



UNITED ARAB EMIRATES
MINISTRY OF EDUCATION



YEAR OF
ZAYED

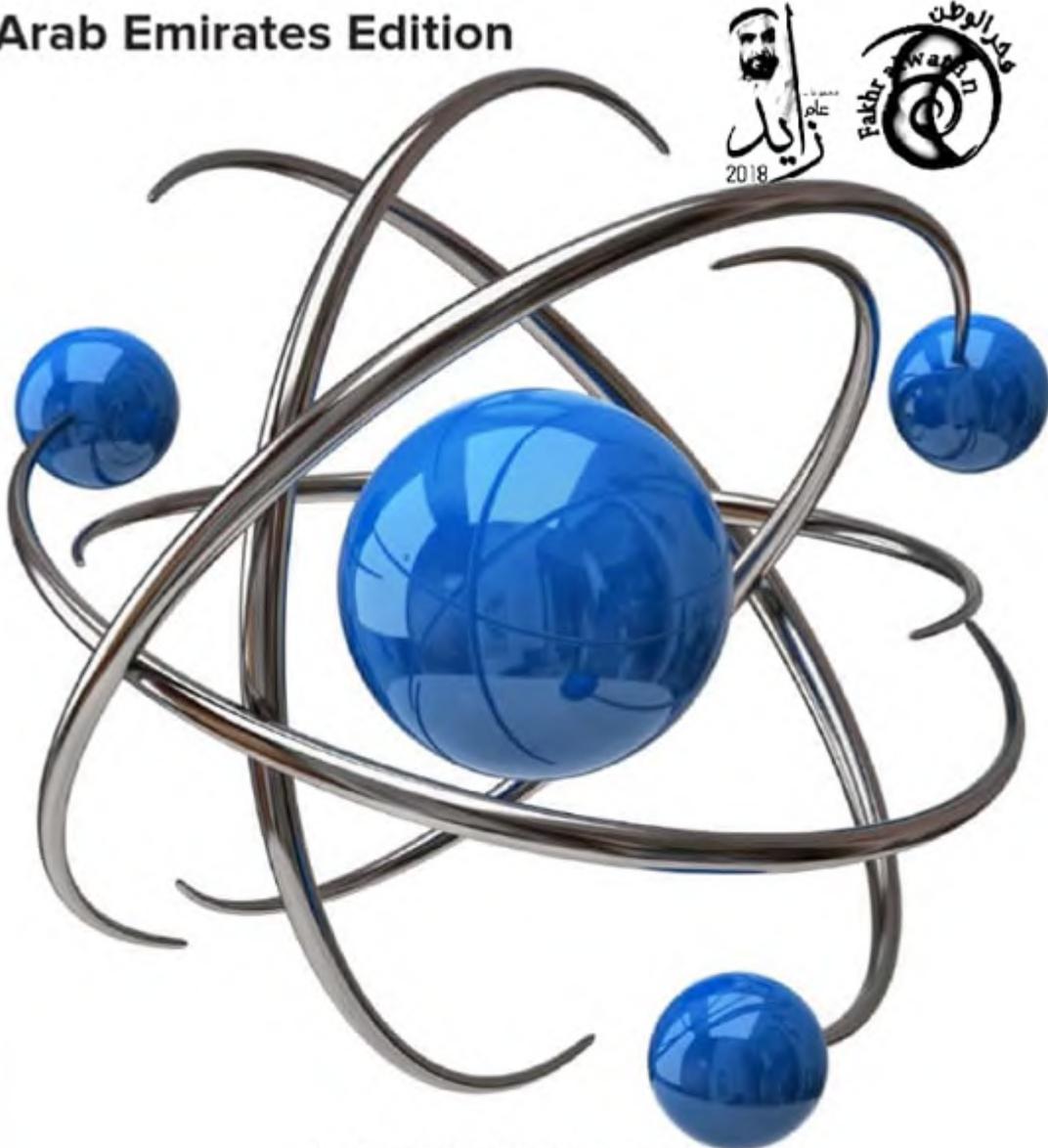
TEACHER EDITION

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McGraw-Hill Education

Advanced Science Program

United Arab Emirates Edition



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GRADE 7 • VOLUME 2



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Chapter 1	Motion, Forces, and Newton's Laws
Chapter 2	Waves
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Chapter 4	Using Energy and Heat
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The Periodic Table



The BIG Idea

How is the periodic table used to classify and provide information about all known elements?



LEARNING GOALS

6.1 Using the Periodic Table

- How are elements arranged on the periodic table?
- What can you learn about elements from the periodic table?



LEARNING GOALS

6.2 Metals

- What elements are metals?
- What are the properties of metals?



LEARNING GOALS

6.3 Nonmetals and metalloids

- Where are nonmetals and metalloids on the periodic table?
- What are the properties of nonmetals and metalloids?



How is it arranged?

Five students were looking at a large poster of the periodic table. They noticed the elements were arranged in rows and columns. They also noticed the elements were arranged in order from L-1R. They had different ideas about the arrangement of the elements on the periodic table. This is what they said.

Ahmed: I think the elements are arranged by increasing mass.

Rashid: I think the elements are arranged according to their properties.

Moana: I think the elements are arranged by when they were discovered.

Khalid: I think the elements are arranged according to how common they are.

Meriam: I don't agree with any of you. I think there must be a different reason for the arrangement.

Which student do you agree with? _____ Explain why you agree with that student.



The Periodic Table



The BIG Idea

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

Guiding Questions

AL How do you arrange your clothes and shoes at home? *Students might respond that they put their shoes in a shoe bag in the closet, fold their jeans and put them in a drawer, and so on. This question initiates students' thinking about the ways they classify and organize items into groups.*

OL How are products arranged and stacked on shelves in a grocery store? *Students might respond that products are arranged in groups, such as fresh produce, cereals, frozen goods, and so on, and are stacked with similar items. This question initiates students' thinking about the ways they classify and organize items into groups.*

BL Books in a library usually are arranged using the Dewey decimal system. Where would you find a dictionary or an encyclopedia? *Dictionaries and encyclopedias are usually found in the reference section of the library.*

Get Ready to Read

What do you think?

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

Anticipation Set for Lesson 1

1. The elements on the periodic table are arranged in rows in the order they were discovered.

Disagree. The elements in the periodic table are arranged in rows according to increasing atomic number and similar properties.

2. The properties of an element are related to the element's location on the periodic table.

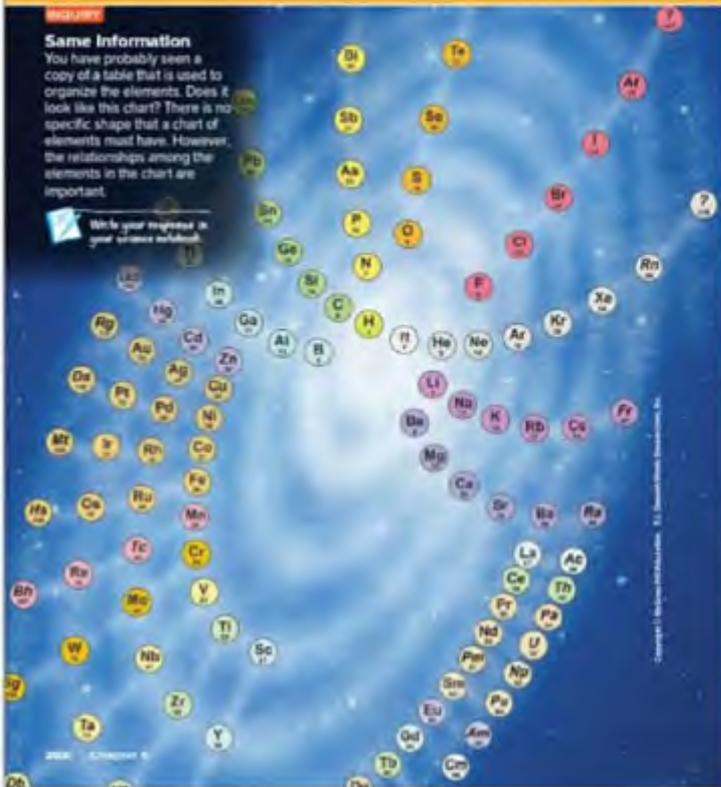
Agree. The elements have been arranged on the periodic table according to their physical and chemical properties. Elements in the same period (row) or group (column) share certain properties. Also, metals are on the left side of the table and most of the middle, nonmetals are on the right side of the table, and metalloids are in between in a stair-step pattern. Therefore, knowing where an element is on the periodic table can help you understand its properties.

6.1 Using the Periodic Table

Same Information

You have probably seen a copy of a table that is used to organize the elements. Does it look like this chart? There is no specific shape that a chart of elements must have. However, the relationships among the elements in the chart are important.

Write your response in your science notebook.



Explore Activity

How can objects be organized?

What would it be like to shop at a grocery store where all the products are mixed up on the shelves? Maybe cereal is next to the dish soap and bread is next to the canned tomatoes. It would take a long time to find the groceries that you needed. How does organizing objects help you to find and use what you need?

1. Read the procedure and identify the safety concerns before work begins.
2. Empty the interlocking plastic bricks from the plastic bag onto your desk and observe their properties. Think about ways you might group and sequence the bricks so that they are organized.
3. Organize the bricks according to your plan.
4. Compare your pattern of organization with those used by several other students.

Think About This

1. Describe in your Science Journal the way you grouped your bricks. Why did you choose that way of grouping?

2. Describe how you sequenced the bricks.

3. **Key Concept** How does organizing things help you to use them more easily?

Essential Questions

- How are elements arranged on the periodic table?
- What can you learn about elements from the periodic table?

Vocabulary

- periodic table
- group
- period

INQUIRY

About the Photo Same Information? Although the image does not resemble a typical periodic table, elements with similar properties are still organized into groups. Examples include the noble gases (group 18), which are strung together in the middle of the image and are all colored light gray.

Guiding Questions

- | | |
|--|---|
| <p>AL How are the symbols in this image the same? How are they different?</p> | <p><i>Similarities include a circular shape and the fact that each symbol includes one or two letters and a number. However, the circles are not all the same color, and no two symbols are the same.</i></p> |
| <p>OL Describe the symbols in this image. How are they arranged?</p> | <p><i>The symbols have a circular shape. Each one has a letter or two plus a number. They seem to be grouped by color. They radiate out from the center from lowest to highest number.</i></p> |
| <p>BL How is color used in this image? What is another way these symbols could be arranged?</p> | <p><i>Color is used to separate the symbols into groups. Answers may vary. Possible answers: similar items could be organized together, assigned the same group name, and so on.</i></p> |

Essential Questions

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

Vocabulary
Classifying Groups

1. Have students name items in the classroom, such as textbooks, pens, paper, and so on. Write a list of all the items they name on chart paper or on the board.
2. Ask students to sort the items into groups. For example, they might group pens, pencils, and markers.
3. Ask students to give a name to each group they create, such as *Writing Tools* for the pens-and-pencils group. Write the name of each group on chart paper or on the board.
4. Discuss with students which properties they considered when they classified each item and decided to which group it belonged. Ask them to consider how scientists might similarly classify substances or materials into groups.

Using the Periodic Table

Use Vocabulary

1. Identify the scientific term used for rows on the periodic table.

2. Name the scientific term used for columns on the periodic table.

Understand Key Concepts

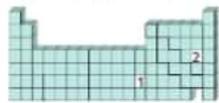
3. The _____ increases by one for each element as you move left to right across a period.

4. What does the decimal number in an element key represent?

- A. atomic mass
- B. atomic number
- C. chemical symbol
- D. state of matter

Interpret Graphics

5. Classify each marked element, 1 and 2, as a metal, a nonmetal, or a metalloid.



6. Identify Copy and fill in the graphic organizer below to identify the color-coded regions of the periodic table.



Critical Thinking

7. Predict Look at the periodic table and predict three elements that have lower melting points than calcium (Ca).

Math Skills

8. Carbon (C) and silicon (Si) are in group 4 of the periodic table. The atomic radius of carbon is 77 pm and sulfur is 103 pm. What is the circumference of each atom?

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My Notes

Use Vocabulary

1. periods
2. groups

Understand Key Concepts

3. atomic number
4. A. atomic mass

Interpret Graphics

5. Element 1, on the left, is a metal. Element 2, on the right, is a nonmetal.
6. In any order: metalloids, nonmetals

Critical Thinking

7. Possible answers: potassium (K), bromine (Br), krypton (Kr)

Math Skills

8. Carbon 484 pm; sulfur 735 pm

6.2 Metals

INQUIRY

Where does it strike? Lightning strikes the top of the Empire State Building approximately 100 times a year. Why does lightning hit the top of this building instead of the city streets or buildings below? Metal lightning rods allow electricity to flow through them more easily than other materials do. Lightning moves through these materials and the building is not harmed.

Write your response in your science notebook.



Explore Activity

What properties make metals useful?

The properties of metals determine their uses. Copper conducts thermal energy, which makes it useful for cookware. Aluminum has low density, so it is used in aircraft bodies. What other properties make metals useful?

Procedure

1. Read the procedure and identify the safety concerns before work begins.
2. With your group, observe the **metal objects** in your **container**. For each object, discuss what properties allow the metal to be used in that way.
3. Observe the **photographs of gold and silver jewelry**. What properties make these two metals useful in jewelry?
4. Examine **other objects around the room** that you think are made of metal. Do they share the same properties as the objects in your container? Do they have other properties that make them useful?

Think About This

1. What properties do all the metals share? What properties are different?

2. **Key Concept** In your Science Journal, list at least four properties of metals that determine their uses.

Essential Questions

- What elements are metals?
- What are the properties of metals?

Vocabulary

- metal
- luster
- ductility
- malleability
- alkali metal
- alkaline earth metal
- transition element

INQUIRY

About the Photo **Where does it strike?** Explain that the Empire State Building was built with a lightning rod at the top. During heavy thunderstorms, this metal rod attracts lightning, protecting the other buildings around it. Because it was designed to withstand lightning's powerful electricity, it is not harmed by lightning strikes.

Guiding Questions

- AL** Looking at this photo, do you think metal conducts electricity? What about air?
Lightning is a form of electricity, and it seems to flow through the metal rod in this photo, suggesting that metal conducts electricity. Air definitely conducts electricity, as evidenced by this photo.
- OL** What physical property of metals is shown in this photo?
Metal conducts electricity.
- BL** Do you think metal might also conduct thermal energy? Why or why not?
Yes, because lightning also carries thermal energy, and it must flow through the metal rod as well. People use metal pots and pans to cook food—more evidence that metal conducts thermal energy.

LAB Manager

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

Essential Questions

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

Vocabulary

Build a Class Definition

1. Bring to class three objects made out of metal, such as a sheet of aluminum foil, an eating utensil, and a piece of jewelry.
2. Hold up each object to allow students to observe it. Ask them to describe each item. Write the terms they use in their descriptions on chart paper or on the board. For example, students might describe the sheet of aluminum foil as shiny or flat.
3. Have students describe how the three objects are the same and how they are different. Then work together to brainstorm a list of possible properties for metals. Ask students to write this list in their Science Journals.
4. After completing the lesson, have students return to the list of possible properties and compare it to what they have learned. Revise the list as needed.

ExploreActivity

What properties make metals useful?

Purpose

To correlate the properties of metals with their uses.

Materials

paper plates or other shallow containers, metal objects (lead fishing sinkers, short lengths of copper wire, pennies, iron washers, iron bolts, spoons, aluminum foil, empty aluminum cans), photographs of gold and silver jewelry from an advertisement or a catalog

Before You Begin

Gather materials. For each group of students, place one of each metal object on a paper plate or in a shallow container.

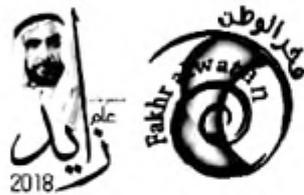
Guide the Investigation

Have students consider metals they use around their homes. Ask students to describe the properties of the metals and what they are used for. Some students may need some guidance in identifying metal in their homes, so be sure to make a list of common metals in your own home prior to the lesson.

Think About This

1. Answers will vary. Metals are generally shiny and solid; most are hard but are malleable or ductile. Some differences may include color, conductivity, density, and malleability/ductility.
2. Answers may include color, luster, ductility, malleability, density, or conductivity.

Teacher Notes



6.3 Nonmetals and Metalloids

INQUIRY

Why don't they melt?

What do you expect to happen to something when a flame is placed against it? As you can see, the nonmetal material the flower sits on protects the flower from the flame. Some materials conduct thermal energy. Other materials, such as this one, do not.

Write your response in your science notebook.



Explore Activity

What are some properties of nonmetals

You now know what the properties of metals are. What properties do nonmetals have?

Procedure

1. Read the procedure and identify the safety concerns before work begins.
2. Examine pieces of **copper**, **carbon**, **aluminum**, and **sulfur**. Describe the appearance of these elements in your Science Journal.
3. Use a **conductivity tester** to check how well these elements conduct electricity. Record your observations.
4. Wrap each element sample in a **paper towel**. Carefully hit the sample with a **hammer**. Unwrap the towel and observe the sample. Record your observations.

Think About This

1. Locate these elements on the periodic table. From their locations, which elements are metals? Which elements are nonmetals?

2. **Key Concept** Using your results, compare the properties of metals and nonmetals.

3. **Key Concept** What property of a nonmetal makes it useful to insulate electrical wires?

Essential Questions

- Where are nonmetals and metalloids on the periodic table?
- What are the properties of nonmetals and metalloids?

Vocabulary

nonmetal
halogen
noble gas
metalloid
semiconductor

INQUIRY

About the Photo **Why don't they melt?** The material in this photo is an aerogel. Aerogels can be made using a number of different elements. The kind shown here is made from the nonmetallic compound silicon dioxide and looks similar to ordinary glass. However, it is much less dense and feels light to the touch. This type of aerogel is an excellent insulator and blocks thermal energy. NASA uses similar aerogels to insulate spacecraft and spacesuits.

Guiding Questions

- | | |
|--|--|
| <p>AL Do you think the material in this photo is made of metal? Why or why not?</p> | <p><i>No; metals conduct thermal energy and this material does not.</i></p> |
| <p>OL What physical property of a nonmetal is shown in this photo?</p> | <p><i>This photo shows a nonmetal that does not conduct thermal energy.</i></p> |
| <p>BL If matches rested on this plate instead of the flower, would they burn? Why or why not?</p> | <p><i>No; this material blocks thermal energy so the matches would not ignite.</i></p> |

LAB Manager

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

Essential Questions

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

Vocabulary

What are nonmetals like?

1. Bring two samples of solids that are nonmetals, such as charcoal (carbon) and sulfur, both of which can be obtained at a garden store, to class. You may also use solid iodine, if available.
2. Hold up the samples so that students can observe them. Ask them to describe each item. Write the terms they use in their descriptions on chart paper or on the board. For example, students might describe the charcoal as dull or brittle.
3. Have students describe how the objects are the same and how they are different. Then work together to brainstorm a

possible list of properties for nonmetals. Ask students to write this list in their Science Journals.

4. After completing the lesson, have students return to the list of possible properties and compare it to what they have learned. Revise the list as needed.

ExploreActivity

What are some properties of nonmetals?

Purpose

To compare properties of nonmetals to metals.

Materials

samples of copper, aluminum, carbon, and sulfur; a conductivity tester (D-cell battery, D-cell battery holder, three insulated wires, flashlight bulb, lightbulb holder); paper towel; hammer

Before You Begin

Have students review the information on metals, metalloids, and nonmetals from the end of **Lesson 1**.

Assemble the conductivity testers by connecting two wires to the lightbulb leads. Connect the opposite end of one of these wires to one end of a D-cell battery holder. Attach a third wire to the opposite end of the battery holder. Make sure the wires are firmly attached to all the leads.

To minimize the number of conductivity testers and hammers needed, half the class can test for conductivity while the other half tests the malleability of the samples. Before class begins, insert a D-cell battery into the battery holder of the constructed conductivity testers.

Guide the Investigation

- Be sure students are not only describing the properties of each sample in their Science Journals but are also comparing and contrasting the metals (copper and aluminum) and nonmetals (carbon and sulfur).
- When students use the conductivity testers, instruct them to touch only the sample with the two free copper wires. Caution students to be careful with this tester because the two freely exposed wires will pass a current between anything they come into contact with, including skin, which will burn.
- Instruct students to wrap the samples well for the malleability test. They will not need to hit the samples hard with the hammer but with enough force to break open a walnut, for instance.

Think About This

1. Copper and aluminum are metals. Carbon and sulfur are nonmetals.
2. Metals are conductive, malleable, and have a metallic luster. Nonmetals have none of these properties.
3. Nonmetals are good insulators because they are not conductive.

Teacher Notes

6.3 Review

Nonmetals and Metalloids

Visualize It!



A nonmetal is an element that has no metallic properties. Solid nonmetals are dull, brittle, and do not conduct thermal energy or electricity.



Halogens and noble gases are nonmetals. These elements are found in groups 17 and group 18 of the periodic table.



Metalloids have some metallic properties and some nonmetallic properties. The most important use of metalloids is as semiconductors.

Summarize It!

1. Where are nonmetals and metalloids on the periodic table?



Use Vocabulary

1. **Distinguish** between a nonmetal and a metalloid.

2. An element in group 17 of the periodic table is called a(n) _____.

3. An element in group 18 of the periodic table is called a(n) _____.

Understand Key Concepts

4. The ability of a halogen to react with a metal to form a salt is an example of a _____ property.
 - A. chemical
 - B. noble gas
 - C. periodic
 - D. physical
5. **Classify** each of the following elements as a metal, a nonmetal, or a metalloid: boron, carbon, aluminum, and silicon.

6. **Infer** which group you would expect to contain element 117. Use the periodic table to help you answer this question.

Interpret Graphics

7. **Sequence** nonmetals, metals, and metalloids in order from left to right across the periodic table by copying and completing the graphic organizer below.



Critical Thinking

8. **Hypothesize** how your classroom would be different if there were no metalloids.

9. **Analyze** why hydrogen is sometimes classified as a metal.

10. **Determine** whether there would be more nonmetals in group 14 or in group 16. Explain your answer.

Visual Summary

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

Summarize It!

- How are nonmetals different from metals?
- Group 17: The Halogens
- Metalloids

Use Vocabulary

1. Answers may vary. Nonmetals have no metallic properties, and metalloids have some properties of metals and some of nonmetals.
2. halogen
3. noble gas

Understand Key Concepts

4. A. chemical
5. Boron and silicon are metalloids, aluminum is a metal, and carbon is a nonmetal.
6. Group 17

Interpret Graphics

7. metals, metalloids, nonmetals

Critical Thinking

8. Possible answer: Any electronics, such as computers, would not be present because there would be no semiconductors.
9. Hydrogen is a gas at room temperature, which indicates that it is a nonmetal. However, it acts chemically as an alkali metal, and as a liquid, hydrogen conducts electrical energy.
10. Group 14 has one nonmetal (carbon), and group 16 has three nonmetals (oxygen, sulfur, and selenium).

The BIG Idea
 Elements are organized on the periodic table according to increasing atomic number and similar properties.

Key Concepts Summary	Vocabulary
<p>6.1 Using the Periodic Table</p> <ul style="list-style-type: none"> Elements are organized on the periodic table by increasing atomic number and similar properties. Elements in the same group or column of the periodic table have similar properties. Elements are arranged into an atomic period, which is a row of the periodic table. Each element key on the periodic table provides the name, symbol, atomic number, and atomic mass for an element. 	<p>periodic table group period</p>
<p>6.2 Metals</p> <ul style="list-style-type: none"> Metals are located on the left and middle side of the periodic table. Metals are elements that have ductility, malleability, luster, and conductivity. The alkali metals are in group 1 of the periodic table, and the alkaline earth metals are in group 2. Transition elements are metals in groups 3–10 of the periodic table, as well as the lanthanide and actinide series. 	<p>metal luster ductility malleability alkali metal alkaline earth metal transition element</p>
<p>6.3 Nonmetals and Metalloids</p> <ul style="list-style-type: none"> Nonmetals are on the right side of the periodic table, and metalloids are located between metals and nonmetals. Nonmetals are elements that have no metallic properties. Solid nonmetals are dull, nonconductive, brittle, and do not conduct electricity. Metalloids are elements that have properties of both metals and nonmetals. Some metalloids are semiconductors. Elements in group 17 are called halogens, and elements in group 18 are noble gases. 	<p>nonmetal halogen noble gas metalloid semiconductor</p>

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

- Use Vocabulary**
- This element magnesium (Mg) is _____ of the periodic table.
 - An element that is shiny, is easily pulled into wires, or hammered into thin sheets, and is a good conductor of electricity and heat is a(n) _____.
 - Group 17 is _____ to make one because it has the property of _____.
 - All elements that are unreactive and have a closed outer shell are _____.
 - An element that is a poor conductor of heat and electricity but is a good insulator is a(n) _____.

Link Vocabulary and Key Concepts



Key Concepts Summary

Study Strategy: Write a Quiz
 Students are often nervous about assessments because they aren't sure what will be on the test. When students write possible test questions from Key Concepts they have explored, it takes some of the mystery out of the assessment and allows them to focus on studying the concepts they have learned.

1. Divide students into groups of four.
2. Have each student develop a ten-question quiz from information in the Key Concepts summary. Encourage students to include a variety of question types including true-false, matching, fill-in-the-blank, multiple choice, and short answer.
3. Have each student exchange papers with another member of the group, who will complete the quiz.
4. Instruct students to exchange papers with another member of the group, who will grade the quiz and give it back to the person who took the quiz.
5. Encourage groups to discuss how writing questions helped them complete a quiz.

Class Activity: I Have... Who Has...?

This activity provides a fun way to engage the entire class while reviewing Key Vocabulary. Divide index cards into left and right halves. Write "START HERE" on the top of the first card only. On the left side write, "I have" and a vocabulary term. On the right side write, "Who has" and a definition for a different vocabulary term. On the next index card write "I have" and write the vocabulary term that matches the definition on the right side of the previous card. Repeat this process until all the vocabulary terms are used. The definition on the last card should define the term on the first card.

1. Distribute the index cards to the students in random order. If you have more cards than students, give some students extra cards.
2. The student with the "START HERE" card begins the game by reading the "I have" statement and asking the "Who has" question.
3. Students need to listen for the question to which their card has the answer. The student who has the answer to the question reads their card.
4. If someone gives a wrong answer, discuss why the answer is incorrect and help students find the card with the correct answer.
5. Continue playing until all the cards have been read and the last question ends with the answer on the first card.

CHAPTER 6 Review

Understand Key Concepts

- What determines the order of elements on today's periodic table?
 - increasing atomic mass
 - decreasing atomic mass
 - increasing atomic number
 - decreasing atomic number
- The element key for nitrogen is shown below.



From this key, determine the atomic mass of nitrogen.

- 7
 - 7.01
 - 14.01
 - 21.01
- Look at the periodic table in Lesson 1. Which of the following lists of elements forms a group on the periodic table?
 - Li, Be, B, C, N, O, F, and Ne
 - He, Ne, Ar, Kr, Xe, and Rn
 - B, Si, As, Te, and At
 - Sc, Ti, V, Cr, Mn, Fe, Co, Cu, Ni, and Zn
 - Which is NOT a property of metals?
 - brittleness
 - conductivity
 - ductility
 - luster
 - What are two properties that make a metal a good choice to use as wire in electronics?
 - conductivity, malleability
 - ductility, conductivity
 - luster, malleability
 - malleability, high density

- Where are most metals on the periodic table?
 - on the left side only
 - on the right side only
 - in the middle only
 - on the left side and in the middle

- Look at the periodic table in Lesson 1 and determine which element is a metalloid.
 - carbon
 - silicon
 - oxygen
 - aluminum

- Iodine is a solid nonmetal. What is one property of iodine?
 - conductivity
 - dull appearance
 - malleability
 - ductility

- The following table lists some information about certain elements in group 12.

Element Symbol	Atomic Number	Melting Point	Boiling Point (°C)
Zn	30	419.5	907
Cd	48	-30.9	321
Hg	80	-38.9	357
Cu	29	1083	2567

Which statement describes what happens to these elements as atomic number increases?

- Both melting point and boiling point decrease.
- Melting point increases and boiling point decreases.
- Melting point decreases and boiling point increases.
- Both melting point and boiling point increase.

Chapter Review

Critical Thinking

- Recommend** an element to use to fill bottles that contain ancient papers. The element should be a gas at room temperature, should be denser than helium, and should not easily react with other elements.

Write a Sentence

- Write a plan that shows how a metal, a nonmetal, and a metalloid could be used when constructing a building.

The BIG Idea

- Apply** Why is mercury the only metal to have been used in thermometers?
- Evaluate** the following types of metals as a choice to make a Sun reflector: alkali metals, alkaline earth metals, or transition metals. The metal cannot react with water or oxygen and must be shiny and strong.
- The figure below shows a pattern of densities.



Infer whether you are looking at a graph of elements within a group or across a period. Explain your answer.

- Contrast** aluminum and nitrogen. Show why aluminum is a metal and nitrogen is not.

- Classify** A student sorted six elements. He placed iron, silver, and sodium in group A. He placed neon, oxygen, and nitrogen in group B. Name one other element that fits in group A and another element that belongs in group B. Explain your answer.

Math Skills

Use Geometry

- The table below shows the atomic radii of three elements in group 1 on the periodic table:

Element	Atomic radius
Li	152 pm
Na	186 pm
K	227 pm

- What is the circumference of each atom?
- Rubidium (Rb) is the next element in Group 1. What would you predict about the radius and circumference of a rubidium atom?

Understand Key Concepts

- C. increasing atomic number
- C. 14.01
- B. He, Ne, Ar, Kr, Xe, and Rn
- A. brittleness
- B. ductility, conductivity
- D. on the left side and in the middle
- B. silicon
- B. dull appearance
- D. Both melting point and boiling point increase.



Critical Thinking

- Answers might include neon or argon.
- Mercury is the only metal that is a liquid at room temperature.
- All the metals reflect light, but only transition elements are strong and relatively unreactive.
- The pattern is of elements in a period (density increases and then decreases from left to right across a period). Elements in a group would have similar densities.
- Aluminum has metallic properties, such as malleability, luster, and ductility. Nitrogen has none of these properties and is a gas at room temperature.
- Answers may vary. Any other metal could be in group A, and any other nonmetal could be in group B.

Writing in Science

- 16 Possible answer: Metals could be used for the structure of the building. Metalloids could be used in any electronics present. Noble gases could be used in signs.



The BIG Idea

- 17 It would be found in group 15. It is placed between the elements with atomic numbers of 114 and 116, and it would have properties similar to those of other elements in that group.
- 18 Elements in the same group have similar chemical and physical properties. Elements with properties similar to those of helium will be in group 18.

Math Skills

Use Geometry

19. a. Li, 955 pm; Na, 1,168 pm; K, 1,426 pm
- b. Because the radii increased going down the group shown in the table, the radius and circumference of rubidium probably increases.

Intervention Planner

Based on the results of the Chapter Review, use the chart below to address individual needs.

Lesson	Questions	Intervention Options
Understand Key Concepts		
1	1–3, 9	Key Concept Builders Content Practice
2	4–6	
3	7–8	
Critical Thinking		
1	10, 13	Enrichment Challenge
2	11–12	
3	14–15	
Writing in Science		
3	16	Language Arts Enrichment
Review the Big Idea		
1	17	Content Practice Enrichment Challenge
3	18	
Math Skills		
1	19	Math Skills Math Practice: Use Geometry

Standardized Test Practice

Standardized Test Practice

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

Multiple Choice

- 1 Where are most nonmetals located on the periodic table?
A in the bottom row
B on the left side and in the middle
C on the right side
D in the top row

Use the figure below to answer question 2.



- 2 What is the atomic mass of calcium?
A 20
B 40.08
C 40.08 + 20
D 40.08 + 20
- 3 Which element is most likely to react with potassium?
A bromine
B calcium
C nickel
D sodium
- 4 Which group of elements can act as semiconductors?
A halogens
B metalloids
C metals
D noble gases

Use the table below about group 13 elements to answer question 5.

Element Symbol	Atomic Number	Density (g/cm ³)	Atomic Mass
B	5	2.34	10.81
Al	13	2.70	26.98
Ga	31	5.90	69.72
In	49	7.30	114.82

- 5 How do density and atomic mass change as atomic number increases?
A Density and atomic mass decrease.
B Density and atomic mass increase.
C Density decreases and atomic mass increases.
D Density increases and atomic mass decreases.
- 6 Which elements have high densities, strength, and resistance to corrosion?
A alkali metals
B alkaline earth metals
C metalloids
D transition elements
- 7 Which is a property of a metal?
A It is brittle.
B It is a good insulator.
C It has a dull appearance.
D It is malleable.

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Use the figure below to answer questions 8 and 9.

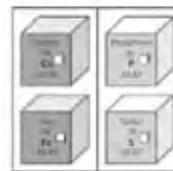


- 8 The figure shows a group in the periodic table. What is the name of this group of elements?
A halogens
B metalloids
C metals
D noble gases
- 9 Which is a property of these elements?
A They are conductors.
B They are semiconductors.
C They are nonreactive with other elements.
D They react easily with other elements.
- 10 What is one similarity among elements in a group?
A atomic mass
B atomic weight
C chemical properties
D practical uses

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Constructed Response

Use the figure below to answer questions 11 and 12.



- 11 Groups A and B each contain two elements. Identify each group as metals, nonmetals, or metalloids. Would silicon belong to one of these groups? Why or why not?

- 12 Which group in the figure above yields the strongest building elements? Why?

- 13 How does the periodic table of elements help scientists today?

- 14 What connection does the human body have with the elements on the periodic table?

Need Extra Help?

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

Multiple Choice

- 1 **C—Correct.** A, B, D—Most nonmetals, with the exception of hydrogen (element 1) are found on the right side of the periodic table. Metals are listed on the left and in the middle of the table, with metalloids located between metals and nonmetals.
- 2 **B—Correct.** A, C, D—The figure shows the element key for calcium. In an element key, the atomic mass is stated directly beneath the element symbol. The atomic mass of calcium is 40.08.
- 3 **A—Correct.** B, C, D—Potassium is a metal and can react with nonmetals such as halogens like bromine, to form salts. The word halogen is a combination of Greek words meaning “salt” and “to produce.”
- 4 **B—Correct.** A, C, D—Semiconductors conduct electricity but not as well as metals do. Metalloids conduct electricity well at high temperatures, acting more like metals. At low temperatures, however, metalloids act like nonmetals and stop electricity from flowing. This property makes metalloids useful in electronic devices.

- 5 **B—Correct.** A, C, D—In the table, atomic number increases down the column of elements—from 5 to 49. Likewise, density and atomic mass increase (density from 2.34 g/cm³ to 7.30g/cm³, atomic mass from 10.81 to 114.82) down a column. Throughout the periodic table, both density and atomic mass increase as you read down a group.
- 6 **D—Correct.** A, B, C—The transition elements are metals with higher melting points, greater strength, and higher densities than both alkali metals and alkaline earth metals. Transition elements also react less quickly with oxygen, so they are more resistant to corrosion. Transition elements are found in groups 3–12.
- 7 **D—Correct.** A, B, C—Metals are malleable; that is, they have the ability to be hammered or rolled into sheets. They are ductile and can be pulled into thin wires. In addition, metals have a shiny appearance and are good conductors of heat and electricity.
- 8 **A—Correct.** B, C, D—The figure shows group 17 of the periodic table, the halogens.

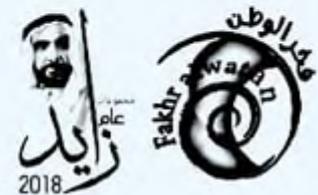
- 9 D—Correct.** A, B, C—Halogens react easily with other elements. They react with metals to form salts; they even form compounds with other nonmetals such as carbon. Because halogens react so easily with other elements, they are found only in compounds in nature.
- 10 C—Correct.** A, B, D—In the periodic table of elements, groups are arranged in columns. All elements in a group share similar chemical properties and react with other elements in a similar way. In addition, there are patterns in a group’s physical properties, such as melting point, boiling point, and density.

Constructed Response

- 11** Group A contains metals. Group B contains nonmetals. Silicon belongs in neither group because silicon is a metalloid. Metalloids do not have the same properties as metals or nonmetals.
- 12** Group A is the best choice. It contains transition elements, which are strong metals. Group B contains nonmetals, which are brittle.
- 13** Answers will vary. Possible response: The periodic table of elements lists unique characteristics of chemical elements. It contains elements that share similar chemical properties in columns called groups. Patterns also exist in the physical properties of groups such as density, melting point, and boiling point. Scientists rely on the periodic table to predict the properties of synthetic elements they create in laboratories.
- 14** Answers will vary. Possible response: Just four elements—oxygen, carbon, nitrogen, and hydrogen—compose 96 percent of the human body. These elements are grouped with other nonmetals in the periodic table. Of the remaining elements in the human body, the most common are also nonmetals—phosphorus and sulfur. Together, these elements form compounds that can be found in fats, proteins, nucleic acids, and other large molecules in the human body and all living organisms.

Answer Key

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



From a Cell to an Organism



The BIG Idea

How can one cell become a multicellular organism?



LESSON

7.1 The Cell Cycle and Cell Division

- What are the phases of the cell cycle?
- Why is the result of the cell cycle important?



LESSON

7.2 Levels of Organization

- How do unicellular and multicellular organisms differ?
- How does cell differentiation lead to the organization within a multicellular organism?

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Getting Bigger

A small baby snake grows into a larger adult snake. Choose the explanation that best describes why a small baby snake grows into a larger adult snake.

- ___ A. The baby snake's cells divide.
- ___ B. The baby snake's cells grow into longer cells.
- ___ C. The baby snake's cells grow into much larger cells.
- ___ D. The baby snake's body parts stretch out and get longer.
- ___ E. The food the baby snake eats makes it grow big and strong.
- ___ F. The baby snake's cells differentiate into different types of cells.

Explain your thinking. Describe your ideas about growth.

Chapter 7 From a Cell to an Organism 241

How can one cell become a multicellular organism?



The BIG Idea

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

Guiding Questions

- | | |
|---|--|
| <p>AL What is a multicellular organism?</p> | <p><i>Use this question to assess student understanding of unicellular and multicellular. Students should recognize that multicellular organisms have several and varied types of cells.</i></p> |
| <p>QL What is the relationship between cell division and growth?</p> | <p><i>Use this question to initiate a general discussion on cell division. Cell division is necessary for organisms to grow.</i></p> |
| <p>BL What is cell differentiation?</p> | <p><i>This question will help students consider the differentiation of cells. Cells in a multicellular organism are specialized in structure and function.</i></p> |

The Cell Cycle and Cell Division

INQUIRY

Time to Split? Unicellular organisms such as these reproduce when one cell divides into two new cells. The two cells are identical to each other. What do you think happened to the contents of the original cell before it divided?

Write your response in your notebook.



Explore Activity

Why isn't your cell like mine?

All living things are made of cells. Some are made of only one cell, while others are made of billions of cells. Where do all those cells come from?

Procedure

1. Read and complete a lab safety form.
2. Ask your team members to face away from you. Draw an animal cell on a sheet of paper. Include as many organelles as you can.
3. Use scissors to cut the cell drawing into equal halves. Fold each sheet of paper in half so the drawing cannot be seen.
4. Ask your team members to face you. Give each team member half of the cell drawing.
5. Have team members sit facing away from each other. Each person should use glue sticks to attach the cell half to one side of a sheet of paper. Then, each person should draw the missing cell half.
6. Compare the two new cells to your original cell.

Think About This

1. How do the new cells compare to the original cell?

2. What are some things that might be done in the early steps to produce two new cells that are more like the original cell?

Essential Questions

- What are the phases of the cell cycle?
- Why is the result of the cell cycle important?

Vocabulary

cell cycle
interphase
sister chromatid
centrioles
mitosis
cytokinesis
daughter cell

INQUIRY

About the Photo Time to Split? Paramecia, such as this dividing cell of the species *Paramecium caudatum*, are common in freshwater environments where they feed on bacteria. The hairy appearance of the dividing cell is due to tiny cilia that cover its surface. The cilia are used for locomotion and gathering food. Unicellular organisms such as these paramecia reproduce when one cell divides into two new cells. Mitosis and cytokinesis of the parent cell produce two identical daughter cells.

Guiding Questions

- AL** What do you think happened to the contents of the original cell before it divided? *Use this question to initiate a discussion about the fact that the genetic material must also replicate so there is one copy for each new cell after cell division.*
- QL** What might happen if cytokinesis did not occur after mitosis? *The cells would remain fused together and the new double cell would have duplicates of all parts.*
- BL** Do you think these cells are at the beginning or end of cell division? Explain your answer. *Answers will vary. Some students may think these cells are mating. Students will learn the step-by-step process of cellular replication, from mitosis to cytokinesis. The cells are at the end of cell division.*

Essential Questions

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

Vocabulary

Breaking Up Vocabulary Terms

1. Write the word *cytokinesis* on chart paper or on the board.
2. **Ask: What action does this term describe?** Tell students they can determine the meaning of a scientific term by breaking up the term into parts. First, cover the *kinesis* portion of the word so that only *cyto* is showing. Ask students if they can think of other words with *cyto* in them. Students may offer such terms as *cytoplasm* or *cytoskeleton*. Then remind students that the term is a prefix that means "cell." Then, cover up *cyto* so that only *kinesis* is showing. Ask students if they know any other words that are similar to *kinesis*. Students may offer such terms as *kinetic*, *telekinesis*, or *psychokinesis*. Explain that *kinesis* means "movement."
3. Without giving the precise definition of the term *cytokinesis*, ask students to guess and then write down a definition for the term.

Reproduction

In some unicellular organisms, cell division is a form of reproduction. For example, an organism called a paramecium often reproduces by dividing into two new daughter cells or two new paramecia. Cell division is also important in other methods of reproduction in which the offspring are identical to the parent organism.

Growth

Cell division allows multicellular organisms, such as humans, to grow and develop from one cell (a fertilized egg). In humans, cell division begins about 24 hours after fertilization and continues rapidly during the first few years of life. It is likely that during the next few years you will go through another period of rapid growth and development. This happens because cells divide and increase in number as you grow and develop.

Replacement

Even after an organism is fully grown, cell division continues. It replaces cells that wear out or are damaged. The outermost layer of your skin is always rubbing or flaking off. A layer of cells below the skin's surface is constantly dividing. This produces millions of new cells daily to replace the ones that are rubbed off.

Repair

Cell division is also critical for repairing damage. When a bone breaks, cell division produces new bone cells that patch the broken pieces back together.

Not all damage can be repaired, however, because not all cells continue to divide. Recall that mature nerve cells stop the cell cycle in interphase. For this reason, injuries to nerve cells often cause permanent damage.

Key Concept Check

7. Why is the result of the cell cycle important?

Describe

List the main ideas from this section in the box below.

7.1 Review**Visualize It!**

During interphase, most cells go through periods of rapid growth and replication of organelles, copying DNA, and preparation for cell division.



The nucleus and its contents divide during mitosis.



The cytoplasm and its contents divide during cytokinesis.

Summarize It!

1. What are the phases of the cell cycle?

2. Why is the result of the cell cycle important?

Reproduction, Growth, Replacement, and Repair

Students can revisit the important functions of cell reproduction by Concepts and terms are easier to remember when they are associated with an image. **Ask:** Which Key Concept does each image relate to?

Guiding Questions

AL Why is cell division important for repairing the body?

Cells or tissues that are injured need to be replaced. Cell division produces new cells that repair some kinds of damage to the body.

OL Why is the result of the cell cycle important?

The cell cycle is important for growth in multicellular organisms, reproduction in some organisms, replacement of worn-out cells, and repair of damaged cells.

BL Certain cells, such as nerve cells, remain in interphase after maturing, so what would happen to these cells if they were injured?

They would not be replaced by daughter cells because they are not replicating. The tissue to which the cells belong may become permanently damaged.

Visual Summary

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

Summarize It!

The Cell Cycle and Cell Division

Use Vocabulary

1. **Distinguish** between mitosis and cytokinesis.
2. A duplicated chromosome is made of two _____.
3. **Use the term** *interphase* in a sentence.

Understand Key Concepts

4. Which is NOT part of mitosis?
 - A. anaphase
 - B. interphase
 - C. prophase
 - D. telophase
5. **Construct** a table to show the different phases of mitosis and what happens during each.
6. **Give three examples** of why the result of the cell cycle is important.

Interpret Graphics

7. **Identify** The animal cell on the right is in what phase of mitosis? Explain your answer.



8. **Organize** Copy and fill in the graphic organizer below to show the results of cell division.



Critical Thinking

9. **Predict** what might happen to a cell if it were unable to divide by mitosis.

Math Skills

10. The mitotic phase of the human cell cycle takes approximately 1 hour. What percentage of the 24-hour cell cycle is the mitotic phase?

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My Notes



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Use Vocabulary

1. During mitosis, the nucleus and its contents divide, and during cytokinesis, the cytoplasm and its contents divide. **DOK 2**
2. sister chromatids **DOK 1**
3. Answers will vary. Possible answer: Interphase is the first phase of the cell cycle and a period of cellular growth and development. **DOK 1**

Understand Key Concepts

4. B. interphase **DOK 1**
- 5.

Phase	What Happens
Prophase	Replicated chromatin coils together and form double-stranded mitotic chromosomes. The nucleolus breaks down, and the nuclear membrane disappears. Spindle fibers form in the cytoplasm.
Metaphase	Spindle fibers move the mitotic chromosomes to the middle of the cell.
Anaphase	Sister chromatids are separated and pulled apart. The cell lengthens.

Telophase

Spindle fibers disappear, and chromosomes uncoil. A nuclear membrane forms around each set of chromosomes, and two new nuclei form.

DOK 3

6. Answers should include three of the following; reproduction, growth, replacement of worn-out or damaged cells, repair. **DOK 3**

Interpret Graphics

7. The cell is in prophase. The DNA is in chromosomes, the nuclear membrane is breaking down, and spindle fibers are forming. **DOK 2**
8. Center oval: Results of cell division. Surrounding ovals: reproduction, growth, cell repair, cell replacement. **DOK 1**

Critical Thinking

9. Answers will vary. Possible answer: The cell would eventually die because it would get too big. The cell would get old and die. There would be no new cells, so repair, growth, cell replacement, and reproduction would cease. **DOK 3**

Math Skills

10. 4.16% **DOK 1**

INQUIRY

Scales on Wings? This butterfly has a distinctive pattern of colors on its wings. The pattern is formed by clusters of tiny scales. In a similar way, multicellular organisms are made of many small parts working together.

Write your response in your notebook.



Explore Activity

How is a system organized?

The places people live are organized in a system. Do you live in or near a city? Cities contain things such as schools and stores that enable them to function on their own. Many cities together make up another level of organization.

Procedure

1. Read and complete a lab safety form.
2. Using a **metric ruler** and **scissors**, measure and cut squares of **construction paper** that are 4 cm, 8 cm, 12 cm, 16 cm, and 20 cm on each side. Use a different color for each square.
3. Stack the squares from largest to smallest, and glue them together.
4. Cut apart the City, Continent, Country, County, and State labels your teacher gives you.
5. Use a **glue stick** to attach the City label to the smallest square. Sort the remaining labels from smallest to largest, and glue to the corresponding square.

Think About This

1. What is the largest level of organization a city belongs to?

2. Can any part of the system function without the others? Explain.

3. How do you think the system used to organize where people live is similar to how your body is organized?

Essential Questions

- How do unicellular and multicellular organisms differ?
- How does cell differentiation lead to the organization within a multicellular organism?

Vocabulary

cell differentiation
stem cell
tissue
organ
organ system

INQUIRY

About the Photo Scales on Wings? Millions of color dots in this photo combine and form a pattern on the butterfly's wing in the same way numerous pixels of color in a digital image combine to form the image. Similarly, organisms are made of multiple small parts working together that form the whole.

Guiding Questions

- AL** What different structures do you see on this butterfly? What do you think these structures are used for?
wings for flying, antennae for feeling, eyes for seeing
- QL** What part(s) of the human body perform a function similar to that of the antenna?
Answers will vary. Nerves in our skin serve a similar purpose.
- BL** How could all the specialized structures visible on this butterfly have developed from just one sperm cell and one egg cell?
DNA in the sperm and egg contained instructions for all these structures, and as the butterfly developed, its cells became specialized for the functions each structure performs.

Essential Questions

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

Vocabulary

Build a Class Definition

1. Write the word *differentiation* on the board.
2. **Ask:** What familiar words do you see in the word *differentiation*? *differ, different* Have students explain what those words mean, and then ask them to predict what the word *differentiation* means.
3. Build a class definition for *differentiation*. Have students record the accepted definition in their Science Journals.

Explore Activity

How is a system organized?

Prep: 5 min Class: 15 min

Purpose

To model levels of organization within a system.

Materials

Teacher: metric rulers, scissors, 5 different colors of construction paper, glue sticks, paper strips with the words *City, Continent, Country, State, and County*.

Optional: Paper strips can use other tiered organizations, such as *student, class, grade, school, school district*.

Before You Begin

Prepare the paper strips in advance. If rulers have both metric and standard units on them, make students aware of this fact.

Guide the Investigation

- This activity can be completed by students individually or in pairs.
- ⚠️ Remind students about necessary precautions when using sharp objects.

Think About This

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

1. a continent
2. As the smallest unit, a city might be able to function without the other parts. Each of the other parts is made up of the level of organization below it, so the parts would not be able to function without other parts.
3. **Key Concept** The systems are similar in that they both show the levels of organization that make up a system—one a continent, the other a body.

Teacher Note



LESSON 7.2 Review

Levels of Organization

Visualize It!



A unicellular organism carries out all the activities necessary for survival within one cell.



Cells become specialized in structure and function (called cell differentiation).



Organs are groups of different tissues that work together to perform a job.

Summarize It!

1. Unicellular organisms do not have all the characteristics of life.
2. All the cells in a multicellular organism are the same.
3. Some organs work together as part of an organ system.

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Use Vocabulary

1. Define *cell differentiation* in your own words.
2. Distinguish between an organ and an organ system.

Understand Key Concepts

3. Explain the difference between a unicellular organism and a multicellular organism.
4. Describe how cell differentiation produces different types of cells in animals.
5. Which is the correct sequence of the levels of organization?
 - A. cell, organ, tissue, organ system, organism
 - B. organism, organ, organ system, tissue, cell
 - C. cell, tissue, organ, organ system, organism
 - D. tissue, organ, organism, organ system, cell

Interpret Graphics

6. Organize Copy and fill in the table below to summarize the characteristics of unicellular and multicellular organisms.

Critical Thinking

Organism Characteristics	
Unicellular	Multicellular

7. Predict A mistake occurs during mitosis of a muscle stem cell. How might this affect muscle tissue?
8. Compare the functions of a cell to the functions of an organism, such as getting rid of wastes.

Visual Literacy: Figure 15

Use the diagram of each organ system in **Figure 15** to review the key structures and function of each of the systems shown.



Ask: What are some of the organs that are part of the digestive system? *stomach, esophagus, small intestine, large intestine, liver; Repeat this question for each system.*

Ask: What is the function of the digestive system? *To break down and release nutrients and energy in food. Repeat this question for each organ system.*

Visual Summary

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

Use Vocabulary

1. Answers will vary. Possible answer: Cell differentiation is the specialization of cells that perform specific functions. **DOK 1**
2. An organ is made up of tissues working together to perform a specific task while an organ system is made up of two or more organs working together to perform a series of tasks. **DOK 2**

Understand Key Concepts

3. Unicellular organisms are composed of one cell, while multicellular organisms are composed of many cells. **DOK 1**
4. In animal cell differentiation, a stem cell can produce cells that become blood cells, muscle cells, or skin cells. **DOK 2**
5. C. cell, tissue, organ, organ system, organism **DOK 1**

Interpret Graphics

6.

Organism Characteristics	
Unicellular	Multicellular
Organism has only one cell, which performs all life processes.	Organism has many cells that differentiate and become specialized. The differentiated cells work together to perform life processes.

DOK 2

Critical Thinking

7. Answers will vary. Possible answer: If a mistake occurs during mitosis of a muscle stem cell, the cell might not be able to divide correctly and form new muscle cells. Old or damaged muscle cells might not be replaced, and the muscle tissue would not stay healthy. The muscle cells formed after the mistake (mutation) may not work correctly, so the muscle tissue may not work correctly. **DOK 3**
8. A single cell is able to perform all the functions a multicellular organism can. A cell has structures to get rid of wastes, just as a multicellular organism has structures to get rid of wastes. **DOK 2**

Teacher Notes



7 Study Guide

The BIG Idea
Through cell division, one cell can produce new cells to grow and develop into a multicellular organism.

Key Concepts Summary

7.1 The Cell Cycle and Cell Division

- The **cell cycle** consists of two phases. During **interphase**, a cell grows and its chromosomes and organelles replicate. During the mitotic phase of the cell cycle, the nucleus divides during **mitosis**, and the cytoplasm divides during **cytokinesis**.
- The cell cycle results in two genetically identical **daughter cells**. The original parent cell no longer exists.
- The cell cycle is important for growth in multicellular organisms, reproduction in some organisms, replacement of worn-out cells, and repair of damaged cells.



7.2 Levels of Organization

- The one cell of a unicellular organism is able to obtain all the materials that it needs to survive.
- In a multicellular organism, cells cannot survive and must work together to provide the organism's needs.
- Through **cell differentiation**, cells become different types of cells with specific functions. Cell differentiation leads to the formation of **tissues**, **organs**, and **organ systems**.



Vocabulary

- cell cycle
- interphase
- mitotic phase
- centrioles
- mitosis
- cytokinesis
- daughter cell

- cell differentiation
- stem cell
- tissue
- organ
- organ system

FOLDABLES Chapter Project

Assemble and present Foldables as shown to make a Chapter Project. Use the projects to review what you have learned in this chapter.

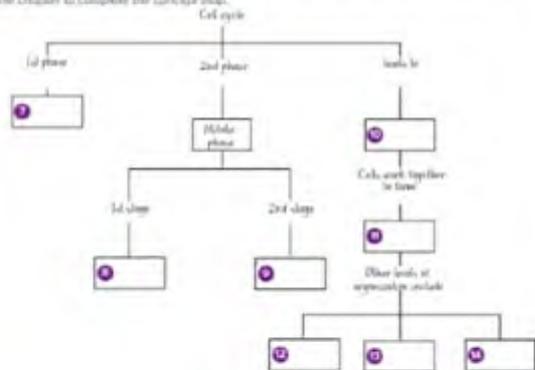


Use Vocabulary

- Use the term **cell differentiation** in a sentence.
- Define the term **cytokinesis** in your own words.
- The new cells formed by mitosis are **genetically identical**.
- Use the term **cell differentiation** in a sentence.
- Define the term **stem cell** in your own words.
- organs** are groups of _____ working together to perform a specific task.

Link Vocabulary and Key Concepts

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



Key Concepts Summary

abc Vocabulary

Study Strategy: Self-Assessment

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

- Ask students to draw two columns in their Science Journals. The left column should be titled *Questions*. The right column should be titled *My Answers*.
- Have students turn the headings found in each lesson into questions. For example, the first heading in **Lesson 1** is **The Cell Cycle**. Students might write *What is the cell cycle?* in the left column.
- Have students write the answer to each of their questions in the right column.
- Create student pairs. Have students ask each other their questions and then compare their answers.

Example:

Questions	My Answers
1. What is the cell cycle?	1. a cell's growth, development, and division.
2. What are the phases of the cell cycle?	2. interphase and mitotic.

Study Strategy: In Your Own Words

Ask students to create vocabulary flash cards using their own words. Connecting vocabulary words to students' own language promotes understanding more effectively than pure memorization.

- Give each student 12 blank index cards, or cut stiff paper to make small cards.
- Have students write a vocabulary term on one side of the card.
- Ask students to define the vocabulary words using their own words on the other side of the card.
- Have students work in pairs to lay out their cards definition-side up. Students take turns matching two definition cards and identifying the vocabulary word.

Example:

Vocabulary Word	My Definition
mitosis	the division of the nucleus and the contents of the nucleus.

Use Vocabulary

- 1 Answers will vary. Possible answer: Sister chromatids are identical strands of DNA that are formed during the second stage of interphase.
- 2 Answers will vary. Possible answer: A centromere is the structure that holds together sister chromatids.
- 3 daughter cells
- 4 Answers will vary. Possible answer: A multicellular organism has many different types of cells because of cell differentiation.
- 5 Answers will vary. Possible answer: Stem cells are cells that become specialized through the process of cell differentiation.
- 6 tissues

Link Vocabulary and Key Concepts

- 7 interphase
- 8 mitosis
- 9 cytokinesis
- 10 cell differentiation
- 11 tissues
- 12 13 14

(Answers can be in any order.)
organs, organ systems, organisms



Understand Key Concepts

- Chromosomes line up in the center of the cell during which phase?
 - anaphase
 - metaphase
 - prophase
 - telophase
- Which stage of the cell cycle precedes cytokinesis?
 - G₁
 - G₂
 - interphase
 - mitosis
- A plant's root system is which level of organization?
 - cell
 - organ
 - organ system
 - tissue
- Where is a meristem often found?
 - liver cells
 - muscle tissue
 - tip of plant root
 - unicellular organism
- Which is NOT a type of human tissue?
 - connective
 - meristem
 - muscle
 - nervous
- Which are specialized cells?
 - blood cells
 - muscle cells
 - nerve cells
 - stem cells

Use the figure below to answer questions 3 and 4.



- The figure represents which stage of mitosis?
 - anaphase
 - metaphase
 - prophase
 - telophase
- What forms during this phase?
 - centrioles
 - furrow
 - sister chromatid
 - two nuclei
- What is the longest part of the cell cycle?
 - anaphase
 - cytokinesis
 - interphase
 - mitosis
- Which level of organization is shown in the figure below?
 - cell
 - organ
 - organ system
 - tissue
- Which level of organization completes a series of tasks?
 - cell
 - organ
 - organ system
 - tissue



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Critical Thinking

- Sequence the events that occur during the phases of mitosis.
- Infer why the chromatin condenses into chromosomes before mitosis begins.
- Create Use the figure below to create a cartoon that shows a duplicated chromosome separating into two sister chromatids.
- Classify a leaf as a tissue or an organ. Explain your choice.



- Distinguish between a tissue and an organ.
- Construct a table that lists and defines the different levels of organization.
- Summarize the differences between unicellular organisms and multicellular organisms.

Write in Science

19 Write a five-sentence paragraph describing a human organ system. Include a main idea, supporting details, and a concluding statement.

The BIG Idea

- Why is cell division important for multicellular organisms?
- The photo below shows a chick growing inside an egg. An egg begins as one cell. How can one cell become a chick?

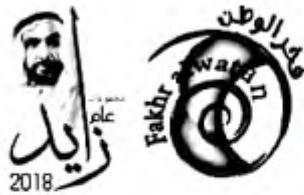


Math Skills

- Use Percentages**
- During an interphase lasting 23 hours, the S stage takes an average of 8.0 hours. What percentage of interphase is taken up by the S stage? Use the following information to answer questions 23 through 25.
 - During a 23-hour interphase, the G₁ stage takes 11 hours and the S stage takes 8.0 hours.
 - What percentage of interphase is taken up by the G₁ and S stages?
 - What percentage of interphase is taken up by the G₂ phase?
 - How many hours does the G₂ phase last?

Understand Key Concepts

- B. metaphase
- D. mitosis
- D. telophase
- D. two nuclei
- C. interphase
- C. organ system
- C. tip of plant root
- B. meristem
- D. stem cells
- C. organ system
- C. organ system



Critical Thinking

- Chromatin coils tightly to form chromosomes, nucleolus disappears and nuclear membrane breaks down, spindle fibers form, chromosomes are pulled to the middle of the cell, line up in a single file, sister chromatids are separated and pulled to opposite ends of the cell, nuclear membrane forms around chromosomes at either end of the cell and the fibers break down.
- Answers will vary. Possible answer: It is easier to move the chromatin around the cell if it is condensed.
- Answers will vary but should demonstrate the students' understanding that the double-stranded chromosome splits, and the sister chromatids form an X-shape with a centromere holding the two chromatids together.
- A leaf is an organ because it is made up of different types of tissues (dermal, ground, and vascular) that work together to perform a job (photosynthesis).
- A tissue is many similar cells working together, while an organ may be made of several types of tissues and therefore several types of cells.

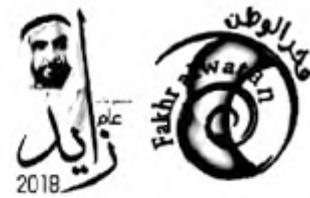
17

Levels of Organization	Definition
Cell	smallest unit of life
Tissue	group of similar types of cells that work together to carry out a specific task
Organ	group of tissues working together to perform a specific job
Organ System	group of organs working together to complete a series of tasks
Organism	composed of organ systems working together to carry out all the functions necessary for the organism's survival

18 Unicellular organisms are made of one cell that can perform all the necessary tasks for the organism's survival. Multicellular organisms are composed of many cells working together. Each cell in a multicellular organism has a role that is important to the organism as a whole.

Writing in Science

19 Answers will vary and should demonstrate students' understanding of definitions and organization. For example: Bone cells make up bone tissue. Bone tissue makes up bones (the organs of the skeletal system). Bones make up the skeletal system. The skeletal system works with the circulatory system by producing blood cells in bone marrow. The skeletal system and other organ systems make up a human body (organism).



The BIG Idea

- 20 Answers will vary. Multicellular organisms use mitosis and repair damaged tissue, make more cells (reproduce), replace old cells, and grow.
- 21 One cell can become a chick through cell division and cell differentiation. The one cell will go through interphase and mitosis, so the cells grow, develop, and multiply. The chick's stem cells will differentiate to become specialized cells, which will form tissues, organs, organ systems, and an organism—the chick.

Math Skills

Use Percentages

- 22 -35% (rounded)
- 23 -83% (rounded)
- 24 -17% (rounded)
- 25 -4 hours

Standardized Test Practice

Standardized Test Practice

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

Multiple Choice

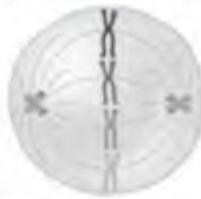
- 1 Which tissue carries messages to and from the brain?
A connective
B epithelial
C muscle
D nervous

Use the diagram below to answer questions 2.



- 2 What is indicated by the arrow?
A centromere
B chromatid
C chromosome
D nucleus
- 3 In which stage of mitosis do spindle fibers form?
A anaphase
B metaphase
C prophase
D telophase
- 4 What structures separate during anaphase?
A centromeres
B chromatids
C nuclei
D organelles

Use the diagram below to answer question 5.



- 5 What stage of mitosis does the image above represent?
A anaphase
B metaphase
C prophase
D telophase
- 6 A plant's dermal tissue
A produces food for the rest of the plant.
B provides protection and helps reduce water loss.
C takes in water and nutrients for use throughout the plant.
D transports water and nutrients throughout the plant.
- 7 Which is the most accurate description of a leaf in your stomach?
A a cell
B an organ
C an organ system
D a tissue

Use the figure below to answer question 8.



- 8 Which does the figure illustrate?
A an organ
B an organism
C an organ system
D a tissue
- 9 If a cell has 30 chromosomes at the start of mitosis, how many chromosomes will be in each new daughter cell?
A 10
B 15
C 30
D 60
- 10 What areas of plants have unspecialized cells?
A flowers
B fruits
C leaves
D meristems

Constructed Response

Use the figure below to answer questions 11 and 12.



- 11 The figures illustrate two phases of mitosis. Which occurs first: A or B? Explain your reasoning.
- 12 What stage of the mitotic phase follows those illustrated above? Explain how this stage differs between plant and animal cells.
- 13 What are some similarities and differences between the G₁ and S stages of interphase?
- 14 Are all human cells capable of mitosis and cell division? How does this affect the body's ability to repair itself? Support your answer with specific examples.

Need Extra Help?

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

Multiple Choice

- 1 **D—Correct.** A, B, C—Connective tissue provides structure and support but does not carry signals. Epithelial tissue forms the skin's protective outer layer as well as the lining of internal body cavities and organs. Muscle tissue causes movement. **DOK 1**
- 2 **A—Correct.** B, C, D—A chromatid is one-half of a chromosome, and chromosomes are contained in the nucleus. **DOK 1**
- 3 **C—Correct.** A, B, D—During metaphase, spindle fibers push and pull the duplicated chromosomes to the middle of the cell. During anaphase, the fibers shorten, drawing the sister chromatids to opposite ends of the cell. In the final mitotic state, telophase, the spindle fibers start to disappear. **DOK 2**
- 4 **B—Correct.** A, C, D—During anaphase, the two identical sister chromatids in each duplicated chromosome separate and move to opposite ends of the cell. Neither centromeres nor nuclei split during anaphase. Organelles are membrane-bound structures in the eukaryotic cell. **DOK 1**
- 5 **B—Correct.** A, C, D—The diagram shows the shortest part of the mitotic stage, metaphase, in which the duplicated

chromosomes align in the center of a cell and attach to spindle fibers. Metaphase is preceded by prophase and followed by anaphase, then telophase. **DOK 2**

- 6 **B—Correct.** A, C, D—Vascular tissue takes in and transports water and nutrients, and photosynthesis takes place in ground tissue. **DOK 2**
- 7 **B—Correct.** A, C, D—Both a leaf and your stomach are multicellular and composed of tissues. Organ systems require more than one organ. **DOK 2**
- 8 **C—Correct.** A, B, D—Organisms, such as humans, are made of organ systems. Organ systems are made of organs, which are made of tissues. **DOK 2**
- 9 **C—Correct.** A, B, D—During interphase, a cell makes complete copies of its DNA, and the cell's duplicated DNA is arranged in pairs of two identical chromosomes, called sister chromatids. When mitosis is complete, each daughter cell will contain one chromosome from each pair. Therefore, if a cell begins mitosis with 30 chromosomes, each daughter cell will contain 30 chromosomes. **DOK 2**
- 10 **D—Correct.** A, B, C—Flowers, fruits, and leaves are all made of specialized cells. **DOK 1**

Constructed Response

- 11** Figure B occurs first since it shows the sister chromatids separating (anaphase). In Figure A, the sister chromatids already have separated, the cell has started to divide, and spindle fibers have started to break down (telophase). **DOK 3**
- 12** Cytokinesis is the next stage of the mitotic phase. The main difference between animal and plant cells in this stage lies in how the cytoplasm divides. In animal cells, fibers surrounding the center of the cell pull together to form a furrow, which deepens until the cell splits in half. In plant cells, a membrane-bound disk called a cell plate forms when vesicles join together. The cell plate then grows outward toward the cell wall until two new cells form. **DOK 3**
- 13** One similarity between the G_1 stage and the S stage is that the cell continues to grow during both stages. One difference between these two stages is that the G_1 stage is longer than the S stage. Also during the S stage, DNA is copied to form duplicate chromosomes. This does not occur in the G_1 stage. **DOK 3**
- 14** Answers will vary but should include the idea that cell division is necessary to the reparation of damage to a part of the human body. Because bone cells, for example, continue to divide, new bone cells patch pieces of a fractured bone together. Damaged and old skin cells can be replaced with new skin cells. However, mature nerve cells do not continue to divide; consequently, neurological damage may be permanent. **DOK 2**

Answer Key

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

Structure and Movement

The BIG Idea

How do bones, muscles, and skin help maintain the body's homeostasis?



LEARNING

6.1 The Skeletal System

- What does the skeletal system do?
- How do the parts of the skeletal system work together?
- How does the skeletal system interact with other body systems?



LEARNING

6.2 The Muscular System

- What does the muscular system do?
- How do the parts of the skeletal system work together?
- How does the skeletal system interact with other body systems?



LEARNING

6.3 The Skin

- What does the skin do?
- How do the three layers of skin differ?
- How does the skin interact with other body systems?



Is bone alive?

Five friends were arguing about bones. They each had different ideas about whether bones were living. This is what they said.



Blat: I think bones are living because they are inside our body.

Rashid: I think bones are living because they are made up of cells.

Ahmed: I think bones are non-living because they are made up of cells that become hard bone after they die.

Jasim: I think bones are non-living because they are made up of minerals like calcium.

Harib: I think bones are non-living because they exist even after a person dies.

Who do you agree with the most? _____ Explain your thinking about bone as living or non-living material.

How do bones, muscles, and skin help maintain the body's homeostasis?

The BIG Idea

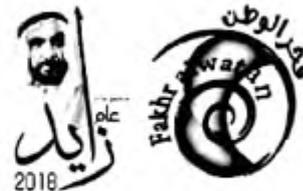
There are no right or wrong answers to these questions. Write student-generated questions produced during the discussion on chart paper and return to them throughout the chapter.

Guiding Questions

- AL** What functions do you think bones, muscles, and skin have? *This question initiates students' thinking about the functions of their bones, muscles, and skin. Guide students to list as many specific examples as they can. Then help them use the list to infer main functions of bones, muscles, and skin.*
- OL** How would you describe your body when homeostasis is being maintained? *When homeostasis is maintained, all of your systems are in balance and working together. You feel healthy and active.*
- BL** How do bones, muscles, and skin work together and help your body function? *This question initiates students' thinking about ways body systems work together and maintain homeostasis. Muscles pull on your bones and allow you to move. Your bones provide structure and support for your skin and muscles.*

Guiding Questions

- AL** What is each soccer player missing in the photo? *Skin and muscle are missing from the skeleton. Skin and bones are missing from the figure with muscles.*
- OL** Why can't the skeleton kick the soccer ball? *Use this question to help students realize that bones move only when muscles contract or shorten.*
- BL** What would happen to your body if you had no skin? No muscles? *Guide students in recognizing the importance of skin for protection and the importance of muscles for movement and support.*



8.1 The Skeletal System

INQUIRY

How do bones move so easily?

Bones work like mechanical joints, enabling you to turn, pivot, twist, and bend. However, they don't do this alone. Other parts of your skeletal system work with the bones and help you move.

Write your response in your science notebook.



Explore Activity

How are bones used for support?

Procedure

If you have ever watched the construction of a building, you may have seen a wood or steel frame being used to provide support. In a similar way, bones support your body and the organs inside it.



1. Read and complete a lab safety form.
2. Using pieces of **stap**, try to build a tower taller than your partner's. One person should use **wooden dowels** to support his or her tower.
3. Measure and record the height of both towers. Find the class average for the height of towers with and without dowels.

Think About This

1. Were towers with or without dowels generally higher?

2. **Key Concept** What do you think your body would be like if you had no bones?

Essential Questions

- What does the skeletal system do?
- How do the parts of the skeletal system work together?
- How does the skeletal system interact with other body systems?

Vocabulary

- skeletal system
- cartilage
- periosteum
- joint
- ligament
- arthritis
- osteoporosis

INQUIRY

About the Photo **How do bones move so easily?** The photo is computer artwork based on an X-ray of a group of runners completing a race. To make an X-ray, radiation is passed through the body. Because calcium in bones absorbs more radiation than surrounding soft tissue does, the bones show up as white areas on a film or photograph created through the X-ray process.

Guiding Questions

- AL** What are some of the movements you see in the photo? *running; raising arms; bending elbows, knees, and ankles*
- OL** What body parts work together to cause these movements? *Bones and muscles work together to cause these movements.*
- BL** Could bones cause movement if they were not attached to each other? Explain. *No, each bone is rigid and cannot move by itself. Joints that connect bones are required for movement.*

Essential Questions

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



Vocabulary

Finding the Right Definition

1. Write *system* on the board.
2. Distribute an index card to pairs of students, and ask them to write a definition of *system* that relates to a living thing. Do not suggest that the definition should be related to the lesson.
3. Collect the cards. Read the definitions aloud. Have students vote to decide which definition for each word best fits the subject of the lesson, the skeletal system.

8.1 Review



Figure 8 Exercises that add weight on bones or work bones against gravity help keep the skeletal system healthy.

Healthy Bones

One of the best ways to keep bones healthy is to exercise. Certain types of exercise, such as those shown in **Figure 8**, place weight on bones. This strengthens bones and builds new bone tissue. Without exercise, bones weaken and lose mass.

A balanced diet also keeps bones healthy. Bones especially need calcium and vitamin D. Calcium makes bones strong. It is also necessary for cellular processes in blood, nerve, and muscle cells. If you do not have enough calcium in your diet, your body will use the calcium stored in your bones. If your body uses too much of the stored calcium, your bones can become weak. Vitamin D is also important because it helps the body use calcium.

The Skeletal System and Homeostasis

You might recall that **homeostasis** is an organism's ability to maintain a stable internal environment. Homeostasis requires that all body systems function properly together. Because bones supply calcium to your nerves, muscles, and heart, a healthy skeletal system is important in maintaining your body's homeostasis.

Bones also help you respond to unpleasant stimuli, such as a mosquito bite. Working together with muscles, bones enable you to move away from unpleasant stimuli or danger, or even swat a mosquito.

Review Vocabulary

Homeostasis the ability of an organism to maintain a stable internal environment

Key Concept Check

4 How does the skeletal system help the body maintain homeostasis?

Visualize It!



The skeletal system consists of all the bones, ligaments, and cartilage in the body.



Joints provide flexibility and enable the skeleton to move.



Osteoporosis is a disease that causes bones to weaken and become brittle.

Summarize It!

1. What does the skeletal system do?
2. How do the parts of the skeletal system work together?
3. How does the skeletal system interact with other body systems?

Healthy Bones

Use the scaffolded questions below to reinforce students' knowledge of ways to keep the skeletal system healthy.

Guiding Questions

- AL** What are two ways to help keep bones healthy? *Exercise and a balanced diet help keep bones healthy.*
- OL** Why is it important to eat calcium-rich foods? *Your body needs calcium. If your diet is calcium-poor, other parts of your body will take calcium from your bones.*
- BL** Why is milk an important part of the diet? *Milk contains both calcium and vitamin D, two nutrients needed for healthy bones.*

The Skeletal System and Homeostasis

Review the concept of homeostasis. Discuss why a stable internal environment is important. Use the questions below to relate homeostasis to the skeletal system.

Guiding Questions

- AL** Why is homeostasis important? *If one of the body's systems is not working properly, it can cause the organism to get sick or make other systems stop working.*
- OL** How does the skeletal system help the body maintain homeostasis? *The skeletal system provides calcium for nerves, muscles, and heart; bones store fat and make blood cells.*
- BL** How does your body get the energy it needs to make bones and muscles work? *You eat food, which contains glucose, a type of sugar. When the glucose is broken down, energy is released and is used by all cells in the body.*

Review Vocabulary

homeostasis

Ask: Why is a healthy skeletal system important to maintaining homeostasis? *A healthy skeletal system is needed to supply calcium to nerves, muscles, and the heart. The skeletal system is also needed to provide support to the entire body so it can function properly. In addition, the skeletal system works with muscles to enable the body to move away from unpleasant stimuli or danger.*

The Skeletal System

Use Vocabulary

1. Strong, flexible tissue that covers the ends of bones is called _____.
2. Bones connect to other bones at _____.
3. A person with _____ has irritated joints.

Understand Key Concepts

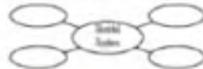
4. Which is NOT a part of the periosteum?
 - A. blood vessels
 - B. bone cells
 - C. bone marrow
 - D. nerves
5. Distinguish between cartilage and ligaments.
6. Give an example of how the skeletal system interacts with the nervous system.

Interpret Graphics

7. Determine the type of joint shown in the figure below.



8. Organize Copy the graphic organizer below and, in the ovals, list the four major functions of the skeletal system.



Critical Thinking

9. Summarize how bones help the body maintain homeostasis.
10. Evaluate why it is better for an adult's skull to have immovable joints and not movable joints.

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My Notes

Blank lined area for taking notes.



Use Vocabulary

1. cartilage **DOK 1**
2. joints **DOK 1**
3. arthritis **DOK 1**

Understand Key Concepts

4. C. bone marrow **DOK 2**
5. Cartilage covers and protects the ends of bones that meet at joints. Ligaments connect bones to other bones. **DOK 2**
6. The nervous system requires calcium, which can be obtained from bones. The periosteum of bones also has nerves. The skeletal system works with the nervous system to help respond to stimuli. **DOK 2**

Interpret Graphics

7. hinge joint **DOK 2**
8. Any order: supports the body, protects organs, stores minerals, helps the body move **DOK 2**

Critical Thinking

9. Bones help the body maintain homeostasis by enabling the body to move to avoid unpleasant or dangerous situations. Bones also provide calcium for various body functions; bones store fat and make blood cells, which are necessary for body function. **DOK 2**
10. The skull contains fragile brain tissue that needs to be protected. Immovable joints allow the bones of the skull to cover the brain without leaving any gaps. If the skull bones met at movable joints, the brain tissue might be exposed at the joints. **DOK 4**

8.2 The Muscular System

INQUIRY

How can they do that? These people are contortionists (kun TOR shuh mist)—people who can bend and flex their bodies in unusual ways. The contortionists pictured here are able to stay in this position because their muscular systems can hold their bodies in place.

Write your response in your science notebook.



288 Chapter 8

Explore Activity

Can you control all your muscles?

Can you feel your heart beating? Your body contains many muscles that you can control by thinking about them. However, not all types of muscle are controllable.



1. Shake hands with another student. Did you have to think about this action?
2. Rest your index and middle fingers on the thumb side of your wrist until you can feel your pulse. Can you change the speed of your pulse by thinking about it?

Think About This

1. Make a list of the muscles in your body that you can consciously control. What are their functions?

2. **Key Concept** Think of other muscles in your body, besides your heart, that work without you thinking about them. How do the functions of these muscles differ from the ones you consciously control?

Essential Questions

- What does the muscular system do?
- How do types of muscle differ?
- How does the muscular system interact with other body systems?

Vocabulary

- muscle
- skeletal muscle
- voluntary muscle
- cardiac muscle
- involuntary muscle
- smooth muscle

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INQUIRY

About the Photo **How can they do that?** To be able to bend their bodies in such ways, these contortionists need to carefully train their muscular and skeletal systems. They must consistently build strength and endurance in their muscles and maintain good flexibility in their joints.

Guiding Questions

- AL** Where in the performer's body are the muscles located that help her do the handstand? *Answers will likely reference the contortionist's hand, arm, back, legs, or even her entire body.*
- OL** How are their skeletal systems important to their performance? *Flexibility of their joints, especially in their spines—for this position—allows them to bend their bodies and reduces the chance of them becoming injured from twisting their bodies into difficult positions.*
- BL** What do you think contortionists might do to train their bodies? *They stretch slowly and for long periods of time to enable their tissues to maintain unusual poses. These tissues are able to expand and stretch more than normal. Some students might suggest other methods such as a healthy diet or vitamins.*

Essential Questions

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

Vocabulary
Muscle Control

Write the terms *voluntary* and *involuntary* on the board.

1. **Ask: What is a volunteer?** Guide students in recognizing that work done by volunteers can be described as "voluntary." Explain that voluntary muscles are moved when a person chooses to move those muscles. Then ask students to identify the meaning of the prefix *in-* and the meaning of *involuntary*. Elicit responses indicating that the prefix *in-* can mean "not" and that *involuntary* means "not voluntary." Explain that an involuntary action is an action that does not result from a person's free will; it does not occur by choice or decision and involuntary muscles are not controlled by decision or choice.

2. **Ask: What type of muscle is cardiac muscle?** *involuntary*
Skeletal muscle? *voluntary*
As they read the lesson, have students classify specific muscles as voluntary or involuntary in their Science Journals.

The Muscular System

Use Vocabulary

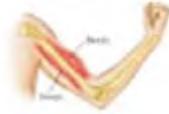
- Muscle that pumps blood through the body is called _____.
- A person is unable to control the contractions of _____.
- Strong tissue that contracts is called _____.

Understand Key Concepts

- Which is a voluntary muscle?
 - biceps
 - stomach
 - blood vessel
 - small intestine
- Explain how the muscular system regulates body temperature.
- Distinguish between a cardiac muscle and a smooth muscle.

Interpret Graphics

- Describe the relationship between the two muscles shown.



- Identify Copy and fill in the graphic organizer below to identify three functions of the muscular system.



Critical Thinking

- Predict what would happen if the smooth muscles in a person's body could not contract.
- Assess the importance of exercise for muscle health.

My Notes



Use Vocabulary

- cardiac muscle **DOK 1**
- involuntary muscle **DOK 1**
- muscle **DOK 1**

Understand Key Concepts

- A. biceps **DOK 1**
- Muscle contractions convert chemical energy to thermal energy, thereby helping to regulate body temperature. **DOK 2**
- Cardiac muscle is only found in the heart. Smooth muscle is found in many organs of the body, including the digestive system and blood vessels. **DOK 2**

Interpret Graphics

- The biceps muscle is contracted, which shortens the muscle, pulling the bones of the lower arm up. The triceps muscle is relaxed and elongated and is not causing any movement. **DOK 2**
- (any three) movement, stability, protection, temperature regulation **DOK 2**

Critical Thinking

- The person would not be able to digest food and absorb nutrients because the food would not pass through the digestive tract. Blood also would not be able to move through blood vessels. Internal organs would not be able to work properly. **DOK 2**
- Exercise builds and maintains the strength of muscles. If muscles are not used and exercised, the muscle will weaken. **DOK 3**

8.3 The Skin

INQUIRY

What is this?
You might think this is a picture of a landscape on another planet. However, this image shows what your skin looks like under a microscope. Your skin sheds its top layer of cells constantly as new cells are made to take their place.

Write your response in your science notebook.



298 Chapter 8

Explore Activity

How does your skin protect your body?

Your skin is your body's first line of defense. When you touch something with your fingers you can instantly tell if it is hot or cold. Are all parts of your body equally sensitive?

1. Read and complete a lab safety form.
2. Touch the back of your hand with ice cubes in a plastic bag.
3. Now do the same to the back of your knee.

Analyze and Conclude

1. Which area was more sensitive to cold?

2. How do you think the skin senses temperature?

3. **Key Concept** How does sensitivity to temperature protect the body?

Essential Questions

- What does the skin do?
- How do the three layers of skin differ?
- How does the skin interact with other body systems?

Vocabulary

- integumentary system
- epidermis
- melanin
- dermis
- bruise

INQUIRY

About the Photo **What is this?** Explain that this is not a forest of dead trees, but rather hairs growing from follicles in the underlying layer of skin, the dermis. The portion of the hair emerging from the skin is made of dead tissue. The outside of the hair, the cuticle, is covered in modified overlapping scales and protects the central cortex. The central cortex includes the fibrous protein keratin, which is not visible in the image.

Guiding Questions

- | | |
|---|--|
| <p>AL What is constantly happening to the top layer of skin cells?</p> | <p><i>The top layer of skin cells is being shed to make room for new skin cells.</i></p> |
| <p>OL Skin is part of the integumentary system. What other structures might be part of this system?</p> | <p><i>The integumentary system includes all the external coverings of the body, including skin, nails, and hair.</i></p> |
| <p>BL Due to nerve damage or other conditions, some people lack proper sensation in some or all of their skin. What problems could this cause?</p> | <p><i>Being able to tell when your skin is being hurt or damaged enables you to respond by moving away from a harmful stimulus. A person who cannot feel pain might suffer severe burns or other injuries before becoming aware of the stimulus.</i></p> |

Essential Questions

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

Vocabulary

Understand Roots: *derm*

1. Write the words *epidermis* and *dermis* on the board. Guide students in responding to the questions below.
2. **Ask:** What do these words have in common? The root is *derm*.
3. **Ask:** What other words have the same root? *dermatology, dermatologist, dermatitis*
4. **Ask:** What do these words mean? Dermatology is the branch of medicine related to the skin. A dermatologist is a doctor who specializes in treating the skin. Dermatitis is a type of skin condition.
5. **Ask:** When you see the root *derm*, what can you assume about the word's meaning? It relates to the skin.

Explore Activity

How does your skin protect your body?

Prep: 5 min Class: 5 min

Purpose

To observe how the skin helps protect the body.

Materials

ice, plastic bags, paper towels

Before You Begin

Place ice cubes in plastic sandwich bags.

Guide the Investigation

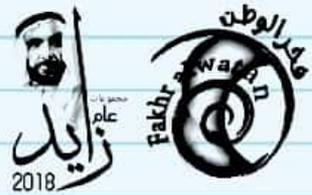
- Ask students to suggest ways they could judge whether a surface is hot or cold.
- Students can test the inside of the elbow instead of the back of the knee.
- A response to warm temperature can be tested with a wet warm paper towel in a plastic bag or a chemical hand warmer.

Think About This

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

1. The back of the hand is more sensitive.
2. The skin has sensory cells that detect temperature.
3. **Key Concept** The skin's sensitivity helps the body avoid temperature extremes.

Teacher Notes



8.3 Review

Visualize It!



The epidermis is the outermost layer of skin.



The dermis is the layer of skin that contains sweat glands, blood vessels, nerves, hair follicles, and muscles.

Summarize It!

1. What does the cap? Do?

2. How do the three layers of skin differ?

3. How does the skin interact with other body systems?



Use Vocabulary

1. A pigment that absorbs ultraviolet rays is called _____.
2. The _____ is the layer that nourishes the skin.

Understand Key Concepts

3. Which is the innermost layer of skin?
 - A. dermis
 - B. epidermis
 - C. fatty layer
 - D. melanin
4. Give an example of how the skin regulates body temperature.

5. Compare the dermis and epidermis. Explain the function of each.

Interpret Graphics

6. Estimate the age of the bruise shown on the right.



7. Organize Information Copy and fill in the table below with details about the three degrees of burns.

First-degree burn	
Second-degree burn	
Third-degree burn	

Critical Thinking

8. Evaluate the importance of your skin to your homeostasis.

Math Skills

9. The palms of the hands and soles of the feet have the highest concentration of sweat glands—about 800/cm². How many sweat glands would there be on the sole of a foot measuring 10 cm × 27 cm?

Visual Summary

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

FOLDABLES Review students' horizontal half books. Check students' information about the different types of skin injuries and how the body repairs them.

Summarize It!

Use Vocabulary

1. melanin **DOK 1**
2. dermis **DOK 1**

Understand Key Concepts

3. C. fatty layer **DOK 1**
4. Body temperature is lowered as thermal energy is released from the skin when blood vessels in the skin dilate. Temperature is raised when blood vessels constrict. **DOK 2**

5. The epidermis is the top, outermost layer of skin that constantly produces new cells and melanin. It forms the protective barrier between the body and the environment. The dermis is below the epidermis and contains sweat glands, hair follicles, nerves, and blood vessels. **DOK 3**

Interpret Graphics

6. The bruise is still purplish-blue. Therefore, it probably happened fairly recently since the bruise has not started to turn green. **DOK 2**
7. First-degree burn: Only the epidermis is damaged. Second-degree burn: The epidermis and lower tissues are damaged. Third-degree burn: All three layers of skin and sometimes the tissue below are damaged. **DOK 2**

Critical Thinking

8. If the skin wasn't present, the body would be exposed to the environment. The body would dry out, not be able to regulate body temperature, not make vitamin D, and not be able to react to stimuli or avoid danger. **DOK 3**

Math Skills

9. 135,000 sweat glands **DOK 3**

Understand Key Concepts

1. What is the arrow pointing to in the figure below?



- A. cartilage
- B. ligament
- C. periosteum
- D. tendon

2. Which is NOT produced or stored inside bones?

- A. calcium
- B. fat
- C. melanin
- D. red blood cells

3. Which organ is NOT protected by the skeletal system?

- A. brain
- B. heart
- C. lungs
- D. skin

4. Which prevents bones from rubbing against each other?

- A. cartilage
- B. compact bone
- C. ligament
- D. spongy bone

5. What happens to a muscle when it contracts?

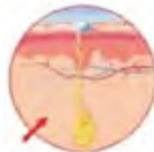
- A. The muscle lengthens.
- B. The muscle pushes on a bone.
- C. The muscle pushes on another muscle.
- D. The muscle shortens.

6. Which type of muscle is responsible for movement of the arms and legs?

- A. cardiac muscle
- B. involuntary muscle
- C. skeletal muscle
- D. smooth muscle

7. A contraction of what type of muscle is not consciously controlled?

- A. arm muscle
- B. involuntary muscle
- C. skeletal muscle
- D. voluntary muscle



8. To which layer of skin is the arrow in the figure above pointing?

- A. dermis
- B. epidermis
- C. fat layer
- D. melanin

9. What is one function of sweating?

- A. allows the body to move
- B. enables calcium to be absorbed
- C. increases body temperature
- D. lowers body temperature

10. Which vitamin is made in the skin?

- A. vitamin A
- B. vitamin B
- C. vitamin C
- D. vitamin D

Critical Thinking

11. Explain how the muscular system and the skin regulate body temperature.

12. Compare spongy bone and compact bone.

13. Assess the importance of calcium in your diet, including the consequences of not getting enough.

14. Give an example of how the skeletal system maintains homeostasis.

15. Predict how your daily life would change if your skin contained no melanin.

16. Discuss why muscles must work in pairs.

17. Evaluate how the skin's ability to continually produce new skin cells helps protect your body.

18. Identify the kind of joint shown below. Give an example of where it is found in the body and what type of movement it enables the body to do. Record what structures you can identify and what system they belong to.



Writing a Science

19. Write a paragraph about how bones grow, starting before birth. Hypothesize why children and teens are in greater danger of breaking a bone than adults. Include a main idea, supporting details and examples, and a concluding sentence.

The BIG Idea

20. How do the skeletal system, the muscular system, and the skin help the body maintain homeostasis? Explain how each system works independently to maintain homeostasis, and give an example of how two of them work together.

21. The photo below shows two soccer players—one using just muscles, the other using just bones. Explain why this would not be possible in real life.



Math Skills

Use Proportions

22. A particular person produces about 95 mg of sweat per minute. How much sweat will the person produce in 1 hour?

23. There is approximately 1.4 m² of skin on the average human body (14 × 10,000 cm²).

- A. What is the surface area of the human body in cm²?
- B. If the body averages 277 sweat glands per square centimeter, about how many sweat glands would the human body contain?

Understand Key Concepts

- 1 B. ligament
- 2 C. melanin
- 3 D. skin
- 4 A. cartilage
- 5 D. The muscle shortens.
- 6 C. skeletal muscle
- 7 B. involuntary muscle
- 8 A. dermis
- 9 D. lowers body temperature
- 10 D. vitamin D

Critical Thinking

- 11 In a cold environment, muscles contract rapidly and change chemical energy to thermal energy. The thermal energy raises the body's temperature. In a hot environment, skin produces sweat, which evaporates, carrying away excess thermal energy. The body feels cooler.
- 12 Compact bone is denser than spongy bone. Spongy bone contains red bone marrow that produces blood cells.
- 13 Calcium is an essential mineral. Without calcium, bones would be weak and the nervous system and heart would not function.
- 14 Answers will vary. Possible answers: The skeletal system works with the muscular system to enable the body to move. The skeletal system also stores some fat in bones. The skeletal system works with the circulatory system by providing new red blood cells, which are made in bone marrow. The skeletal system also provides calcium for the nervous system and the heart.
- 15 Answers will vary. Possible answer: I would have to cover my skin because, without melanin, skin has no defense against ultraviolet rays.
- 16 Muscles can only pull on bones; they cannot push bones. So, for a bone to move and then return to its original location, two opposing muscles must act on the bone as a pair.

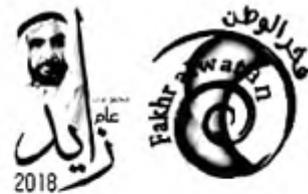
- 17** Answers will vary. Possible answer: Damaged skin cells flake off the top layer of skin and are continually replaced by new skin cells. This process enables skin to continue to be a barrier between the body and the external environment.
- 18** The ball-and-socket joint is found in hips and shoulders. This joint enables bones to move and rotate in nearly all directions. The joint is made up of bones held together by ligaments and is part of the skeletal system.

Writing in Science

- 19** Answers will vary. Possible answer: Bones grow and change from the time before a person is born through adulthood. The skeleton of an unborn baby is made mostly of cartilage, which is a strong, flexible tissue. After a person is born, this cartilage is eventually replaced by bone. Development occurs at growth plates in long bones. These regions produce new bone cells and are the weakest part of the bone. Because these growth plates create weak spots, children and teens are more prone to break bones than adults. In adults, cartilage is frequently worn away.

Math Skills

- 22** 5,700 mg of sweat
- 23** A. 18,000 cm²
B. 4,986,000 sweat glands



The BIG Idea

- 20** Answers will vary. Sample answer: The skeletal system maintains homeostasis by helping a person move away from unpleasant or potentially dangerous stimuli in the environment. Bones also produce and store substances such as red blood cells that are important for maintaining homeostasis. Muscles maintain homeostasis by converting chemical energy into thermal energy and mechanical energy when muscles contract and move. This keeps the body warm and enables it to move. Homeostasis is maintained when the skin protects the body from outside substances and objects and by making vitamin D. These systems work independently, but they also work together. If a person touches something sharp or hot, pain and touch sensory organs in skin respond. Muscles contract and pull the hand away from stimuli such as the sharp spines of a cactus or the hot handle of a pan.
- 21** Answers will vary. Sample answer: A soccer player made just of bones and a player made only of muscle is not possible. Muscles need to be attached to bone, otherwise they would have no structure. Bones cannot move unless muscles pull on them.

Standardized Test Practice

Standardized Test Practice

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

Multiple Choice

- 1 Which is a part of the integumentary system?
A fingernail
B lung
C muscle
D nerve

Use the diagram below to answer question 2.



- 2 What does the arrow in the figure point to?
A cartilage
B compact bone
C spongy bone
D yellow marrow
- 3 Which does NOT help to control a person's body temperature?
A contracting muscles rapidly
B enlarging blood vessels
C producing melanin
D sweating through pores

- 4 Which is a characteristic of skeletal muscles?
A They are involuntary.
B They are smooth muscle.
C They contain discs.
D They have striations.

- 5 Where is cardiac muscle?
A heart
B legs
C lungs
D stomach

Use the diagram below to answer question 6.



- 6 Where is this type of joint in the human body?
A finger
B knee
C neck
D shoulder



Use the figure below to answer questions 7 and 8.



- 7 Where is melanin produced?
A 1
B 2
C 3
D 4

- 8 Which area gives the skin strength, flexibility, and nourishment?
A 1
B 2
C 3
D 4

- 9 Which bone material stores fat?
A cartilage
B compact bone
C spongy bone
D yellow bone marrow

Constructed Response

Use the image below to answer questions 10-13.



- 10 What joint type is circled in the diagram? What other area of the body contains the same kind of joint?

- 11 How do ligaments and tendons function in this type of joint?

- 12 What kind of muscle is attached to the joint shown? Explain your answer. How does this type of muscle differ from the muscle in a person's stomach?

- 13 How are the functions of muscle and skin similar? Explain how each performs these functions.

Need Extra Help?

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

Multiple Choice

- 1 **A—Correct.** B, C, D—Fingernails are part of the integumentary system, which includes skin, nails, sweat glands, and hair. Lungs are part of the respiratory system; muscle makes up the muscular system; nerves are part of the nervous system. **DOK 1**
- 2 **C—Correct.** A, B, D—The arrow in the diagram points to spongy bone. Cartilage is soft and smooth and located over the ends of many bones; compact bone makes up the hard outer portions of bones; yellow marrow stores fat and is inside the longest part of long bones. **DOK 1**
- 3 **C—Correct.** A, B, D—Sweating and enlarging blood vessels help release excess thermal energy. Contracting muscles rapidly helps warm the body up. **DOK 2**
- 4 **D—Correct.** A, B, C—Skeletal muscles are voluntary muscles without the intercalated discs present in cardiac muscle. Skeletal muscle tissue has dark bands called striations which are visible under a microscope. Smooth muscle is involuntary. **DOK 1**
- 5 **A—Correct.** B, C, D—Cardiac muscle, found only in the heart. Legs are made up of skeletal muscle; lungs are made up of alveoli; the stomach wall is made up of smooth muscle. **DOK 1**

- 6 **C—Correct.** A, B, D—The diagram shows a pivot joint, which allows bones to rotate. This type of joint can be found in the neck and also in the lower arm below the elbow. The knee and fingers have hinge joints; the shoulder contains a ball-and-socket joint. **DOK 2**
- 7 **A—Correct.** B, C, D—Melanin is produced in the epidermis, the outermost layer of skin and the only layer directly exposed to the outside environment. **DOK 2**
- 8 **B—Correct.** A, C, D—The second layer of the skin, the dermis, gives the skin strength, flexibility, and nourishment. The dermis contains sweat glands, nerves, blood vessels, hair follicles, and muscles. **DOK 2**
- 9 **D—Correct.** A, B, C—The body stores fat in yellow bone marrow, located inside the shafts of long bones. Cartilage is a flexible tissue over the ends of many bones; compact bone makes up the hard outer portion of most bones; spongy bone has many open spaces and is less dense than compact bone. **DOK 1**

Constructed Response

- 10** The figure shows a ball-and-socket joint in the shoulder. The joints in the hips are also ball-and-socket joints. **DOK 1**
- 11** Tendons connect muscles to bones; they work with muscles and keep joints from moving out of place while a person is in motion. Ligaments connect bones to bones; they stretch when a joint moves. **DOK 3**
- 12** The figure shows skeletal muscle, which is attached to bones. Skeletal muscle is a voluntary muscle because it can be consciously controlled. When skeletal muscle contracts, it pulls on the bone to which it is attached and causes movement. The stomach has smooth, involuntary muscle. This muscle helps move food throughout the digestive system and is not controlled by conscious thought. **DOK 3**
- 13** Muscles and the skin both provide protection and help regulate body temperature. Muscles cover the skeleton and protect a person's internal organs by functioning as a layer of padding. The skin protects the muscles and the skeleton from the outside environment and keeps the body from drying out. Muscles help maintain body temperature by contracting rapidly when a person is cold, causing him or her to shiver. The skin helps control body temperature by releasing sweat through pores and enlarging blood vessels. **DOK 3**

Answer Key

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



9.1 The Digestive System

INQUIRY

Under the Sea? These colorful projections look like something you might see on the ocean floor, but they are found in your body. They line the walls of the small intestine, which is part of your digestive system. What do you think these projections do?

Write your response in your notebook.



Explore Activity

Which dissolves faster?

Has anyone ever told you to take small bites and chew your food thoroughly? The size of chewed food particles can affect how quickly food is digested. Similarly, the size of a sugar particle can affect how fast it dissolves in water.

Procedure

1. Read and complete a lab safety form.
2. Add the contents of one serving package of **granulated sugar** to a **500-ml beaker** containing 300 mL of **warm water**.
3. Gently stir the contents of the beaker with a **plastic spoon** and have your partner use a **stopwatch** to time how long it takes the sugar to dissolve. Record the time in your Science Journal.
4. Add **sugar cubes** to another **500-ml beaker** containing 300 mL of warm water.
5. Repeat step 3.

Think About This

1. Which dissolved faster—the granulated sugar or the sugar cube?

2. Why do you think particle size affects the rate at which sugar dissolves?

3. How might food particle size affect how quickly food is digested?

Essential Questions

- What does the digestive system do?
- How do the parts of the digestive system work together?
- How does the digestive system interact with other systems?

Vocabulary

digestion
mechanical digestion
chemical digestion
enzymes
esophagus
peristalsis
chyme
villi

INQUIRY

About the Photo Under the Sea? Have students study the projections in the photo. Read the caption. Have students speculate on what the green matter is between the projections. Have students speculate on why the projections are red. Explain that most digestion and absorption of nutrients takes place in the small intestine, which has an extensive blood supply.

Guiding Questions

- AL** What do you think the projections in the photo do? *Use this question to begin a discussion on functions of the digestive system.*
- OL** What happens to your body if your digestive system is not working properly? *Use this question to help students recognize the importance of digestion to total well-being.*
- BL** What happens if food is not properly digested? *Students may speculate that there is a loss of nutrients to the body and, eventually, poor health.*

Essential Questions

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



Vocabulary

Making Observations

1. Write the words *mechanical* and *chemical* on chart paper or the board. Explain that these words describe processes. Give an example of a mechanical process (cutting an apple into pieces) and a chemical process (the cut surface changes color and texture after awhile). Help students recognize that in a mechanical process, the material changes shape but not composition. In a chemical process, there is a chemical reaction and new products form.
2. **Ask:** What is the first thing that happens when you eat an apple? *bite down and chew* Is this a mechanical or a chemical process? *mechanical; The shape changes but a chemical change does not occur.* **Ask:** What do you think happens to the apple after it is chewed and swallowed? **How does your body gain energy from an eaten apple?** *Students should note some type of change must take place to release energy. Is that a mechanical or chemical process?* *chemical*

Visual Check

3. Cocci bacteria are spherical, bacilli bacteria are rod-shaped, and spirilla bacteria are spiral-shaped. Which type of bacteria is shown in the photo?



© iStockphoto.com/DA Wright

Figure 8 The bacteria shown here live in the large intestine. Without them, your food would not be digested well.

The Large Intestine

The parts of your cheeseburger and pie that are not absorbed in the small intestine move by peristalsis into the large intestine, also called the colon. The large intestine, shown **Figure 8**, has a larger diameter (about 5 cm) than the small intestine. However, at about 1.5 m long, it is much shorter than the small intestine.

Most of the water in ingested foods and liquids is absorbed in the small intestine. As food travels through the large intestine, even more water is absorbed. Materials that pass through the large intestine are the waste products of digestion. The waste products become more solid as excess water is absorbed. Peristalsis continues to force the remaining semisolid waste material into the last section of the large intestine, called the rectum. Muscles in the rectum and anus control the release of this semisolid waste, called feces (FEE-see).

Bacteria and Digestion

You might think that all bacteria are harmful. However, some bacteria have an important role in the digestive system. Bacteria such as the ones shown **Figure 8**, digest food and produce important vitamins and amino acids. Bacteria in the intestines are essential for proper digestion.

The Digestive System and Homeostasis

Recall that nutrients from food are absorbed in the small intestine. The digestive system must be functioning properly for this absorption to occur. These nutrients are necessary for other body systems to maintain homeostasis. For example, the blood in the circulatory system absorbs the products of digestion. The blood carries the nutrients to all other body systems, providing them with materials that contain energy.

Use Percentages

A percentage is a ratio that compares a number to 100. For example, the total length of the intestines is about 8.5 m. That value represents 100%. If the rectum is 0.12 m long, what percentage of the intestines is made up of the rectum?

$$\frac{0.12}{8.5} = \frac{x}{100}$$

Find the equivalent fraction for the ratio.

$$\frac{0.12}{8.5} = \frac{1.41}{100}$$

Multiply for 100.

$$0.014 \times 100 = 1.4\%$$

Practice

The total length of the intestines is about 8.5 m. If the small intestine is 7.0 m long, what percentage of the intestines is made up of the small intestine?

LESSON 9.1 Review

Visualize It!



Stomach in the digestive system break down food so nutrients can be absorbed by your body.



Food moves through the digestive tract by waves of peristalsis.



The liver and the pancreas produce substances that help with chemical digestion.

Summarize It!

1. What does the digestive system do?

2. How do the parts of the digestive system work together? How do the parts of the digestive system work together?

3. How does the digestive system interact with other systems?

The Large Intestine, Bacteria, and Digestion

Compare the absorption that occurs in the small intestine with what occurs in the large intestine. Students should understand that not all bacterial are harmful. Discuss the role of beneficial bacteria found in the digestive system.

Visual Literacy: Figure 8

Direct students' attention to the **Figure 8** photographs and point out the magnified image showing bacteria of the large intestine. Use the question below to help students analyze the photographs and to understand the important role of bacteria in digestion.

Guiding Questions

- | | |
|--|--|
| AL What happens to water in the large intestine? | <i>Some of it gets absorbed by the large intestine.</i> |
| AL Why is it important to have certain types of bacteria in the intestine? | <i>They help to digest food and produce important vitamins.</i> |
| OL Which materials pass through the large intestine? | <i>The waste products of digestion pass through the large intestine.</i> |
| BL What might happen if a person lacks beneficial bacteria in his or her intestine? | <i>Sample answer: The person might experience difficulty digesting food.</i> |
| BL How do the small and large intestines maximize opportunity to absorb nutrients? | <i>Sample answer: Between the small and large intestines, digested food travels almost 9 m before waste is expelled from the body.</i> |

Ask: Cocci bacteria are spherical, bacilli bacteria are rod-shaped, and spirilla bacteria are spiral-shaped. Which type of bacteria is shown in the photo? *bacilli bacteria*

Summarize It!

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

The Digestive System

Use Vocabulary

1. Define enzyme in your own words.

2. Distinguish between absorption and digestion.

Understand Key Concepts

3. Where is the first place digestion occurs?

A. mouth C. large intestine
B. stomach D. small intestine

4. Compare the functions of the stomach and the small intestine.

5. Give an example of how the digestive system affects other body systems.

Interpret Graphics

6. Explain how do structures like the one to the right affect digestion?



7. Organize Information Copy and fill in the graphic organizer below to show how food moves through the digestive tract.



Critical Thinking

8. Infer what would happen if food passed more quickly than normal through the digestive system.

Math Skills

9. If the total length of the intestines is 8.5 m and the large intestine is 1.5 m long, what percentage of the intestines is made up of the small intestine?

My Notes



2018

Use Vocabulary

- Possible answer: An enzyme is a protein that helps to break down food. Some responses might include that enzymes help speed up reactions. **DOK 1**
- Absorption occurs when the cells of the digestive system take in digested food particles. Digestion occurs when food is broken down into small particles. **DOK 2**

Understand Key Concepts

- A. mouth **DOK 2**
- The stomach stores food and aids in chemical digestion. The small intestine chemically digests food and absorbs nutrients. **DOK 2**
- Sample Answer: The blood in the circulatory system absorbs the products of digestion. **DOK 2**

Interpret Graphics

- Villi help move nutrients out of the small intestine and into the blood. **DOK 3**
- mouth, esophagus, stomach, small intestine, large intestine **DOK 2**

Critical Thinking

- Answers may vary. Food might not have time to be fully digested, leaving fewer nutrients available for absorption. **DOK 2**

Math Skills

- 82.4 percent **DOK 1**

INQUIRY

A Sweaty Job? Did you know that these are the ridges on a fingertip? The circular openings along the ridges are sweat glands. The sweat from these glands can leave a mark or fingerprint, on objects that you touch. Why does sweat, or any material, leave your body?

Write your response in your notebook.



Explore Activity

What happens when you breathe out?

Look again at the photo of the fingertip on the previous page. The sweat glands in your skin are one way substances leave your body. Do substances also leave your body when you breathe out?

Procedure

1. Read and complete a lab safety form.
2. Take a deep breath and hold it.
3. Breathe out through your mouth into a **plastic bag**. Leave a small opening to allow some of the air to leave the bag as you blow into it.
4. Remove the bag from around your mouth. Let the air escape from the bag, but do not push the sides of the bag together.
5. Using the same plastic bag, repeat steps 2–4 three more times.
6. Observe the contents of the bag. Record your observations in your Science Journal.

Think About This

1. Did the plastic bag look different after you breathed into it? Explain.
2. What do you think was in the plastic bag at the end of the activity?
3. Based on your observations, do you think the respiratory system is part of the excretory system? Explain.

Essential Questions

- What does the excretory system do?
- How do the parts of the excretory system work together?
- How does the excretory system interact with other body systems?

Vocabulary

excretory system
kidney
nephron
urine
urter
bladder
urethra

INQUIRY

About the Photo A Sweaty Job? The magnified ridges on the fingertip in the photo illustrate the role of skin in the excretory system. The sweat glands, which are small circular openings along the ridges, are difficult to see. Sweat glands are found almost everywhere on the skin. Although the main purpose of perspiration is to cool the body and help maintain the body's temperature, it also contains waste products, such as salt and urea, from cellular activities.

Guiding Questions

- AL** Do you think a person's sweat glands can make sweat without a person being aware of it? *Explain that sweat may not be noticeable unless a lot of it is being produced. Other organs of the excretory system are also working without a person being aware of them.*
- OL** Why does perspiration, or any material, leave your body? *To rid the body of waste products.*
- BL** What other organs are involved in removing wastes from the body? *Students might mention the lungs, the large intestine, the kidneys, or other organs of the urinary system.*

LAB Manager

Labs can be found in the *Student Resource Handbook* and the *Activity Lab Workbook*.

Essential Questions

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

Vocabulary Be a Word Detective

1. Write the words *excrete*, *excretion*, and *excretory* on chart paper or the board. Add descriptions as students answer the questions.
2. Have students look up the words in a dictionary. **Ask: What part of speech is each word? What does each word mean?** *Answers will vary depending on the dictionary. Sample answer: Excrete is a verb that means "to discharge waste matter from the body." Excretion is a noun that means "the waste matter that is discharged from the body." Excretory is an adjective that means "involved in or used in excretion."*

LESSON 9.2 Review

The Excretory System

Visualize It!



The excretory system collects and eliminates wastes from the body and regulates the level of fluid in the body.



The respiratory system is one of the body systems that make up the excretory system.



The organs of the urinary system process, transport, collect, and excrete waste.

Summarize It!

1. What does the excretory system do?

2. How do the parts of the excretory system work together?

3. How does the excretory system interact with other body systems?



Use Vocabulary

- Define the word *excrete* in your own words.
- Distinguish between *ureter* and *urethra*.
- Use the term *bladder* in a sentence.

Understand Key Concepts

- The kidneys filter wastes from the
 - A. blood
 - B. intestine
 - C. lungs
 - D. skin
- Construct a diagram of the urinary system showing the production and flow of urine.
- Distinguish between the excretory functions of the respiratory system and the integumentary system.

Interpret Graphics

- Identify the function of the highlighted portion of the diagram to the right.
- Organize Information Copy and fill in the table below with details about each organ of the urinary system.



Organ	Structure and Function

Critical Thinking

- Hypothesize What might happen if urine did not go through a second filtration?
- Evaluate the role of the hypothalamus in maintaining the level of fluid in the body.

Visual Summary

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

Use Vocabulary

- Answers will vary. Possible answer: A nephron is a network of capillaries and small tubes that filter blood in the kidneys. **DOK 1**
- Ureters are tubes that connect the kidneys to the bladder. The urethra is the tube through which urine leaves the bladder. **DOK 2**
- Answers will vary. Possible answer; The bladder is like a balloon that expands and contracts as urine is stored and excreted. **DOK 1**

Understand Key Concepts

- A. blood **DOK 1**
- Diagrams should show production of urine in the kidney. Urine moves from the kidney to the ureter, to the bladder, to the urethra, and out of the body. **DOK 2**
- The excretory function of the respiratory system is to eliminate carbon dioxide and water during breathing. The excretory function of the integumentary system is to eliminate water and salts during perspiration. **DOK 2**

Interpret Graphics

- Wastes are being filtered from the blood. **DOK 2**
- DOK 1**

Organ	Structure and Function
Kidney	bean-shaped organ that filters wastes from blood
Ureters	tubes through which urine leaves the kidneys
Bladder	muscular sac that holds urine until the urine is excreted
Urethra	tube through which urine leaves the bladder

Critical Thinking

- Too much water would be excreted and nutrients would be lost. This could lead to dehydration and nutrient deficiency. **DOK 3**
- The hypothalamus controls hormones that cause the kidneys to absorb or retain water. If this function was not working properly, the body might have too much or too little fluid. **DOK 3**

9 Study Guide

The BIG Idea

The digestive and excretory systems move materials through the body and remove waste. The digestive system also absorbs nutrients.

Key Concepts Summary

9.1: The Digestive System

- The function of the digestive system is to break down food and absorb nutrients for the body.
- Organs of the digestive system include the mouth, **esophagus**, stomach, small intestine, and large intestine.
- The digestive system interacts with other body systems to maintain the body's internal balance.



Vocabulary

digestion
mechanical digestion
chemical digestion
enzyme
esophagus
peristalsis
chyme
villi

9.2: The Excretory System

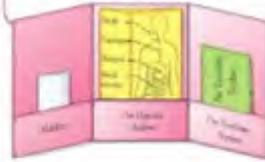
- The function of the **excretory system** is to collect and eliminate wastes from the body and regulate the level of fluids in the body.
- The excretory system is made up of the digestive system, respiratory system, urinary system, and the integumentary system.
- The excretory system works with other body systems, including the nervous system, to maintain homeostasis.



excretory system
kidney
nephron
urine
ureter
bladder
urethra

FOLDABLES Chapter Project

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

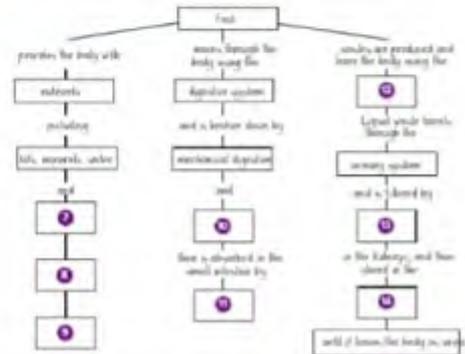


Use Vocabulary

- About 25–35 percent of your total daily _____ should be from fats.
- One type of nutrient _____ is made of long chains of sugars.
- Food moves down the esophagus by _____.
- The breakdown of food into small particles and molecules is called _____.
- A tube that connects a kidney to the bladder is called a(n) _____.
- Urine is stored in(n) _____.

Link Vocabulary and Key Concepts

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



Key Concepts Summary

Study Strategy: Bulleted Lists

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

- Have students write a question from each lesson heading. For example, the question for **Lesson 1** could be *What is nutrition?*
- Students should reread each lesson to create a bulleted list below the lesson question. For example:

What is nutrition?

- Proteins protect against disease, relay signals between cells, provide support to cells, speed up chemical reactions.*
- Carbohydrates: body's major source of energy.*
- Fats: major part of cell membranes, help insulate against cold temperatures.*

- You may want to have students work individually or in small groups to complete their bulleted lists.
- An alternative approach would be to divide the class into three groups and assign each group one lesson. Groups can then share bulleted lists for the other lessons.

abc Vocabulary

Study Strategy: Categorizing

Ask students to put vocabulary words into categories. Placing vocabulary words into categories promotes understanding.

- Have students use plain paper to create the following chart.

Nutrients My Body Uses to Stay Healthy	Body Parts Used to Process Food	Body Processes	What My Body Produces
--	---------------------------------	----------------	-----------------------

- Have students work individually to place the vocabulary words from each lesson into the chart. **Ask:** In which column would you place the word *protein*? Where would you place *esophagus*? Have students continue independently.
- Have students meet in small groups to compare their charts and discuss why they chose to place words in particular columns.

Understand Key Concepts

- What are proteins made of?
 - amino acids
 - minerals
 - sugars
 - vitamins
- Which would be considered a grain?
 - black beans
 - brown rice
 - canola oil
 - lean chicken
- What is the main source of energy for your body?
 - carbohydrates
 - minerals
 - proteins
 - water
- Look at the diagram below. Where does most absorption of nutrients occur?
 
 - A
 - B
 - C
 - D
- What is the correct order for how food is processed in the digestive system?
 - absorption, digestion, ingestion, elimination
 - elimination, ingestion, absorption, digestion
 - ingestion, absorption, digestion, elimination
 - ingestion, digestion, absorption, elimination
- What organ is shown below?
 
 - bladder
 - hypothalamus
 - kidney
 - ureter
- What organ produces a substance that neutralizes acid from the stomach?
 - esophagus
 - gallbladder
 - liver
 - pancreas
- What fluid produced in the mouth contains digestive enzymes?
 - bile
 - blood
 - chyme
 - saliva
- Carbon dioxide is eliminated by which body system?
 - digestive system
 - integumentary system
 - respiratory system
 - urinary system
- What is produced by the urinary system?
 - blood
 - feces
 - perspiration
 - urine
- The bladder is most similar to which object?
 - a balloon
 - a tube
 - a folded paper
 - a rigid container

Critical Thinking

- Distinguish between minerals and vitamins.
- Hypothesize why a child might have different nutritional needs than an adult over the age of 60.
- Select Study the nutrient information below. Select the snack that would be a better choice as part of a healthy lifestyle. Explain your choice.

Nutrient Information	Tortilla Chips	
	Fried	Baked
Calories	150	100
Calories from fat	60	5
Total fat (g)	7	1
Saturated fat (g)	1	0
Sodium (mg)	135	200
Total carbohydrate (g)	22	24
Sugars	3	0
Protein	3	2

- Differentiate Suppose your teacher showed you a diagram of a small intestine and a diagram of a large intestine. How might you distinguish between them?
- Hypothesize How might digestion be affected if a person swallowed his or her food without first chewing it?
- Critique the following statement: "Bacteria are harmful and should not be in the digestive system."
- Compare the excretions of the urinary system and the digestive system.

Writing a Sentence

- Create a commercial to encourage people to eat a healthy amount from each food group. Include a setting and dialogue for your commercial.

The BIG Idea

- Give examples of how the digestive system and excretory system help to maintain homeostasis.

- What is the function of the small intestine?



Math Skills

Use Percentages

Use the table below to answer questions 22–24.

Location of fat	Time in location (hrs)
Stomach	4
Small intestine	6
Large intestine	24

- What percentage of the total digestive time does food spend in the stomach?
- What percentage of the total digestive time does food spend in the large intestine?
- What percentage of the total digestive time does food spend in the stomach and the small intestine combined?

Understand Key Concepts

- A. amino acids
- B. brown rice
- A. carbohydrates
- C. small intestine
- D. ingestion, digestion, absorption, elimination
- C. kidney
- D. pancreas
- D. saliva
- C. respiratory system
- D. urine
- A. a balloon



Critical Thinking

- Vitamins aid in growth, regulate body functions, and prevent some diseases. Minerals are elements that regulate many chemical reactions in the body.
- Answers will vary. A child is still growing, while an adult over 60 has stopped growing. Young children require diets that are higher in fat, while an adult may need a diet rich in calcium to support bone health. Also, their activity levels are likely different.
- Baked tortilla chips would be a better choice. They have fewer calories from fat, less saturated fat, and less sugar.
- The small intestine is longer in length and smaller in diameter than the large intestine. It is also lined with villi.
- Chewing breaks up food into smaller pieces. If food were not chewed, it would take longer to digest or might not digest completely.
- The statement is false because certain bacteria are needed for digestion of food.
- The urinary system produces urine that contains wastes from the blood. The digestive system produces solid wastes mostly from undigested food.

Standardized Test Practice

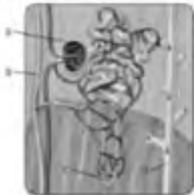
Record your answers on the answer sheet provided by your instructor or on a sheet of paper.

Multiple Choice

1 Which process depends on enzymes?

- A Chemical digestion
- B elimination
- C mechanical digestion
- D respiration

Use the diagram below to answer question 2.



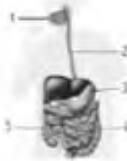
2 Where does the first filtration process occur in the nephron shown above?

- A A
- B B
- C C
- D D

3 Which factor does NOT influence how much energy a person needs?

- A age
- B gender
- C height
- D weight

Use the diagram below to answer questions 4 and 5.



4 In which part of the system pictured above does chemical digestion begin?

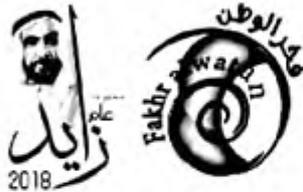
- A 1
- B 2
- C 3
- D 4

5 In the diagram above, from which organ are nutrients absorbed into the bloodstream?

- A 2
- B 3
- C 4
- D 5

6 What is a main function of the excretory system?

- A fight disease
- B move limbs
- C pump blood
- D remove wastes



Standardized Test Practice

7 Which part of the brain works with the urinary system to help maintain homeostasis?

- A cerebellum
- B cerebrum
- C hypothalamus
- D medulla

Use the diagram below to answer question 8.



8 In the diagram above, where is urine produced?

- A 1
- B 2
- C 3
- D 4

9 Which system works with the digestive system to carry nutrients to the cells of the body?

- A circulatory
- B excretory
- C lymphatic
- D respiratory

Constructed Response

Use the table below to answer questions 10 and 11.

Nutrient	Example of Food
Carbohydrates	
Fats	
Minerals	
Proteins	
Vitamins	
Water	

10 In the table above, the six main groups of nutrients are provided. What is an example of a food that contains each nutrient? What is the function of each nutrient in the body?

11 Explain how the nutrients in the table above are related to eating a balanced diet.

Use the table below to answer question 12.

Process	Description
Ingestion	
Digestion	
Absorption	
Elimination	

12 When a person eats food, the food undergoes four processes in the digestive system. Briefly describe each process provided in the table above.

Need Extra Help?

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

Multiple Choice

- 1 **A—Correct.** B, C, D—Enzymes are not part of the elimination of solid or liquid wastes from the body. Mechanical digestion is the breakdown of food into smaller pieces by chewing. Respiration involves breathing in and out through the lungs. **DOK 2**
- 2 **A—Correct.** B, C, D—During the first filtration, water, sugar, wastes, and salt pass from the glomerulus into small tubes. Other structures take part in the second filtration and collection of urine. **DOK 2**
- 3 **C—Correct.** A, B, D—The types and amounts of energy people need depend on factors such as their gender, age, and weight. **DOK 1**
- 4 **A—Correct.** B, C, D—Chemical digestion begins in the mouth and is continued in the stomach and small intestine. No digestion takes place in the large intestine. **DOK 2**
- 5 **C—Correct.** A, B, D—All other organs are used for processing food or moving it along. **DOK 2**
- 6 **D—Correct.** A, B, C—Disease is fought mainly by the lymphatic and immune systems. Limbs are moved when muscles in the muscular system pull on the bones of the skeletal system. The heart pumps blood. **DOK 1**

- 7 **C—Correct.** A, B, D—The hypothalamus produces a hormone that causes tubules in the kidneys to absorb more water. The cerebellum controls balance and coordination. The cerebrum processes language, learning, memory, and voluntary muscle movement. The medulla controls blood pressure and breathing and heart rates. **DOK 1**
- 8 **A—Correct.** B, C, D—When the kidney (1) filters blood as it passes through, it produces urine. Ureters carry urine to the bladder where it is stored until it leaves the body through the urethra. **DOK 2**
- 9 **A—Correct.** B, C, D—Organs that are part of the excretory system carries away the body's wastes. The lymphatic system works to fight disease and keep tissue fluid balanced. The respiratory system supplies oxygen but also has an excretory function as it carries away carbon dioxide. **DOK 2**

Constructed Response

10

Nutrient	Example of Food
Carbohydrates	rice, wheat, corn, potato
Fats	olive oil, avocado
Minerals	vegetables, whole grains, milk, meat
Proteins	fish, beans, beef, chicken
Vitamins	oranges, broccoli
Water	water, juices

Carbohydrates are the body's major source of energy. Proteins are in all cells and speed up chemical reactions. Fats provide energy, help absorb vitamins, and form cell membranes. Body fat provides insulation against cold temperatures. Vitamins promote growth, regulate body functions, and prevent some diseases. Minerals help build parts of the body, such as bones and teeth, and regulate many chemical reactions. Water makes up most of blood, is needed for chemical reactions and transports wastes and other materials. **DOK 2, 3**

11 Answers will vary. Possible answer: A healthful diet includes carbohydrates, fats, minerals, proteins, vitamins, and water. Your body needs each type of nutrient because each performs a unique function. To get each type of nutrient, you have to eat a balanced diet. **DOK 1**

12 Answers will vary. Possible answers:



DOK 3

Answer Key

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

10 Respiration and Circulation

The BIG Idea

How do the respiratory and circulatory systems help maintain the body's homeostasis?



LESSON

10.1 The Respiratory System

- What does the respiratory system do?
- How do the parts of the respiratory system work together?
- How does the respiratory system interact with other body systems?



LESSON

10.2 The Circulatory System

- What does the circulatory system do?
- How do parts of the circulatory system work together?
- How does the circulatory system interact with other body systems?



LESSON

10.3 Blood

- What does the blood do?
- How do the parts of the blood differ?



LESSON

10.4 The Lymphatic System

- What does the lymphatic system do?
- How do the parts of the lymphatic system work together?
- How does the lymphatic system interact with other body systems?



Oxygen in, Carbon Dioxide out

The human body has systems that perform specific functions. Place an X before the system or systems you think are responsible for moving the gases oxygen and carbon dioxide.



- | | | |
|------------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> muscular | <input type="checkbox"/> skeletal | <input type="checkbox"/> respiratory |
| <input type="checkbox"/> digestive | <input type="checkbox"/> endocrine | <input type="checkbox"/> immune |
| <input type="checkbox"/> excretory | <input type="checkbox"/> circulatory | <input type="checkbox"/> nervous |

Explain your thinking. Why did you check off that system or systems?

How do the respiratory and circulatory systems help maintain the body's homeostasis?

The BIG Idea

There are no right or wrong answers to these questions. Write student-generated questions produced during the discussion on the margin of the board and return to them later in the chapter.

Guiding Questions

- AL** What is meant by respiration? *Use this question to assess students' understanding of the difference between breathing and respiration. Breathing is the movement of air into and out of the lungs. Respiration is the transport of oxygen to cells and includes cellular activity.*
- OL** How is oxygen taken into the body? How does oxygen reach the body's cells? *Use these questions to assess students' understanding of the circulatory system.*
- BL** In what way do the body's respiratory system and circulatory system work together? *Use this question to initiate a discussion about how one body system is dependent on others to maintain homeostasis.*

Get Ready to Read

What do you think?

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

Anticipation Set for Lesson 1

- Breathing and respiration are the same.**
Disagree. Breathing is the movement of air into and out of the lungs; respiration is a broader term including cellular activity.
- Lungs are the only part of the body that use oxygen.**
Disagree. All cells throughout the body need oxygen.

Anticipation Set for Lesson 2

- There are four chambers in a human heart.**
Agree. The heart has two upper chambers, called atria, and two lower chambers, called ventricles.
- Blood travels in both directions in veins.**
Disagree. Valves in veins keep blood traveling toward the heart.

10.1 The Respiratory System

INQUIRY

Cleaning Up? The hairlike structures shown here are called cilia (SIGH lee uh). They move together in wavelike motions. Cilia line the air passages in your nose, throat, and lungs. The round particles on top of the cilia are bits of dust and other things that can block or irritate airways. What do you think these cilia are doing?

Write your response in your notebook.



Explore Activity

How much air is in a breath?

Procedure

Do your lungs empty completely every time you breathe out? You can use a balloon to find out.



1. Read and complete a lab safety form.
2. Place your hands on your ribs as you breathe in and out. Record your observations in your Science Journal.
3. Breathe in normally. Breathe out normally into a balloon. Twist and hold the end of the balloon.
4. Have your partner use a metric tape measure to measure around the balloon at its widest point. Record the measurement. Let the air out of the balloon.
5. Breathe in normally again. Breathe out as much air as you can into the balloon. Twist and hold the end. Repeat step 4.
6. Switch roles with your partner, and repeat steps 3–5 using a different balloon.

Think About This

1. Was there a difference in the two measurements? Why do you think this happened?

2. **Key Concept** How do your lungs interact with the bones and muscles of your chest?

Essential Questions

- What does the respiratory system do?
- How do the parts of the respiratory system work together?
- How does the respiratory system interact with other body systems?

Vocabulary

- breathing
- pharynx
- trachea
- bronchi
- lungs
- diaphragm

INQUIRY

About the Photo What makes the bubbles? Use the photo to start a discussion that connects students to The Big Idea. To focus the discussion, ask the class the questions below.

TIP Creating Graphic Organizers As students work through the lessons, have them create flowcharts to show how one process leads to another in the respiratory and circulatory systems.

Guiding Questions

- AL** Why does the diver need air while she's under water? *Students should already know that humans need to breathe. Our bodies need air to take in oxygen and eliminate carbon dioxide.*
- OL** Why do bubbles form when the diver breathes out? *Use this question to discuss the importance of the body's releasing waste products, such as carbon dioxide.*
- BL** How do you think your respiratory system helps your body maintain homeostasis? *Respiration is necessary to keep a body balanced because every cell needs oxygen to stay alive.*

Guiding Questions

- AL** Where are cilia located in the body? *They are located in the nose, throat, and lungs.*
- OL** What do you think these cilia are doing? *They are moving with a wavelike motion, pushing particles out of, or away from, the lungs.*
- BL** Where do those particles end up? *Some are exhaled from the nose. Others are swallowed and pass through the stomach and intestines to be expelled with other body waste. Others are coughed out.*

Essential Questions

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

Cleaning Up? Explain that the cilia in the photo, magnified many times, perform a vital function—ridding airways of dust and other foreign particles.

The Respiratory System

Use Vocabulary

- The trachea branches into two narrower airways called _____.
- Capillaries surround the _____, where gas exchange occurs.
- Distinguish** between breathing and respiration.

Understand Key Concepts

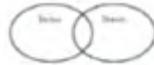
- Explain** how the nose helps to clean air as the air enters the respiratory system.
- Describe** the functions of the respiratory system.
- Which body system helps the respiratory system bring oxygen into the body?
 - circulatory
 - digestive
 - excretory
 - muscular

Interpret Graphics

- Explain** how oxygen moves into and out of the structures shown to the right.



- Compare** Copy and fill in the Venn diagram below to explain the similarities and differences between the trachea and the bronchi.

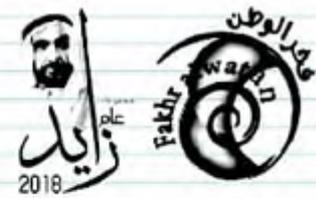


Critical Thinking

- Compose** a letter explaining why a friend of the family should stop smoking. Focus on the health reasons.
- Justify** Imagine that you answered a question in class by saying the contraction of the diaphragm causes a person to inhale. Another student disagrees. Justify your answer using words and a drawing.

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My Notes



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Use Vocabulary

- bronchi **DOK 1**
- alveoli **DOK 1**
- Breathing is the movement of air into and out of the lungs. Respiration is the use of oxygen by cells to release energy stored in glucose. **DOK 1**

Understand Key Concepts

- Mucus and hairs trap dirt. Cilia prevent particles from penetrating deep into respiratory system. **DOK 1**
- The respiratory system brings in oxygen and eliminates carbon dioxide in the body so that cells can function. **DOK 1**
- D. muscular **DOK 1**

Interpret Graphics

- Answers will vary, but should indicate that air moves into the alveoli through the upper parts of the respiratory system. Oxygen passes through the walls of the alveoli and the capillaries that are in contact with them and is then taken up by red blood cells. **DOK 2**

- Trachea: larger diameter; held open by C-shaped rings of cartilage; branches into two bronchi; Overlap: tube-shaped; branch into smaller tubes; help move air into and out of lungs; Bronchi: smaller diameter; branch into bronchioles; lead into lungs **DOK 2**

Critical Thinking

- Answers will vary. Students should point out that smoking is associated with several serious respiratory diseases, including emphysema and cancer. Students might note that smoking also can worsen bronchitis, pneumonia, and asthma. **DOK 3**
- Answers will vary. Drawings should show that the diaphragm moves down when it contracts, increasing space inside the chest, which lowers air pressure and leads to inhalation. **DOK 3**

10.2 The Circulatory System

INQUIRY

Where To? How does food get from where it's grown to your dinner table? Food and most other products that people need are transported on roads and highways. Believe it or not, the vessels that carry blood through your body share similarities with roads and highways.

Write your response in your notebook.



Explore Activity

How fast does your heart beat?

Have you ever felt your heart beat speed up when you're exercising or when you're watching a scary movie? You can take your own pulse to find out how many times your heart beats every minute.



1. Read and complete a lab safety form.
2. Sit quietly for 1 minute.
3. Feel your pulse by placing the middle and index fingers of one hand on an artery in your neck or an artery in your wrist.
4. While sitting quietly, count the number of heartbeats you feel in 30 seconds. Multiply this number by two to calculate your pulse. Record your data in your Science Journal.
5. Jog in place for 1 minute.
6. Immediately repeat step 4.

Think About This

1. How do your pulse after exercising compare to your resting pulse?

2. **Key Concept** Why do you think your pulse changed when you exercised?

Essential Questions

- What does the circulatory system do?
- How do parts of the circulatory system work together?
- How does the circulatory system interact with other body systems?

Vocabulary

- atrium
- ventricle
- artery
- capillary
- vein
- systemic circulation
- coronary circulation
- pulmonary circulation
- atherosclerosis

INQUIRY

About the Photo Where To? The analogy of the circulatory system to a highway system is appropriate. In fact, major roads carrying a lot of traffic in and around a city are often called arteries.

Guiding Questions

- AL** How does an item in your household get from where it's produced to your home? *Students should recognize that many products are shipped on trucks via highways.*
- OL** What is it about the kinds of roads shown in the photo that makes them analogous to blood vessels? *They are expressways, with no stoplights, so traffic moves unimpeded. Traffic also flows in one direction on specific roads, similar to blood vessels.*
- BL** What common situation at rush hour provides yet another analogy to the circulatory system? *The flow of vehicles is sometimes halted by a traffic jam. This is analogous to a blockage in an artery that stops the flow of blood.*

Essential Questions

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

Vocabulary
Comparing Two Similar Terms

1. Write the word *atherosclerosis* on chart paper or on the board.
2. Explain that atherosclerosis is a buildup of fatty deposits within the walls of arteries. Sclerosis refers to hardening of a tissue.
3. Tell students they may sometimes encounter a similar word, arteriosclerosis, which means literally "hardening of the arteries." Some hardening of the arteries often occurs naturally with aging, but it can be made worse by the accumulation of various kinds of deposits, including calcium.
4. Atherosclerosis, like arteriosclerosis, causes arteries to lose their flexibility. Explain that atherosclerosis is a specific form of arteriosclerosis, and it is the term that is nearly always used in relation to the cause of most heart attacks and strokes.

Explore Activity

How fast does your heart beat?

Prep: 5 min Class: 10 min

Purpose

To explore how pulse rate is affected after moderate exercise.

Materials

Student: stopwatches or a clock with a second hand

Before You Begin

Before starting this lab, make sure no students have heart or respiratory problems.

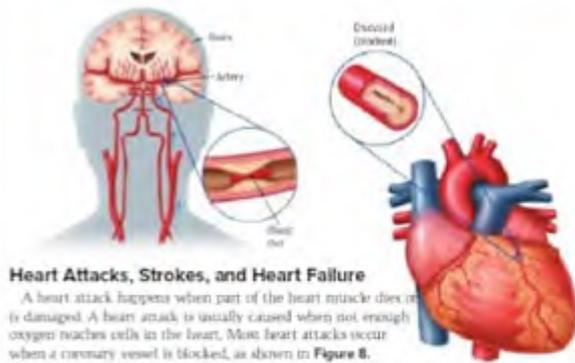
Guide the Investigation

- Read and check students' lab safety forms.
- **Troubleshooting** If there is a student who cannot participate in exercising, he or she could act as official timekeeper.
- The teacher should model how to correctly take both a carotid pulse (place two fingers on either side of your jaw) and a radial pulse (place two fingers on your wrist below the thumb).
- The teacher should ensure that students understand why they multiply the number of beats in 30 seconds by 2 to find their pulse rate.
-  Be sure students allow enough space to jog in place for 1 min without injuring themselves or others.

Think About This

1. The pulse rate increased with activity.
2. **Key Concept** Greater activity requires the heart to pump more oxygen-rich blood to the muscles and to carry away carbon dioxide, which builds up in cells.

Teacher Note



Heart Attacks, Strokes, and Heart Failure

A heart attack happens when part of the heart muscle dies or is damaged. A heart attack is usually caused when not enough oxygen reaches cells in the heart. Most heart attacks occur when a coronary vessel is blocked, as shown in Figure 8.

A stroke happens when part of the brain dies or is damaged. Most strokes are caused when not enough oxygen reaches cells in the brain. A stroke might occur if a blood clot blocks a blood vessel in the brain, also shown in Figure 8.

Heart failure occurs when the heart is not working efficiently. It can result from a previous heart attack, a problem with heart valves, or diseases that damage the heart.

Preventing Circulatory System Disorders

Some risk factors for circulatory system diseases cannot be avoided. For example, if one of your parents has a circulatory disease, you might have inherited a slightly higher risk of developing a similar disease. However, most risk factors can be controlled by making good life choices, like eating a healthful diet, controlling weight, exercising, and not smoking.

The Circulatory System and Homeostasis

The circulatory system is closely connected with other body systems. Once oxygen enters your body, the respiratory system interacts with the circulatory system and transports oxygen to your body's cells. It also transports nutrients from the digestive system and hormones from the endocrine system. The nervous system regulates your heartbeat. Later in this chapter, you'll read how the circulatory and skeletal systems work together.

Academic Vocabulary
factor (noun) something that helps produce a result

Key Concept Check
 How do the circulatory system and the respiratory system work together to maintain homeostasis?

Visualize It!



The contractions of the heart push blood through the circulatory system.



Arteries and veins carry blood through-out the body. Materials move between blood and cells through capillary walls.



Circulatory circulation supplies blood to heart cells.

Summarize It!

1. What does the circulatory system do?
2. How do parts of the circulatory system work together?
3. How does the circulatory system interact with other body systems?

Heart Attacks, Strokes, and Heart Failure

Students should understand the difference between a heart attack and heart failure. They should also understand what a stroke is.

Preventing Circulatory System Disorders

Students should understand what risk factors are and how to control them.

Academic Vocabulary factor

Ask: What are the risk factors of circulatory system diseases? *heredity, smoking, not eating a healthful diet, not exercising, not maintaining a healthful weight*

The Circulatory System and Homeostasis

Explain that the circulatory system plays a key role in maintaining homeostasis.

Guiding Questions

- AL** What is meant by the statement "the circulatory system is closely connected with other body systems"? *It means that the body systems work together; they interact in many different ways.*
- OL** How do the circulatory system and the respiratory system work together to maintain homeostasis? *The circulatory system delivers oxygen from the respiratory system to other parts of the body and transports waste products (carbon dioxide) from the other parts of the body to the respiratory system for removal from the body.*

Visual Literacy: Figure 8

Use the image of the heart and the blocked artery in Figure 8 to discuss the progressive effects of heart disease.



The Circulatory System

Use Vocabulary

1. The narrow blood vessels where gas exchange occurs are _____.
2. The two lower chambers of the heart are _____.
3. Distinguish between veins and arteries.

Understand Key Concepts

4. **Explain** how blood keeps flowing continuously through the body.
5. **Illustrate** at least five parts of the heart and the main blood vessels that enter and leave the heart.
6. A blockage of blood vessels in the brain can cause
 - A. a heart attack.
 - B. a stroke.
 - C. heart failure.
 - D. hypertension.

Interpret Graphics

7. **Identify** the artery and the vein in the figure below. Explain your answer.



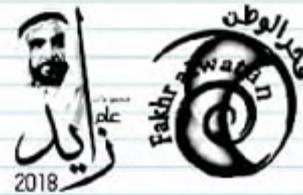
8. **Summarize** Copy and fill in the graphic organizer below to identify the three types of circulation.



Critical Thinking

9. **Design** a daily schedule that includes at least three lifestyle choices that can help you avoid circulatory system disorders.
10. **Justify** A physician has a patient, age 42, whose blood pressure averages 141/89 mm Hg. Why might the physician recommend healthful life choices to the patient?

My Notes



Use Vocabulary

1. capillaries **DOK 1**
2. ventricles **DOK 1**
3. Veins carry blood toward the heart. Arteries carry blood away from the heart. **DOK 1**

Understand Key Concepts

4. Blood keeps flowing continuously through the body because it is pumped by the heart. The circulatory system makes a loop from the heart, through the body (arteries), and back to heart (veins). **DOK 1**
5. Drawings may reflect Figure 4. They should show and label the two atria and two ventricles, the pulmonary arteries and pulmonary veins, the aorta, and the vena cava. **DOK 2**
6. B. a stroke. **DOK 1**

Interpret Graphics

7. The artery is the red blood vessel; it is carrying oxygen-rich blood to the cells. The vein is the blue blood vessel; it is carrying oxygen-poor blood back to the heart. **DOK 2**
8. Systemic; Coronary; Pulmonary (in any order) **DOK 2**

Critical Thinking

9. Answers will vary. Schedules should include dietary considerations, exercise, and avoiding smoking. **DOK 2**
10. The patient's blood pressure is just above normal (120/80). The physician's advice could help the patient avoid hypertension. **DOK 3**

LESSON 10.3 Blood

INQUIRY

Working Hard? You might have noticed that the cheeks of some people turn bright red during vigorous exercise. Why does this happen? The red color comes from blood flowing near the surface of the skin. It helps release excess thermal energy from the body. What else does your blood do?

Write your response in your notebook.



Explore Activity

What do blood cells look like?

Procedure Like every tissue in your body, blood is a tissue made of different cells. Take a look in the microscope to see the different types of blood cells.



1. Read and complete a lab safety form.
2. Observe a prepared blood smear slide under low power on a microscope.
3. Switch to high power, and observe the different cell types on the slide. In your Science Journal, draw one example of each type of cell you see.
4. Return to low power, and remove the slide.

Think About This

1. How many kinds of cells did you observe? How did their appearances differ?

2. **Key Concept** Why do you think there are different kinds of blood cells?



Essential Questions

- What does the blood do?
- How do the parts of the blood differ?

Vocabulary

- platelet
- plasma
- Rh factor

INQUIRY

About the Photo Working Hard? In the photo, Ashley Brown is competing in a Class A girls' 300-m low hurdles preliminary heat at the state track meet in Omaha, Nebraska, on Friday, May 23, 2003. Earlier in the day, Brown set a state record of 14.66 seconds in the 100-meter-high hurdle event. In the image, her cheeks turn red as blood flow increases to capillaries in her face. Blood flow also increases to other parts of her body as her heart beats faster. This supplies her muscles with the oxygen they need and removes the carbon dioxide her muscles produce.

Guiding Questions

OL Why do the girl's cheeks turn red?

Students might propose that she gets hot as she runs and the red cheeks allow some of the thermal energy to leave her body. In this lesson, students will learn that blood helps the body maintain a steady temperature.

BL What else does your blood do?

Students might discuss the role of blood in picking up oxygen in the lungs, transporting it to cells throughout the body, picking up carbon dioxide from body cells, and carrying it to the lungs. Her heart and breathing rates increase to deliver more oxygen for muscles and to carry away carbon dioxide faster.

? Essential Questions

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

abc Vocabulary

Where have you heard it?

1. Write the word *plasma* on chart paper or on the board.
2. **Ask:** Where have you heard this word? Students might mention plasma TVs, plasma used in transfusions, plasma membrane used instead of cell membrane, or other scientific uses.
3. To avoid confusion, tell students that the plasma used in a plasma TV refers to a fourth state of matter that contains a huge number of electrically charged particles. It is another form of a gas.
4. **Ask:** Do you think the kind of plasma in a TV is the same as the plasma in blood? No, the plasma in blood is a liquid.
5. Tell students that blood cells and other materials are transported in this liquid.
6. Have students write each of the lesson's vocabulary terms in their Science Journals. Remind them to write the definition after each word as they read the lesson.

Explore Activity

What do blood cells look like?

Prep: 5 min Class: 10 min

Purpose

To observe different types of blood cells.

Materials

Student: microscope, prepared blood-smear slide

Before You Begin

Students should preview **Figure 9** and information on parts of blood.

Guide the Investigation

- Read and check students' lab safety forms.
- Students may need help focusing their microscopes.
- Tell students that one type of blood component they will see is smaller than the others and may not look like a cell.

Think About This

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

1. Students should identify three types of cells—white blood cells, red blood cells, and platelets. White blood cells look like fuzzy spheres; red blood cells are round and have a concave center (like a donut without a hole); and platelets are small and irregularly shaped.
2. **Key Concept** The blood has different types of cells that perform different functions in the body.

Teacher Note

Blood

Use Vocabulary

1. **Identify** the yellowish liquid part of blood.

2. **Distinguish** between plasma and platelets.

3. **Define** the term Rh factor using your own words.

Understand Key Concepts

4. **Give an example** of a blood disorder and explain how it can affect health.

5. Which part of the blood carries dissolved molecules such as glucose and salt?
 - A. plasma
 - B. platelets
 - C. red blood cells
 - D. white blood cells

Interpret Graphics

6. What blood type is shown below? What blood type(s) can a person with this blood type receive in a transfusion?



7. **Organize Information** Copy the table below and list the parts of blood and their functions.

Part of Blood	Functions

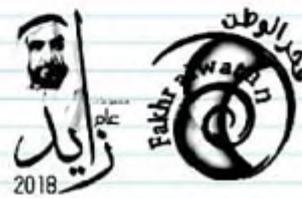
Critical Thinking

8. **Design** a model to show how blood can help regulate body temperature.

Math Skills

9. In the US, 4.2% of people have type A blood, 10% have type B, 4% have type AB, and 4.4% have type O. People with type B and type AB blood can receive type B blood. What percentage of people can receive transfusions of type B blood?

My Notes



Use Vocabulary

1. plasma **DOK 1**
2. Plasma is the liquid part of blood that transports blood cells. Platelets are pieces of cells that help blood to clot. **DOK 2**
3. Sample answer: Rh is a protein (or chemical marker) found on the red blood cells of some individuals. **DOK 1**

Understand Key Concepts

4. Answers will vary. Students should describe one of these disorders: hemophilia, anemia, sickle-cell disease, or leukemia, and its effects on health. **DOK 2**
5. A. plasma **DOK 1**

Interpret Graphics

6. O; A person with type O blood can receive only type O in a transfusion **DOK 2**

Part of Blood	Functions
Red blood cells	carry oxygen
White blood cells	fight infection
Platelets	promote clotting
Plasma	thin blood and transport dissolved substances

DOK 2

Critical Thinking

8. Answers will vary. Students' models should show blood vessels near the surface of the skin widening and illustrate how increasing the volume of blood at the surface of the skin increases thermal loss and can help cool the body. **DOK 3**

Math Skills

9. $10\% + 4\% = 14\%$ **DOK 3**

10.4 The Lymphatic System

INQUIRY

Healthy or Not? Do you know anyone who has had his or her tonsils removed? Tonsils are clusters of lymph tissue that help the body fight off disease. Why do tonsils sometimes get swollen and inflamed, like the ones shown here? Knowing how the lymphatic system works will help you answer that question.

Write your response in your notebook.



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Explore Activity

How can you model a lymph node?



Procedure

Fluid surrounds your body cells. Body cells absorb materials from and release materials into this fluid. Some of the fluid drains into vessels and then drains into spongy structures called lymph nodes. What happens in the lymph nodes?

1. Read and complete a lab safety form.
2. Observe a liquid provided by your teacher. Record the observations in your Science Journal.
3. Use a rubber band to attach a square of cheesecloth to a plastic drinking straw. Hold the straw upright over a paper plate.
4. Use a plastic dropper to squeeze about 1 mL of the liquid into the open end of the straw.
5. Allow the liquid to drain from the cheesecloth and onto the plate. Observe the liquid. Record the observations in your Science Journal.

Think About This

1. What differences did you observe in the liquid after it passed through the cheesecloth?

2. **Key Concept** What do you think the function of the lymph nodes might be?

Essential Questions

- What does the lymphatic system do?
- How do the parts of the lymphatic system work together?
- How does the lymphatic system interact with other body systems?

Vocabulary

- lymphatic system
- lymph
- lymph node
- thymus
- spleen

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INQUIRY

About the Photo Healthy or Not? Point out to students that the tonsils are the two enlarged white areas at the back of the mouth. The white coating and the enlarged size are two clues that the tonsils are infected. The tonsils play a role in the body's response to infection by trapping and destroying microorganisms that enter the throat. Tonsillitis, inflammation of the tonsils, is due to bacterial or viral infection. It causes a sore throat, fever, and difficulty in swallowing.

Guiding Questions

AL What can be done if your tonsils often become infected?	<i>They can be removed. Your body can function without tonsils.</i>
OL Why do tonsils sometimes get swollen and inflamed?	<i>Students may suggest that the tonsils trapped viruses or bacteria, which then infected the tonsils.</i>
BL How can a person with no tonsils get rid of invading bacteria?	<i>Students might suggest that other parts of the immune system destroy the bacteria.</i>

Essential Questions

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

Vocabulary

Venting Your Spleen

1. Write the word *spleen* on the board.
2. Tell students that people in the Middle Ages used to believe that the spleen was the seat of emotions or passions. The spleen was thought to be the source of "humours," or body fluids that caused anger.
3. **Ask:** Have you ever heard the phrase *venting your spleen*? What does it mean? *to express your anger*
4. Have each student write a sentence using the phrase. Ask students to read their sentences to the class.

Explore Activity

How can you model a lymph node?

Prep: 5 min Class: 10 min

Purpose

To model how lymph nodes function.

Materials

Student: large diameter plastic drinking straws ; cheesecloth squares; rubber bands; clear, colored liquid; paper plates; droppers

Before You Begin

- Provide containers with small amounts of the test liquid for students to share. To prepare the liquid, mix very small beads (such as seed beads) into a clear liquid, such as a clear shampoo. It might be necessary to snip the ends from plastic droppers to enable the liquid to flow into the dropper.
- Ask students how blood moves through the body.

Guide the Investigation

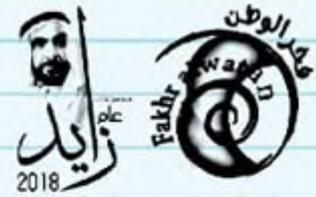
- Read and check students' lab safety forms.
- Discuss with students what the straw, liquid, and cheesecloth represent in the model (the straw—lymph vessel; the liquid—tissue fluid or lymph; the cheesecloth—lymph node; the beads—bacteria).
- After the investigation, have students hypothesize the functions of lymph and lymph nodes.

Think About This

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

1. The cheesecloth absorbs some of the liquid and filters the liquid.
2. Key Concept Answers will vary. Students should hypothesize that lymph nodes filter harmful substances (viruses, bacteria) and waste (dead cells) out of tissue fluid.

Teacher Note



10.4 Review

Digestion and Excretion

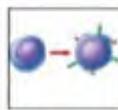
Visualize It!



Tissue fluid that drains into the lymph vessels becomes lymph.



The lymphatic system consists of lymph nodes, lymph vessels, lymph, and some other organs.



The lymphatic system cleans lymph, fights infection, and includes structures in which white blood cells develop.

Summarize It!

1. What does the lymphatic system do?

2. How do the parts of the lymphatic system work together?

3. How does the lymphatic system interact with the circulatory system?



Use Vocabulary

1. Define the term *lymph*.

2. Distinguish between the spleen and the thymus.

3. Clusters of small, spongy structures that filter particles from lymph are called _____.

Understand Key Concepts

4. Describe the function of the lymph nodes.

5. Distinguish between lymph and tissue fluid.

6. The lymphatic system cleans fluid for which system?
 - A. circulatory
 - B. digestive
 - C. immune
 - D. respiratory

Interpret Graphics

7. Identify the structures of the lymphatic system shown in the figure below.



8. Summarize Copy and fill in the graphic organizer below to identify the functions of the lymphatic system.



Critical Thinking

9. Synthesis Design a three-dimensional model of the lymphatic system.

10. Evaluate In what ways are the circulatory and lymphatic systems similar? In what ways are they different?

Visual Summary

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

FOLDABLES Review students' eight-page books. Check students' information about the parts of the lymphatic system and their functions.

Use Vocabulary

1. tissue fluid that has entered lymph vessels **DOK 1**
2. The spleen recycles worn-out red blood cells, stores red blood cells, and produces lymphocytes. T cells mature in the thymus. **DOK 1**
3. lymph nodes **DOK 1**

Understand Key Concepts

4. They filter lymph. **DOK 1**
5. Tissue fluid: leaks from capillaries; cells absorb nutrients from it and release wastes into it; most is reabsorbed by capillaries. Lymph: the 10 percent of tissue fluid that is absorbed by lymph vessels and filtered by the lymphatic system. **DOK 2**
6. C. immune **DOK 1**

Interpret Graphics

7. A tonsils; B thymus; C spleen **DOK 2**
8. absorb excess tissue fluid; filter lymph; fight infection (in any order) **DOK 2**

Critical Thinking

9. Answers will vary. Models should include lymph vessels, lymph nodes, thymus, and spleen. **DOK 3**
10. Both systems are composed of vessels and contain white blood cells that fight infection. The lymphatic system filters unneeded particles and contains structures in which lymphocytes develop or are stored. The circulatory system contains red blood cells and platelets, transports needed materials to body cells, and removes wastes from body cells. **DOK 3**

10 Study Guide



The BIG Idea

The respiratory and circulatory systems move materials through the body and remove wastes.

Key Concepts Summary

10.1: The Respiratory System

- The respiratory system provides the body with oxygen and removes carbon dioxide.
- In the **lungs**, oxygen is carried by the **hemoglobin** and the **hemocytes** to the **alveoli**.
- The respiratory system works with the circulatory and muscular systems to maintain homeostasis.



Vocabulary

breathing
pharynx
larynx
trachea
bronchi
lungs
alveoli
diaphragm

10.2: The Circulatory System

- The circulatory system moves materials throughout the body.
- Arteries** carry blood away from the heart. **Capillaries** allow the exchange of materials between blood and body cells. **Veins** return blood to the heart.
- The circulatory system works with the respiratory, digestive, nervous, and excretory systems to maintain homeostasis.



atrium
ventricle
artery
capillary
vein
systemic circulation
coronary circulation
pulmonary circulation
atherosclerosis

10.3: Blood

- Blood transports oxygen, nutrients, and wastes; protects against illness and injury; and regulates body temperature.
- Red blood cells contain hemoglobin and carry oxygen. White blood cells fight infection. **Platelets** help with clotting. **Plasma** is the liquid portion of blood.



platelet
plasma
Rn factor

10.4: The Lymphatic System

- The **lymphatic system** drains waste, excess tissue fluid, and antibodies while moving cells that fight infection.
- Lymph nodes** filter **lymph**. The **spleen** recycles worn out red blood cells, B cells, and T cells. **Antibodies** are the body's defense against invading organisms. T cells mature in the **thymus**.
- The lymphatic system works together with the circulatory system to regulate the amount of fluid between cells.



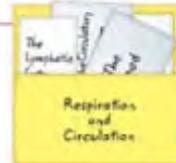
lymphatic system
lymph
lymph node
thymus
spleen

Chapter 10 Study Guide

FOLDABLES

Chapter Project

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

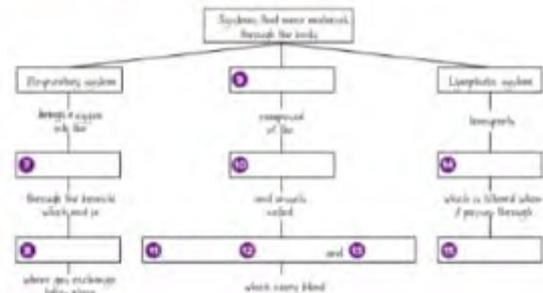


Use Vocabulary

- The large muscle that contracts and relaxes to move gases into and out of the lungs is the _____.
- A **trachea** is a section in which the bronchi swell to _____.
- The smallest blood vessels are _____.
- The two lower chambers of the heart are called _____.
- Small, irregularly shaped pieces of cells in blood are _____.
- The organ that holds a **reservoir** of blood and produces white blood cells is the _____.

Link Vocabulary and Key Concepts

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



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Key Concepts Summary

Study Strategy: Self-Assessment

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

- Ask students to create a chart similar to the one below in their Science Journals.
- Have students use the information in each Key Concept statement to note the role of each body system and how that role is accomplished.

Example:

Body System	What It Does	How It Does It
Respiratory		
Circulatory		
Blood		
Lymphatic		



Vocabulary

Study Strategy: Associating

Ask students to complete a chart as shown. Associating the body part with its purpose will assist students' recall and comprehension.

- Have students create the chart in their Science Journals.
- Students should write each vocabulary word, connect the term with the correct system(s), and define its role in maintaining the body's homeostasis.
- Have students work in small groups to review their charts. Work with each group and clarify any misunderstanding.

Example:

Vocabulary Word	System It is a Part Of	What It Does to Maintain Homeostasis
trachea	respiratory	allows for the flow of air to the lungs

Use Vocabulary

- 1 diaphragm
- 2 bronchitis
- 3 capillaries
- 4 ventricles
- 5 platelets
- 6 spleen

Link Vocabulary and Key Concepts

- 7 trachea
- 8 alveoli
- 9 circulatory system
- 10 heart
- 11 12 13 arteries, capillaries, veins
- 14 lymph
- 15 lymph nodes



Teacher Notes

Understand Key Concepts

1. Which process takes place in the structure shown below?



- A. breathing
- B. immunity
- C. blood clotting
- D. gas exchange

2. Which structure is held open by rings of cartilage?

- A. alveolus
- B. larynx
- C. pharynx
- D. trachea

3. What happens to the diaphragm during inhalation?

- A. It contracts and moves down.
- B. It contracts and moves up.
- C. It relaxes and moves down.
- D. It relaxes and moves up.

4. Which term describes the main function of pulmonary circulation?

- A. fight infection
- B. oxygenate blood
- C. produce T cells
- D. stop bleeding

5. Which type of circulation supplies oxygen to the cells of the heart?

- A. coronary
- B. lymphatic
- C. pulmonary
- D. systemic

6. Which organ keeps blood flowing through the body?

- A. heart
- B. lungs
- C. spleen
- D. thymus

7. The arrow in the diagram below points to which structure?



- A. aorta
- B. atrium
- C. vein
- D. ventricle

8. Which part of the blood helps defend the body from a virus infection?

- A. plasma
- B. platelets
- C. red blood cells
- D. white blood cells

9. What is the primary role of hemoglobin in blood?

- A. attract platelets
- B. blood typing
- C. carry oxygen
- D. fight parasites

10. Which body system filters infection-causing organisms from tissue fluids?

- A. circulatory
- B. immune
- C. lymphatic
- D. respiratory

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Critical Thinking

11. Illustrate the path of air from the nose into the lungs.

12. Compare the structures and functions of the circulatory and lymphatic systems.

13. Give an example of a life choice that can harm the health of both the respiratory and circulatory systems.

14. Interpret Graphics The arrow below points to one of the chambers of the heart. Where does blood entering this chamber come from? Where does it go when it leaves this chamber? Is the blood oxygen-rich or oxygen-poor?



15. Determine A person with type AB blood regularly donates blood to a community service. Determine the blood type(s) that can receive this blood in a transfusion.

16. Synthesis Design a brochure for a tour through the lymphatic system. Include at least the structures of the lymphatic system.

Writing a Sentence

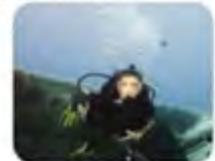
17. Write a paragraph comparing the functions of the alveoli, the capillaries, and the lymph nodes. Your paragraph should have a topic sentence, supporting details, and a concluding sentence.

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The BIG Idea

18. How does oxygen reach the cells of the body? Explain how the respiratory and circulatory systems work together to supply cells with the materials they need.

19. The photo below shows bubbles of gas exhaled by a diver who is breathing from an air tank. Why is it important that the bubbles be released into the water rather than going back into the air tank?



Math Skills

Use Percentages

The table below shows the percentages of the total population in the US with different blood types and with Rh- blood. Use the table to answer questions 20–22.

Blood type	A	B	AB	O
Percent with blood type	42	10	4	44
Percent who are Rh-	6	2	1	7

20. What percentage of people has Rh- blood?

21. What percentage of the total population has AB+ blood?

22. What percentage of people could donate blood to a person with O+ blood?

Understand Key Concepts

1. D. gas exchange
2. D. trachea
3. A. It contracts and moves down.
4. B. oxygenate blood
5. A. coronary
6. A. heart
7. B. atrium
8. D. white blood cells
9. C. carry oxygen
10. C. lymphatic

Critical Thinking

11. Illustrations should resemble Figure 1. Air travels from the nose and mouth into the pharynx, larynx, trachea, bronchi, bronchioles, and alveoli, which make up the lungs.
12. Answers will vary. The circulatory system is made up of the heart, blood vessels, and blood. The heart pumps blood through the blood vessels. Blood transports food, water, and oxygen and removes waste products. The lymphatic system is made up of lymph nodes, lymph vessels (similar to blood vessels), and lymph. Muscle contractions pump tissue fluid and lymph through the lymph vessels. Lymph nodes filter dead cells, bacteria, viruses and other particles out of the fluid and return the fluid to the bloodstream.
13. Answers will vary but may include smoking, poor diet, and lack of exercise.
14. Veins bring deoxygenated blood from the body into the right atrium. From there, the blood flows into the right ventricle and into the lungs. This blood is oxygen-poor.
15. AB only
16. Answers will vary. Students should include tonsils, lymph nodes, the thymus, the spleen, and lymph vessels.

Writing in Science

17. Answers will vary. Students should demonstrate their understanding of each structure's function. Alveoli are the sites of gas exchange between blood and lungs. Capillaries deliver blood to individual cells and remove waste. Lymph nodes filter unneeded particles from lymph fluid, which comes from the circulatory system.



The BIG Idea

18. Answers will vary. Students should describe components of the respiratory and circulatory systems, delivery of oxygen and nutrients to body cells, and removal of carbon dioxide and other wastes from body cells.
19. The bubbles contain carbon dioxide waste from respiration. If the gas went back into the tank, the tank would eventually contain too much carbon dioxide to support breathing.

Math Skills

Use Percentages

22. 11.8 percent
 23. 70.6 percent
 24. 29.4 percent



Intervention Planne

Based on the results of the Chapter Review, use the chart below to address individual needs.

Lesson	Questions	Intervention Options
Understand Key Concepts		
1	1–3	Key Concept Builders
2	4–7	Content Practice
3	8–9	Animations: Respiration; Lungs; Heart; Pulmonary Circulation
4	10	Interactive Concept Map: Systems that move materials through the body Personal Tutor: Four-Chambered Heart
Critical Thinking		
1	11	Enrichment
2	12–14	Challenge
3	15	Virtual Lab: What factors affect the likelihood of hypertension?
4	16	WebQuest: Asthma and Air Pollution
Writing in Science		
4	17	Language Arts Enrichment WebQuest: Asthma and Air Pollution
Review the Big Idea		
1	19	Content Practice
2	18	Enrichment Challenge Online Test Practice
Math Skills		
3	20–22	Math Skills Math Practice: Use Percentages Math Personal Tutor: Find the Percent

Standardized Test Practice

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

Multiple Choice

Use the diagram below to answer question 5.

1 Where in the human body does gas exchange occur?

- A alveoli
- B bronchi
- C pharynx
- D trachea

Use the diagram below to answer question 2.



2 Which numbered blood vessel in the diagram above could be the aorta?

- A 1
- B 2
- C 3
- D 4

3 Which blood component stops the bleeding after a cut?

- A plasma
- B platelets
- C red blood cells
- D white blood cells

4 Which shows the general path of blood from the time it leaves the heart until it returns?

- A arteries → capillaries → veins
- B arteries → veins → capillaries
- C capillaries → arteries → veins
- D veins → capillaries → arteries



5 Which organ is highlighted in the diagram above?

- A heart
- B lung
- C spleen
- D stomach

6 Which blood type can be donated to all humans?

- A type A
- B type AB
- C type B
- D type O

Standardized Test Practice

7 Which is a function of the lymphatic system?

- A circulate blood
- B digest food
- C fight infection
- D transport gas

Use the diagram below to answer question 8.



8 What process do the dotted lines in the diagram represent?

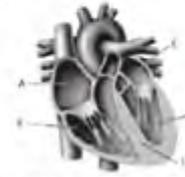
- A gas exchange
- B diaphragm contraction
- C muscle expansion
- D weight increase

9 Which contracts to move lymph through the lymphatic system?

- A heart
- B stomach
- C body muscle
- D heart muscle

Constructed Response

Use the diagram below to answer questions 10 and 11.



10 The four main chambers of the heart are represented by letters in the diagram above. Identify each chamber. What is the structure in the heart represented by the number 1? Describe its function.

11 Use the labels in the diagram to describe in a paragraph the path of blood through the heart.

12 Describe the three types of circulation in the human body.

13 Which organs of the respiratory system help keep dirt and food from entering the lungs? Describe how each functions to protect the lungs.

14 How does your body know when to breathe? How and why does air pressure change in your body as you breathe?

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

Multiple Choice

- A—Correct.** B, C, D—Bronchi, the pharynx, and the trachea are all passageways through which air passes. **DOK 1**
- A—Correct.** B, C, D—In the diagram, (1) represents the aorta, the largest of the arteries. Arteries carry oxygen-rich blood away from the heart to the rest of the body. The aorta and other arteries branch off into arterioles, smaller vessels that branch into tiny vessels known as capillaries (2). Capillaries come together and form venules (3), which come together and form veins (4). Veins carry oxygen-poor blood from various parts of the body to the heart. **DOK 2**
- B—Correct.** A, C, D—Plasma is the liquid component of blood and contains dissolved minerals and other materials. Red blood cells contain hemoglobin, which attaches to oxygen, and white blood cells are part of the immune system. **DOK 2**
- A—Correct.** B, C, D—Arteries carry blood away from the heart and branch out into the smaller arterioles, which branch into the tiny capillaries, where blood delivers nutrients to individual cells and removes waste. Veins return oxygen-deficient blood to the heart. **DOK 2**
- C—Correct.** A, B, D—The highlighted organ in the diagram is the spleen, an organ of the lymphatic system. The heart and lungs are located above the spleen, and the stomach is part of the digestive system. **DOK 2**

- D—Correct.** A, B, C—Type O red blood cells contain no A or B antigens and therefore can be donated to all humans. A, B, and AB blood cells have antigens on the surface that might react with the recipient's antibodies in the blood. **DOK 1**
- C—Correct.** A, B, D—The lymphatic system, part of the immune system, helps destroy microorganisms that enter the body. It also filters dead cells, viruses, bacteria, and other unwanted materials from tissue fluid. Blood circulates through the circulatory system; food is digested in the digestive system; and gases are transported in the respiratory and circulatory systems. **DOK 1**
- B—Correct.** A, C, D—The dotted lines in the diagram illustrate how the diaphragm contracts and moves down during inhalation, expanding the chest cavity and causing air to rush into the lungs until pressure within and outside of the lungs is equalized. **DOK 2**
- C—Correct.** A, B, D—Lymph, tissue fluid absorbed by lymph vessels, is pushed through lymph vessels by contractions of muscles necessary for body movement. Lymph is not pumped by contractions of the heart. The heart pushes blood through the circulatory system. The stomach mixes food and performs some digestion of proteins. The heart muscle contracts and forms the heart beat. **DOK 1**

Constructed Response

10 Answers should indicate that **A** represents the right atrium, **B** the right ventricle, **C** the left atrium, and **D** the left ventricle. Answers should include that structure **1** in the diagram is the septum, which keeps oxygen-rich blood on the left side of the heart from mixing with oxygen-poor blood on the right. **DOK 3**

11 Answers will vary but should include: **A** (the right atrium) receives oxygen-poor blood from the body and pumps blood into **B** (the right ventricle). The right ventricle receives blood from the right atrium and pumps it to the pulmonary artery. **C** (the left atrium) receives oxygen-rich blood from the pulmonary veins and pumps it into **D** (the left ventricle). The left ventricle pumps blood into the aorta and out to the body. **DOK 3**

12 Answers will vary. Possible answer: Pulmonary circulation moves oxygen-poor blood from the heart to the lungs, where oxygen is exchanged with carbon-dioxide, then returns oxygen-rich blood to the heart, where it is pumped to the rest of the body. Coronary circulation moves blood to the heart, providing oxygen and nutrients to cells and removing wastes. Systemic circulation transports oxygen-rich blood from the heart to all other parts of the body and returns oxygen-poor blood to the heart. **DOK 3**

13 Answers will vary but should include some or all of the following: The nose warms the air; nasal hairs and mucus help trap dust and dirt. Wavelike motions of cilia trap particles and keep them from going deep into the lungs. From the nose (and mouth), air moves into the throat, then into the trachea, bronchi, bronchioles, and into the alveoli. **DOK 3**

14 Answers will vary. Possible response: The nervous system senses when the carbon dioxide levels in the blood are high and signals the body to exhale (breathe out). After exhaling, the body automatically inhales (breathes in). The diaphragm, a large muscle below the lungs, contracts and relaxes as a person breathes, which causes air pressure inside the chest to change. When a person inhales, the diaphragm contracts and moves down, increasing the space around the lungs and reducing air pressure in the chest. Then, air enters and fills the lungs until pressure inside and outside the chest are equal. When a person exhales, the space around the lungs decreases because the diaphragm relaxes and moves up. Then air pressure in the chest increases and waste gases leave the lungs. **DOK 3**

Answer Key

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

