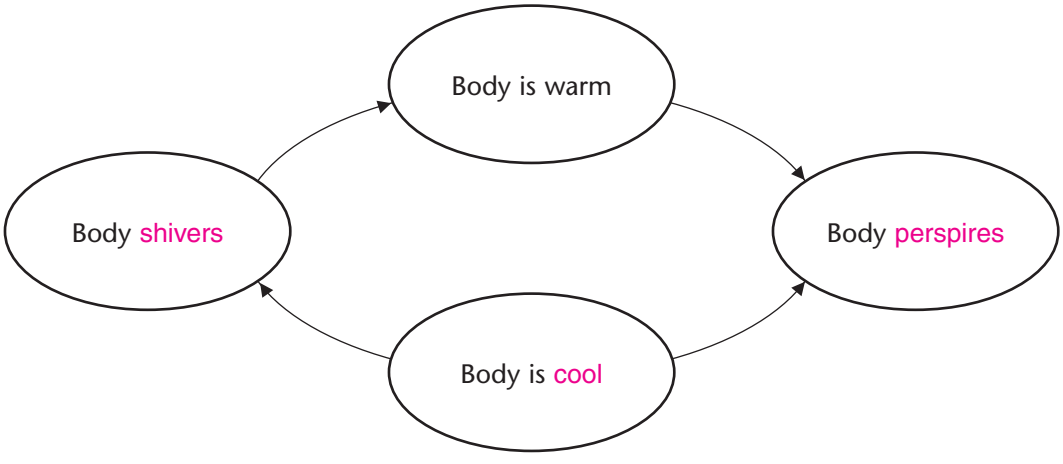
4. The operation of a thermostat is an example of negative feedback.

▶ Keeping Body Temperature Constant (page 657)

5. Is the following sentence true or false? The internal body temperature of birds and mammals is always about the same. true

6. Complete the cycle diagram.

Temperature Regulation



7. How do animals such as dogs get rid of excess heat? They get rid of excess heat by panting. When they pant, some of the saliva in the mouth evaporates, which cools the body.

8. Why does shivering warm the body? When you shiver, muscles contract. Muscle contractions require energy, and the production of energy generates heat.

▶ Maintaining Glucose Levels in the Blood (pages 657–658)

9. Where does your body get glucose? From the foods you eat

10. What is a hormone? A hormone is a chemical produced by an endocrine gland that affects the activity of a tissue or organ.

11. One hormone that helps regulate glucose levels is insulin.

12. Circle the letter of each statement that is true about the regulation of glucose levels.

a. When the level of glucose in the blood is high, the pancreas releases insulin.

b. Insulin stimulates body cells to release glucose into the blood.

c. Low levels of glucose in the blood "turn off" production of insulin.

d. High levels of glucose in the blood lead to an increase in glucose levels in the blood.

▶ Maintaining Water Equilibrium in Plant Cells (pages 658–659)

13. Is the following sentence true or false? Regulating the amount of water in cells and tissues is not necessary for maintaining homeostasis.

false

14. Water enters and leaves cells through the process of osmosis.

15. What happens when the concentration of water molecules is greater outside a cell than inside? Water molecules move into the cell.

16. What is turgor pressure? Turgor pressure is the pressure of water against the cell wall of a plant cell.

17. Is the following sentence true or false? Turgor pressure helps keep excess water from entering the plant even if the concentration of water molecules is very high outside the plant's cells. true

Name _____ Date _____ Class _____

▶ Water Equilibrium in Animals (page 660)

18. How does your body respond to a need for water? You feel thirsty and so you drink fluids.

19. What are two functions of the kidneys?

a. Remove wastes produced by the cells

b. Adjust the amount of water in the blood

20. How do kidneys help keep water inside the body on a hot day when you are perspiring? The kidneys produce urine that has relatively little water in it.

Reading Skill Practice

A cycle diagram can be used to show a sequence of events that is continuous, or cyclical. Read the information on water equilibrium in animals on page 660. Make a cycle diagram to show how this equilibrium is maintained. Do your work on a separate sheet of paper.

Cycle diagrams should reflect the information on page 660, and show how changes in water concentration in urine maintain water equilibrium.

SECTION 19–3 Interactions Among Living Things (pages 661-670)

This section describes adaptations that help living things survive. It also describes how organisms interact in an ecosystem.

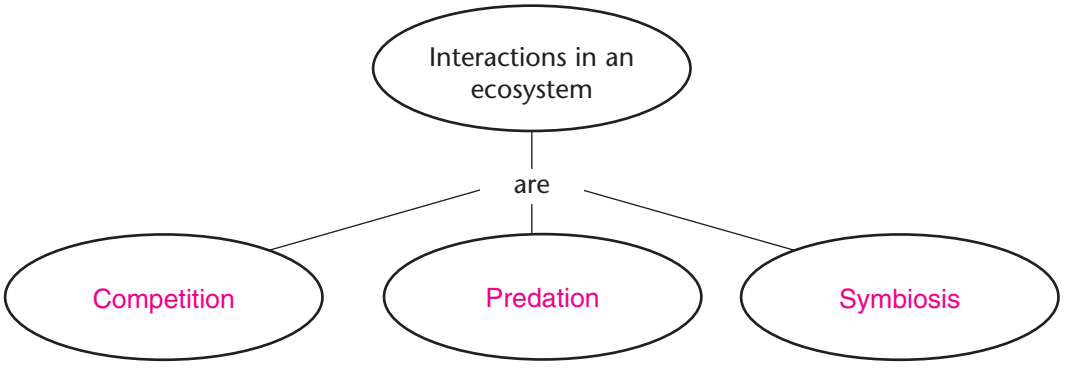
▶ Adapting to the Environment (page 662)

1. What is an ecosystem? An ecosystem is all the living and nonliving things that interact in an area.

2. Is the following sentence true or false? Every organism in an ecosystem has a variety of adaptations that are suited to its specific living conditions. true

3. An organism's particular role in an ecosystem is its niche.

4. Complete the concept map.



▶ Competition (page 663)

5. What is competition? Competition is the struggle between organisms to survive in a habitat with limited resources.

6. Is the following sentence true or false? Some species of birds avoid competition by feeding in different parts of trees. true

7. How do plants use chemicals to ward off competition? Some shrubs release toxic chemicals into the ground. The chemicals keep grass and weeds from growing around the shrubs.

▶ Predation (pages 664–665)

8. What is predation? Predation is an interaction in which one organism hunts and kills another for food.

9. A shark catches a young albatross; the shark is the [predator] and the albatross is the shark's prey.

10. Claws and sharp teeth are adaptations of predators.

11. List five kinds of adaptations that help animals avoid becoming prey.

a. camouflage b. protective coverings c. warning coloration

d. mimicry e. false coloring

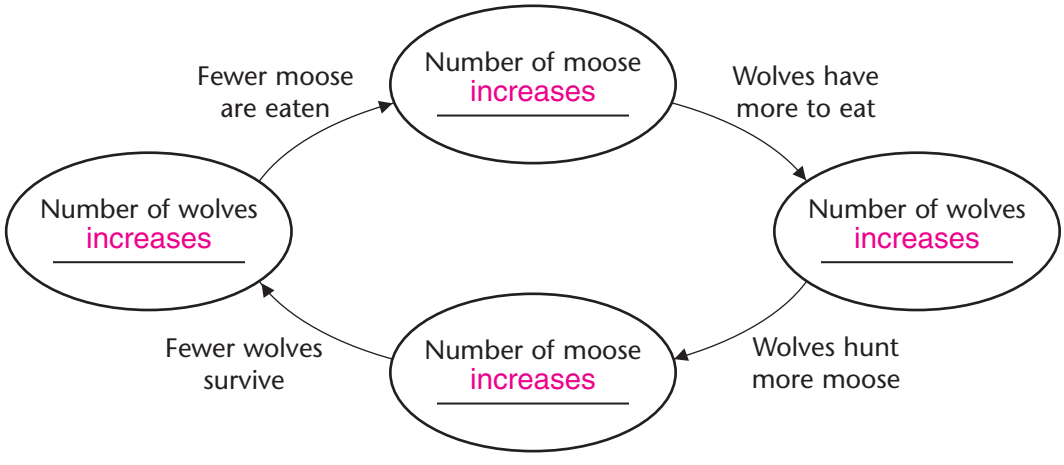
Name _____ Date _____ Class _____

▶ The Effect of Predation on Population Size (page 668)

12. When the death rate exceeds the birth rate in a population, the size of the population usually decreases.

13. Complete the cycle diagram by filling in the blanks with increases or decreases.

Population Changes



▶ Symbiosis (pages 669–670)

14. What is symbiosis? Symbiosis is a close relationship between two species that benefits at least one of the species.

Match the kind of symbiosis with its definition.

Kind of Symbiosis	Definition
b **15.** mutualism	**a.** One organism living on or inside another organism and harming it
c **16.** commensalism	**b.** Relationship in which both species benefit
a **17.** parasitism	**c.** Relationship in which one species benefits and the other species is neither helped nor harmed

18. The organisms that a parasite lives on is its host.

Word Wise

Solve the clues by writing the correct key terms from Chapter 19 in the blanks. Use the numbered letters in the terms to find the hidden key term. Then write a definition for the hidden key term.

Clues	Key Terms
Tube through which air travels to the lungs	t r a c h e a 1
Group of tissues that performs a specific function	o r g a n 2
Chemical produced by an endocrine gland that affects the activity of a tissue or organ	h o r m o n e 3
An organism's role in an ecosystem	n i c h e 4
Diffusion of water through a selectively permeable membrane	o s m o s i s 5
Organism that lives on or in another organism	p a r a s i t e 6
Group of cells that perform the same function	t i s s u e 7
Structure in the lung through which oxygen moves from the air into the blood	a l v e o l u s 8
Relationship in which one species benefits and the other is neither helped nor harmed	c o m m e n s a l i s m 9
Close relationship between two species that benefits at least one of the species	s y m b i o s i s 10
The organism a parasite lives on or in	h o s t 11

Key Term

h	o	m	e	o	s	t	a	s	i	s
1	2	3	4	5	6	7	8	9	10	11

Definition: The process by which the body's internal environment is kept stable in spite of changes in the external environment.