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AL = Approaching Level  BL = Beyond Level
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Family Letter

Dear Parent or Guardian:

Today we began Chapter 10: Measurement: Area and Volume. In this chapter, your student will learn how to find the circumference and area of circles and the area and volume of three-dimensional figures. Also, we will learn how to find the area of composite figures. Included in this letter are key vocabulary words and activities you can do with your student.

You may also wish to log on to glencoe.com for other study help. If you have any questions or comments, feel free to contact me at school.

Sincerely,

---

Family Resources

Family Introduction to Course 3 (Available in Chapter 0)
- Talks about the focus of the grade level.
- Gives Web site information.

Family Letter
- English and Spanish
- Overview of the chapter
- Key vocabulary
- Provides at home activities

Chapter Resources

Are You Ready Worksheets
- Use after the Are You Ready section in the Student Edition.
- CN: Review: Approaching-level students
- Practice: On-level students
- DN: Apply: Beyond-level students

Chapter Diagnostic Test
- Use to test skills needed for success in the upcoming chapter.
- Retest approaching-level students after the Are You Ready worksheets.

Chapter Pretest
- Quick check of the upcoming chapter’s concepts to determine pacing.
- Use before the chapter to gauge students’ skill level.
- Use to determine class grouping.
Language Arts Resources

Student Glossary

- Includes key vocabulary terms from the chapter.
- Students record definitions and/or examples for each term.
- Students can use the page as a bookmark as they study the chapter.

Practice and Reinforcement

Facts Practice

- Quick recall of concepts needed in the upcoming chapter.
- Use as a timed test to gauge student mastery of prior concepts.

Lesson Resources

Explore

- Provides additional practice for the activities and exercises found in the Student Edition.
- Use as homework for same-day teaching.

Reteach

- Provides vocabulary, key concepts, additional worked-out examples, and exercises.
- Use for students who have been absent.

Skills Practice

- Focuses on the computational nature of the lesson.
- Use as an additional practice.
- Use as homework for second-day teaching.

Homework Practice

- Mimics the types of problems found in the Practice and Problem Solving of the Student Edition.
- Use as an additional practice.
- Use as homework for second-day teaching.

Problem-Solving Practice

- Includes word problems that apply the concepts of the lesson.
- Use as an additional practice.
- Use as homework for second-day teaching.
Enrich
- Provides an extension of the concepts, offers a historical or multicultural look at the concepts, or widens students’ perspectives on the mathematics.
- For use with all levels of students.

Technology Activities
- Presents ways in which technology can be used with the concepts in some of the lessons.
- Use as an alternative approach to teaching the concept.
- Use as part of the lesson presentation.

Assessment Resources
Reflecting on Chapter 10
- Three open-ended questions
- Allows students to write about mathematics.

Chapter Quizzes
- Free-response questions
- One quiz for each multi-part lesson

Vocabulary Test
- Includes a list of vocabulary words and questions to assess students’ knowledge of those words.
- Use in conjunction with one of the Chapter Tests.

Chapter Tests
- CN 1A-1B Approaching-level students
  - Contains multiple-choice questions.
- 2A-2B On-level students
  - Contains both multiple-choice and free-response questions.
- DN 3A-3B Beyond-level students
  - Contains free-response questions.
  - Tests A and B are the same format with different numbers.
  - Use when students are absent or for different rows.

Standardized Test Practice
- Test is cumulative.
- Includes multiple-choice and short-response questions.
Extended-Response Test
- Contains performance-assessment tasks
- Sample answers are included.

Extended-Response Rubric
- The scoring rubric for the Extended-Response Test.

Student Recording Sheet
- Corresponds with the Test Practice at the end of the Student Edition chapter.

Chapter Project Rubric
- The scoring rubric for the Chapter Project found in the Teacher Edition.

Answers

Chapter and Lesson Resources
- Chapter Resources, Facts Practice, and Lesson Resources are provided as reduced pages with answers appearing in black.

Assessments
- Full-size answer keys are provided for the assessment masters.
Dear Parent or Guardian:

Today we began Chapter 10: Measurement: Area and Volume. In this chapter, your student will learn how to find the circumference and area of circles and the area and volume of three-dimensional figures. Also, we will learn how to find the area of composite figures. Included in this letter are key vocabulary words and activities you can do with your student. You may also wish to log on to glencoe.com for other study help. If you have any questions or comments, feel free to contact me at school.

Sincerely,

______________________________________

Key Vocabulary

**composite figure** A figure made up of two or more shapes.

**cylinder** A three-dimensional figure with congruent, parallel bases that are circles connected with a curved side.

**edge** Where two planes intersect in a line.

**face** A flat surface.

**lateral surface area** For a solid, it is the sum of the areas of all of its lateral faces.

**net** A two-dimensional pattern of a three-dimensional figure.

**polyhedron** A solid with flat surfaces that are polygons.

**slant height** The altitude or height of a lateral face of a regular pyramid.

**total surface area** The sum of the areas of all the faces of a solid.
At-Home Activities

Real-World Activity

- Collect various three-dimensional objects in the home like cereal boxes, oatmeal containers, and so on.

- Measure and label each object with its dimensions.

- Make a table to record the dimensions, surface area, and volume of each object.

- Find some examples of objects that are not the typical three-dimensional objects. Discuss how you might find the volume or surface area of the objects by estimating the volume or surface area of individual parts of the object.

Hands-On Activity

- Unfold a cereal box into a net.

- Find the area of each piece of the net. Then find the surface area of the net. Compare this to the area you would find if you did not unfold the box.

- Make a net of another box and find the area of each piece of the net. Then make the box, measure it, and find the area of each side using formulas. Compare each area to the area of each piece of the net.

- Why may formulas be used in manufacturing boxes?
Estimado padre o apoderado:

Hoy comenzamos el Capítulo 10: Medición: Área y volumen. En este capítulo, su estudiante aprenderá a calcular la circunferencia y el área de círculos y el área y el volumen de figuras tridimensionales. Además, aprenderemos a calcular el área de figuras compuestas. En esta carta se incluyen palabras del vocabulario clave y actividades que pueden realizar con su estudiante. Si desean obtener más ayuda para el estudio, visiten glencoe.com. Si tienen alguna pregunta o desean hacer algún comentario, pueden contactarme en la escuela.

Sinceramente,

Vocabulario clave

- **figura compuesta**: Figura formada por dos o más formas.
- **cilindro**: Figura tridimensional con bases circulares, paralelas y congruentes conectadas por un lado curvo.
- **arista**: Lugar donde se intersecan dos planos en una recta.
- **cara**: Superficie plana.
- **área de superficie lateral**: En un sólido, la suma de las áreas de todas sus caras laterales.
- **red**: Patrón bidimensional de una figura tridimensional.
- **poliedro**: Sólido con superficies planas poligonales.
- **altura oblicua**: Altitud o altura de la cara lateral de una pirámide regular.
- **área de superficie total**: Suma de las áreas de todas las caras de un sólido.
Actividades para el hogar

**Actividad concreta**

- Reúnan varios objetos tridimensionales en el hogar, como cajas de cereal, envases de avena, etc.
- Midan y rotulen cada objeto con sus dimensiones.
- Hagan una tabla para anotar las dimensiones, el área de superficie y el volumen de cada objeto.
- Hallen algunos ejemplos de objetos que no sean los típicos objetos tridimensionales. Comenten cómo calcularían el volumen o el área de superficie de los objetos estimando el volumen o el área de superficie de partes individuales del objeto.

**Actividad manual**

- Desdoblen una caja de cereal para tener una red.
- Calculan el área de cada parte de la red. Luego, calculen el área de superficie de la red. Comprueben esto con el área que obtendrían si no desdoblaran la caja.
- Hagan una red de otra caja y calculen el área de cada parte de la red. Luego, armen la caja y usen fórmulas para calcular el área de cada lado. Comprueben cada área con el área de cada parte de la red.
- ¿Por qué se usarían fórmulas en la fabricación de cajas?
Are You Ready for Chapter 10?

Practice

Find the area of each figure.

1. \[
\text{Area} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 38 \text{ cm} \times 20 \text{ cm} = 380 \text{ cm}^2
\]

2. \[
\text{Area} = \frac{1}{2} \times (10 \text{ ft} + 24 \text{ ft}) \times 10 \text{ ft} = 170 \text{ ft}^2
\]

3. \[
\text{Area} = \frac{1}{2} \times (39 \text{ in.} + 19 \text{ in.}) \times 16 \text{ in.} = 368 \text{ in.}^2
\]

4. \[
\text{Area} = \text{length} \times \text{width} = 8.2 \text{ m} \times 8.2 \text{ m} = 67.24 \text{ m}^2
\]

5. \[
\text{Area} = \frac{1}{2} \times (16 \text{ cm} + 17 \text{ cm}) \times 15 \text{ cm} = 187.5 \text{ cm}^2
\]

6. \[
\text{Area} = \text{length} \times \text{width} = 32 \text{ yd} \times 16 \text{ yd} = 512 \text{ yd}^2
\]

7. DOG RUN Rowena is installing a fence for a dog run on the side of her house. The dog run will be 12 feet long and cover an area of 84 square feet. How wide is the dog run?

\[ \text{width} = \frac{\text{area}}{\text{length}} = \frac{84 \text{ ft}^2}{12 \text{ ft}} = 7 \text{ ft} \]

Find the value of each expression. Use 3.14 for \( \pi \). Round to the nearest tenth.

8. \[ \pi \cdot 16 = 50.24 \]

9. \[ 2 \cdot \pi \cdot 8.1 = 50.88 \]

10. \[ \pi \cdot 5^2 = 78.5 \]

11. \[ \pi \cdot (15 \div 2)^2 = 176.63 \]

12. FLYING DISC The distance, in inches, around a toy flying disc with diameter 10 inches is given by the expression \( \pi \cdot 10 \). Evaluate this expression. Round to the nearest tenth.

\[ \text{Distance} = \pi \cdot 10 = 31.4 \]

For more examples, go to glencoe.com.
Review

The area of a triangle can be found using the formula $A = \frac{1}{2} bh$.

Example

Find the area of the triangle below.

![Triangle diagram]

$$A = \frac{1}{2} bh$$  
Formula for the area of a triangle

$$A = \frac{1}{2} \cdot 15 \cdot 10$$  
Replace $b$ with 15 and $h$ with 10.

$$A = 75$$  
Simplify.

The area is 75 square centimeters.

Exercises

Find the area of each triangle.

1. $\text{23 cm}$
2. $\text{20 ft}$
3. $\text{12 mm}$
4. $\text{60 ft}$
5. $\text{26 in.}$
6. $\text{8 yd}$
Apply

1. **FLAG** A flag of Florida measures 12 inches by 18 inches. What is the area of the flag?

2. **TILES** Rondell covered a table top with 36 square tiles. Each tile measures 8 inches by 8 inches. What is the area of the table top?

3. **ROAD SIGN** Cullen saw the sign below on his walk. The triangle is 12 inches on each side and the height is 10.4 inches. Find the area of the sign.

4. **HEXAGONS** The patio shown below is made up of hexagons, which are two trapezoids joined at one base. If each trapezoid has a height of 1.7 feet and base lengths of 2 feet and 4 feet, what is the area of one hexagon?

5. **LOGO** Josh used the figure below for a logo contest. If the height of the figure is 1.8 inches and the base is 3.8 inches, what is the area of the figure?

6. **DESIGN** Russell made the design below on his computer. Each triangle has a height of 12 millimeters and a base of 42 millimeters. Find the area of the design.
Diagnostic Test

Find the area of each figure.

1. \( \frac{1}{2} \times 35 \text{ ft} \times 15 \text{ ft} \)

2. \( 38 \text{ cm} \times 16 \text{ cm} \)

3. \( 10 \text{ ft} \times 13 \text{ ft} \)

4. \( 7.6 \text{ yd} \times 7.6 \text{ yd} \)

5. \( 30 \text{ in.} \times 20 \text{ in.} \)

6. \( 23 \text{ mm} 	imes 23 \text{ mm} \)

7. ROOF Brendan is adding an addition to his house. The addition will have a roof with rectangular sides 24 feet long and will cover an area of 360 square feet. How wide is the side of the roof?

Find the value of each expression.
Use 3.14 for \( \pi \). Round to the nearest tenth.

8. \( \pi \times 11 \)

9. \( 3 \times \pi \times 7.5 \)

10. \( \pi \times 3^2 \)

11. \( \pi \times (17 \div 2)^2 \)

12. POOL The distance, in feet, around a pool with a diameter of 6 feet is given by the expression \( \pi \times 6 \). Evaluate this expression. Round to the nearest tenth.
Find the circumference and area of each circle. 
Round to the nearest tenth.

1. radius: 12 in. 
2. diameter: 8 mm

Find the area of each figure. Round to the nearest tenth if necessary.

3. 
4.

Identify each figure. Then name the bases, faces, edges, and vertices.

5.
6.

Find the volume of each solid.

7.
8.

Find the surface area of each solid. Round to the nearest tenth if necessary.

9.
10.

11. **TOY BOX** A toy box is shaped like a rectangular prism and is 3 feet long, 2 feet wide, and 2 feet tall. What is the volume of the toy box?
### Student Glossary

This is an alphabetical list of new vocabulary terms you will learn in Chapter 10. Fold the page vertically and use it as a bookmark. As you study the chapter, write each term's definition or description in as few words as possible.

<table>
<thead>
<tr>
<th>Vocabulary Word</th>
<th>Definition/Description/Example</th>
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<tr>
<td>circumference</td>
<td></td>
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<tr>
<td>composite figure</td>
<td></td>
</tr>
<tr>
<td>cone</td>
<td></td>
</tr>
<tr>
<td>cross section</td>
<td></td>
</tr>
<tr>
<td>polyhedron</td>
<td></td>
</tr>
<tr>
<td>prism</td>
<td></td>
</tr>
<tr>
<td>pyramid</td>
<td></td>
</tr>
<tr>
<td>sphere</td>
<td></td>
</tr>
<tr>
<td>total surface area</td>
<td></td>
</tr>
<tr>
<td>volume</td>
<td></td>
</tr>
</tbody>
</table>
Evaluate each expression for \( b = 6, h = 10, l = 4, \) and \( r = 12. \) Use 3.14 for \( \pi. \) Round to the nearest tenth.

<p>| | | | |</p>
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<thead>
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<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>( \frac{1}{2} \cdot b \cdot h )</td>
<td>2.</td>
<td>( 2 \cdot \pi \cdot r )</td>
</tr>
<tr>
<td>3.</td>
<td>( r^2 )</td>
<td>4.</td>
<td>( \pi \cdot r^2 )</td>
</tr>
<tr>
<td>5.</td>
<td>( b \cdot h )</td>
<td>6.</td>
<td>( \pi \cdot r \cdot l )</td>
</tr>
<tr>
<td>7.</td>
<td>( 2 \cdot r )</td>
<td>8.</td>
<td>( 2 \cdot \pi \cdot r \cdot h )</td>
</tr>
<tr>
<td>9.</td>
<td>( 4 \cdot 7 \cdot h )</td>
<td>10.</td>
<td>( \frac{4}{3} \cdot \pi \cdot r^3 )</td>
</tr>
<tr>
<td>11.</td>
<td>( \frac{1}{3} \cdot \pi \cdot r^2 \cdot h )</td>
<td>12.</td>
<td>( 20 - l )</td>
</tr>
<tr>
<td>13.</td>
<td>( b \cdot h \cdot l )</td>
<td>14.</td>
<td>( \pi \cdot (r^2 + r \cdot l) )</td>
</tr>
<tr>
<td>15.</td>
<td>( 2 \cdot (b + h) )</td>
<td>16.</td>
<td>( 2 \cdot (b + h) \cdot l )</td>
</tr>
<tr>
<td>17.</td>
<td>( \frac{1}{2} \cdot b \cdot h \cdot 14 )</td>
<td>18.</td>
<td>( \sqrt{\pi \cdot l} )</td>
</tr>
<tr>
<td>19.</td>
<td>( \frac{244}{h} )</td>
<td>20.</td>
<td>( \frac{1}{3} \cdot b^2 \cdot h )</td>
</tr>
</tbody>
</table>
1. Janine wants to construct a playhouse. The playhouse will be a rectangle with a perimeter of 36 feet. She wants to have the largest possible area for the floor in the playhouse.

   a. If \( l \) represents the length of the playhouse, what expression represents the width of the playhouse?

   b. Create a spreadsheet with the new values.

   c. Describe your spreadsheet by giving the formulas you used.

   d. Find the dimensions of the playhouse that will give the largest possible area.

2. Use a spreadsheet to find the largest possible floor area Janine could have for a playhouse with a perimeter of 28 feet or 32 feet.

3. Compare and contrast the spreadsheet for Exercise 1 with the spreadsheet in Exercise 2.

4. WRITE MATH What type of rectangle is the rectangle with the most area? Explain.
**Reteach**

**Circumference and Area of Circles**

The **circumference** $C$ of a circle is equal to its diameter $d$ times $\pi$, or 2 times its radius $r$ times $\pi$, or $C = \pi d$, or $C = 2\pi r$.

The **area** $A$ of a circle is equal to $\pi$ times the square of the radius $r$, or $A = \pi r^2$.

### Examples

#### Find the circumference of each circle. Round to the nearest tenth.

1. $C = \pi d$

   - $C = \pi \cdot 4$
     - Replace $d$ with 4.
   - $C = 4\pi$
     - This is the exact circumference.
   - $C \approx 12.6$
     - Use a calculator to find $4\pi$.

   The circumference is about 12.6 inches.

2. $C = 2\pi r$

   - $C = 2 \cdot \pi \cdot 5.4$
     - Replace $r$ with 5.4.
   - $C \approx 33.9$
     - Use a calculator.

   The circumference is about 33.9 meters.

#### Example 3

#### Find the area of the circle. Round to the nearest tenth.

- $A = \pi r^2$
  - Area of a circle
- $A = \pi (1.5)^2$
  - Replace $r$ with half of 3 or 1.5.
- $A = \pi \cdot 2.25$
  - Evaluate $(1.5)^2$. This is the exact area.
- $A \approx 7.1$
  - Use a calculator.

The area is about 7.1 square feet.

### Exercises

Find the circumference and area of each circle. Round to the nearest tenth.

1. 

2. 

3. 

---

Chapter 10
**Skills Practice**

**Circumference and Area of Circles**

Find the circumference and area of each circle. Round to the nearest tenth.

1. \( \text{1 ft} \)
2. \( \text{4 m} \)
3. \( \text{12 in.} \)
4. \( \text{1.9 yd} \)
5. \( \text{5.7 mm} \)
6. \( \text{8.3 mi} \)
7. \( \text{11.6 km} \)
8. \( \text{2} \frac{4}{5} \text{ ft} \)
9. \( \text{6} \frac{3}{4} \text{ m} \)

10. The diameter is 7.7 feet. 
11. The radius is 9.6 millimeters.

12. The radius is 3.8 meters. 
13. The diameter is 17.4 yards.

Find the exact circumference and area of each circle.

14. The radius is 11.3 centimeters. 
15. The diameter is \( 4 \frac{3}{4} \) miles.

16. The radius is \( 2 \frac{1}{3} \) inches. 
17. The diameter is \( 7 \frac{5}{8} \) feet.
Homework Practice
Circumference and Area of Circles

Find the circumference of each circle. Round to the nearest tenth.
1. 10 in.
2. 14 mm
3. 22 yd
4. 25 m

Find the area of each circle. Round to the nearest tenth.
5. 25 m
6. 8.5 ft
7. 6.75 mi
8. 5.25 cm

Find the exact circumference and area of each circle.
9. The diameter is 8 centimeters.
10. The radius is 4.7 inches.
11. The radius is 0.9 feet.
12. The diameter is 6.8 kilometers.
13. The diameter is 14 yards.
14. The radius is $1\frac{1}{6}$ millimeters.

15. WINDMILL Each sail on a windmill is 5 meters in length. How much area do the sails cover as they turn from the force of the wind?

16. ALGEBRA Find the radius of a circle if its area is 314 square miles.

For more examples, go to glencoe.com.
## Problem-Solving Practice

### Circumference and Area of Circles

1. **Fountains** The circular fountain in front of the courthouse has a radius of 9.4 feet. What is the circumference of the fountain? Round to the nearest tenth.

2. **Pets** A dog is leashed to a point in the center of a large yard, so the area the dog is able to explore is circular. The leash is 20 feet long. What is the area of the region the dog is able to explore? Round to the nearest tenth.

3. **Gardening** A flowerpot has a circular base with a diameter of 27 centimeters. Find the circumference of the base of the flowerpot. Round to the nearest tenth.

4. **Windows** Find the area of the window shown below. Round to the nearest tenth.

5. **Bicycles** A bicycle tire has a radius of $13 \frac{1}{4}$ inches. How far will the bicycle travel in 40 rotations of the tire? Round to the nearest tenth.

6. **Landscaping** Joni has a circular garden with a diameter of $14 \frac{1}{2}$ feet. If she uses 2 teaspoons of fertilizer for every 25 square feet of garden, how much fertilizer will Joni need for her entire garden? Round to the nearest tenth.
Angles and Arcs

A **central angle** is an angle that intersects a circle in two points and has its vertex at the center of the circle. It separates a circle into a **major arc** and a **minor arc**.

- The degree measure of a minor arc is the degree measure of the central angle. In circle $B$, 
  \[ m\widehat{AC} = m\angle ABC. \]

- The degree measure of a major arc is 360 minus the degree measure of the central angle. In circle $B$, 
  \[ m\widehat{ADC} = 360^\circ - m\angle ABC. \]

An **inscribed angle** has its vertex on the circle and sides that contain chords. The measure of an inscribed angle equals one-half the measure of its intercepted arc. In the circle shown at the right, 
\[ m\angle XYZ = \frac{1}{2} m\widehat{XZ}. \] Thus, 
\[ m\widehat{XZ} = 2 \cdot m\angle XYZ. \]

---

### Find the measure of each arc.

1. minor arc $LN$

2. minor arc $QS$

3. major arc $VT$

### Refer to the diagram at the right. Find the measure of each of the following angles or arcs.

4. minor arc $JG$

5. $\angle 1$

6. major arc $GJ$

7. $\angle 2$

8. minor arc $KH$

9. minor arc $GK$

10. minor arc $FH$

11. $\angle FJK$

12. $\angle JFG$

13. arc $HJG$
Scientific Calculator Activity

The \( \pi \) Key

\( \pi \) is a specially marked key on many calculators that makes it easier to evaluate expressions containing \( \pi \).

Example

Find the circumference of a bicycle tire with a diameter of 30 inches.

\[
C = \pi d
\]

\[
C = \pi \times 30
\]

Enter: \( \pi \times \) Enter \( 94.24777961 \)

Rounded to the nearest inch, the circumference is 94 inches.

Exercises

Find the circumference of each circle to the nearest tenth.

1. \[ \text{10 m} \]

3. The diameter is 11 inches.

4. The radius is 0.5 centimeter.

5. The radius of the equator of Earth is 4,000 miles.

6. The diameter of the rim of a can is 2.5 inches.

7. The diameter of the base of a lamp is 6 inches.

8. The radius of the base of a cone is 8 centimeters.

9. The diameter of an orange is 7 centimeters.

10. The diameter of an automobile headlight is 8.5 inches.
You may need to use the *make a model* strategy to solve some problems.

You can always use the four-step plan to solve a problem.

**Understand**
- Determine what information is given in the problem and what you need to find.

**Plan**
- Select a strategy including a possible estimate.

**Solve**
- Solve the problem by carrying out your plan.

**Check**
- Examine your answer to see if it seems reasonable.

**Example**

Kisha is trying to make a box out of a piece of cardboard by cutting a square out of each corner. She will then fold up the sides and tape them together. The cardboard measures 4 feet 6 inches by 6 feet 6 inches. She wants the box to measure 3 feet wide by 5 feet long. What size squares should Kisha cut out of the corners to make the box?

**Understand** She wants to know what size squares to cut out of each corner to make a box which measures 3 feet by 5 feet.

**Plan** Start by making a model of the cardboard. Label the sides of the cardboard in feet. Draw lines to show the squares that will be cut out of the corners.

**Solve**

- Subtract 5 feet from 6 feet 6 inches and divide by 2.
- \( \frac{6 \text{ ft 6 in.}}{2} = 1 \text{ ft 6 in.} \)
- The square must have sides that are 9 inches long.

**Check** Check that width of the box meets the specifications. Subtracting 18 inches or 1 foot 6 inches from 4 feet 6 inches yields 3 feet, which is the width required.

**Exercises**

Make a model to solve each problem.

1. **CONSTRUCTION** A chicken coop will be 20 feet long and 16 feet wide. One side that is 20 feet long will be formed by the barn. The other three sides will be made of wire fencing with posts at every corner and every 4 feet between each corner. How many feet of fencing and how many posts are needed to build the chicken coop?

2. **GEOMETRY** What is the fewest number of one-inch cubes needed to make a rectangular prism that measures 4 inches by 5 inches by 6 inches? (*Hint:* The prism can be hollow inside.)
Skills Practice

Problem-Solving Investigation: Make a Model

Make a model to solve each problem.

1. **SHIPPING** A spice distributor is making boxes in which to pack cylindrical spice containers. The diameter of each container is 2 inches. The height of each container is 4 inches. If they place 4 rows with 3 containers in each row in a box, what is the volume of the box?

2. **SEWING** Kacey has a bread basket in the shape of a rectangular prism that measures 12 inches high, 18 inches long, and 16 inches wide. She wants to cover the inside of the basket with a 50-inch by 20-inch piece of fabric. Does Kacey have enough fabric to cover the inside of the basket? Explain your answer.

3. **BEADS** Elsa is making a wooden box for sorting and storing her bead collection. The outer dimensions of the box are 10 inches by 10 inches. She wants to make 100 compartments that are approximately 1-inch squares. How many horizontal and vertical dividers will Elsa need to make the compartments?

4. **ARRANGING TABLES** Donna is arranging four tables to make seating for her party guests. Standing alone, each table will seat 4 people on each side and 2 people at each end. She can either place the tables end-to-end to make one long table or she can separate the tables into four individual tables. How many more guests can she seat if she separates the tables than if she places them end-to-end?

5. **MAKING FRAMES** Hamish is making pictures frames by gluing square tiles onto the wooden sides. The wooden sides measure 8 inches wide by 10 inches long by 1 inch wide. If he glues a 1-inch square tile at every corner and covers the remainder of the wood sides with \( \frac{1}{2} \) inch square tiles, how many of each size tile does Hamish need to make 4 frames?

Use any strategy to solve Exercises 6–8.

6. **QUIZ SCORES** Mandy answered 10 questions out of 12 correctly on her math quiz. How many questions must she answer correctly to get the same score on a quiz with 30 questions?

7. **NUMBER THEORY** There are two single digit numbers. One number is 4 less than the other number. The sum of the digits is 12. Find the two numbers.

8. **GARDENING** Justin helped his dad in the yard 3 times as long as Paula. Paula helped her dad 2 hours less than Carly. Carly helped her dad in the yard 4 hours. How many hours did Justin help his dad?
Mixed Problem Solving

For Exercises 1 and 2, solve using the *make a model* strategy.

1. **QUILTS** Mrs. Renoir has completed the interior portion of a quilt top measuring 4 feet by 6 feet. She is outlining this with squares measuring 4 inches on each side. How many such squares will she need?

2. **GEOMETRY** Sunhee has four plastic shapes: a circle, a square, a triangle, and a pentagon. In how many ways can she line up the four shapes if the circle cannot be next to the square?

Use any strategy to solve Exercises 3–7. Some strategies are shown below.

<table>
<thead>
<tr>
<th><strong>PROBLEM-SOLVING STRATEGIES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Make a model.</td>
</tr>
<tr>
<td>• Draw a diagram.</td>
</tr>
<tr>
<td>• Guess, check, and revise.</td>
</tr>
<tr>
<td>• Choose an operation.</td>
</tr>
</tbody>
</table>

3. **FOOTBALL** The attendance at the first two football games of the season are shown in the table. Did the attendance increase by about 1% or about 10%?

   **Football Attendance**
   
<table>
<thead>
<tr>
<th>Game</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game 1</td>
<td>5,049</td>
</tr>
<tr>
<td>Game 2</td>
<td>5,582</td>
</tr>
</tbody>
</table>

4. **GAMES** Jonas has a deck of 40 cards. After giving each player in the game an equal number of cards, he has four cards left over, which is not enough to give each player another card. How many players could be in the game?

5. **CLOTHING** Salome has 5 T-shirts, 3 pairs of jeans, and 2 pairs of sneakers. In how many ways can she choose one T-shirt, one pair of jeans, and one pair of sneakers to wear today?

6. **NUMBER THEORY** After adding 8 to a number and then dividing by 3, the result is 19. What is the number?

7. **TRAVEL** Celia begins saving $28 each week from her paycheck to put toward a trip to Sicily. Airfare will be $942 including taxes and fees. How many weeks will it take Celia to save for the airfare?

For more examples, go to glencoe.com.
Problem-Solving Practice

Problem-Solving Investigation: Make a Model

Make a model to solve each problem.

**SHIPPING COCOA** For Exercises 1 and 2, use the information at the right. This table gives information about cocoa tins that a distributor needs to box up and ship to various stores around the country.

<table>
<thead>
<tr>
<th>Sure-Safe Cocoa Tins</th>
</tr>
</thead>
<tbody>
<tr>
<td>dimensions</td>
</tr>
<tr>
<td>diameter: 4 in.</td>
</tr>
<tr>
<td>height: 8 in.</td>
</tr>
<tr>
<td>quantity to be shipped</td>
</tr>
<tr>
<td>dimensions of large shipping boxes</td>
</tr>
</tbody>
</table>

1. How many large shipping boxes can be filled with cocoa tins? How many cocoa tins will be left over?

2. What are the dimensions of the smallest box that could be used to ship the remaining cocoa tins?

3. **GAMES** A hollow tower is built of 1-inch cubes with dimensions of 4 inches wide by 4 inches long by 15 inches high. How many 1-inch cubes would it take to fill the tower?

4. **STAMPS** Dina wants to display her stamp collection on a poster. Each stamp is a 1-inch square. She wants to arrange the stamps in a 24-by-48 array with one-half inch between each stamp and leave a 2-inch border around the outer edges of the array. What should the length and width of the poster board be?

5. **TILING** A wooden box is to be covered with 1-inch square tiles. The dimensions of the box are 10 inches by 6 inches by 4 inches. There is an opening in the top of the box that measures 8 inches by 4 inches. How many 1-inch tiles are needed to cover the sides and the top of the box?

6. **PICTURE DISPLAY** Julia is arranging pictures of her mother, her father, her brother, and herself on a shelf. If she wants to keep the pictures of her parents next to each other, how many different ways can she arrange the four pictures?
Reteach

Area of Composite Figures

To find the area of a composite figure, decompose the figure into shapes whose areas you know how to find. Then find the sum of these areas.

**Example**

Find the area of the composite figure.

The figure can be separated into a semicircle and trapezoid.

**Area of semicircle**

\[ A = \frac{1}{2} \pi r^2 \]

\[ A = \frac{1}{2} \cdot \pi \cdot (7)^2 \]

\[ A \approx 77.0 \]

**Area of trapezoid**

\[ A = \frac{1}{2} h(b_1 + b_2) \]

\[ A = \frac{1}{2} \cdot 10 \cdot (14 + 18) \]

\[ A = 160 \]

The area of the figure is about 77.0 + 160 or 237 square inches.

**Exercises**

Find the area of each figure. Round to the nearest tenth if necessary.

1. 
   - Width: 8 mm
   - Height: 5 mm
   - Base: 6 mm

2. 
   - Height: 6 ft
   - Base 1: 9 ft
   - Base 2: 7 ft

3. 
   - Height: 5 mi
   - Base 1: 14 mi
   - Base 2: 7 mi

4. 
   - Height: 10.8 m
   - Base: 12 m

5. 
   - Height: 8 yd
   - Base: 8 yd

6. 
   - Height: 6.1 in
   - Base: 3 in
Skills Practice
Area of Composite Figures

Find the area of each figure. Round to the nearest tenth if necessary.

1. 
   - 6 m
   - 10 m
   - 7 m

2. 
   - 12 yd

3. 
   - 5 cm
   - 10 cm
   - 6 cm
   - 14 cm

4. 
   - 6 ft
   - 3 ft
   - 4 ft
   - 5 ft

5. 
   - 6 cm
   - 5 cm

6. 
   - 9 in.
   - 5 in.
   - 4 in.
   - 4 in.
   - 10 in.

7. 
   - 17 m
   - 8 m
   - 7 m
   - 14 m
   - 14 m
   - 7 m
   - 6 m
   - 14 m
   - 6 m

8. 
   - 13 m
   - 13 m
   - 12 m
   - 10 m

9. 
   - 4 km
   - 5 km
   - 12 km

Find the area of the shaded region.

10. 
    - 20 cm
    - 16 cm
    - 40 cm

11. 
    - 8 ft
    - 32 ft
    - 8 ft
    - 8 ft
    - 8 ft

Find the area of each figure. Round to the nearest tenth if necessary.

1. 
   \[ \text{Area} = \frac{1}{2} \times (5 \text{ mi} + 18 \text{ mi}) \times 8 \text{ mi} \]

2. 
   \[ \text{Area} = \frac{1}{2} \times (4.8 \text{ cm} + 1.1 \text{ cm}) \times 5.9 \text{ cm} \]

3. 
   \[ \text{Area of triangle} + \text{Area of circle} \]

4. 
   \[ \text{Area} = (8 \text{ m} \times 10 \text{ m}) + (6 \text{ m} \times 12 \text{ m}) \]

5. 
   \[ \text{Area} = \frac{1}{2} \times (9 \text{ yd} + 8 \text{ yd}) \times 11 \text{ yd} \]

6. 
   \[ \text{Area} = 7 \text{ in} \times 9 \text{ in} \]

In each diagram, one square unit represents 10 square centimeters. Find the area of each figure. Round to the nearest tenth if necessary.

7. 
   \[ \text{Area} = \text{Number of square units} \times 10 \]

8. 
   \[ \text{Area} = \text{Number of square units} \times 10 \]

9. **GAZEBO** The Parks and Recreation department is building a gazebo in the local park with the dimensions shown in the figure. What is the area of the floor?

10. **DECK** The Pueyo family wants to paint the deck around their swimming pool with the dimensions shown in the figure. If a gallon covers 200 square feet, how many gallons of paint are needed to apply two coats of paint?

For more examples, go to glencoe.com.
**Problem-Solving Practice**

**Area of Composite Figures**

**LANDSCAPING** For Exercises 1 and 2 use the diagram of a yard and the following information. The figure shows the measurements of Buzz’s yard which he intends to sod.

1. Find the area of the yard.

2. One pallet of sod covers 400 square feet. How many full pallets of sod will Buzz need to buy to have enough for his entire yard?

3. **ICE CREAM** Leeor was asked to repaint the sign for his mother’s ice cream shop, so he needs to figure out how much paint he will need. Find the area of the ice cream cone on the sign. Round to the nearest tenth.

4. **HOME IMPROVEMENT** Ward is planning to install a new countertop in his kitchen, as shown in the figure. Find the area of the countertop.

5. **SCHOOL PRIDE** Cindy has a jacket with the first letter of her school’s name on it. Find the area of the letter on Cindy’s jacket.

6. **SWIMMING POOLS** The Cruz family is buying a custom-made cover for their swimming pool, shown below. The cover costs $2.95 per square foot. How much will the cover cost? Round to the nearest cent.

---

**Diagram for LANDSCAPING**

- Rectangular area: 15 ft x 30 ft
- Rectangular area: 20 ft x 50 ft

**Diagram for ICE CREAM**

- Ice cream cone: 6 in. (radius) x 12 in. (slant height)

**Diagram for HOME IMPROVEMENT**

- Countertop: 2.5 ft x 2.5 ft x 2.5 ft x 2.5 ft

**Diagram for SCHOOL PRIDE**

- Letter: 6 in. x 6 in. x 10 in. x 2 in.

**Diagram for SWIMMING POOLS**

- Swimming pool: 25 ft x 15 ft
Inuit Architecture

The Inuit are a Native American people who live primarily in the arctic regions of Alaska, Canada, Siberia, and Greenland. The Inuit word *iglu* means “winter house,” and it originally referred to any permanent structure used for shelter in the winter months. In the nineteenth century, however, the term came to mean a domed structure built of snow blocks, as shown in the figure at the right.

An iglu could shelter a family of five or six people. Sometimes several families built a *cluster* of iglus that were connected by passageways and shared storage and recreation chambers. The figure below is a drawing of such a cluster. Use the drawing to answer each of the following questions. When appropriate, round answers to the nearest whole number.

1. What is the circumference of the entry chamber?

2. What is the circumference of one of the living chambers?

3. Estimate the distance from the front of the entry chamber to the back of the storage chamber.

4. An iglu is a *hemisphere*, or half a sphere. The formula for the volume of a sphere is $V = \frac{4}{3}\pi r^3$, where $r$ is the radius. Estimate the volume of the storage chamber.
Reteach

Three-Dimensional Figures

A polyhedron is a solid with flat surfaces that are polygons. A prism is a polyhedron with two parallel, congruent faces called bases. A pyramid is a polyhedron with one base that is a polygon and faces that are triangles. Prisms and pyramids are named by the shape of their bases.

Example

Identify the figure. Then name the bases, faces, edges, and vertices.

The figure has one base that is a triangle, so it is a triangular pyramid.

base: ABC
faces: ABC, ADC, ABD, BDC
edges: AB, BC, AC, AD, BD, CD
vertices: A, B, C, D

Exercises

Identify each figure. Then name the bases, faces, edges, and vertices.

1.

2.

3.

4. Draw and label the top, front, and side views of the chair shown.
Skills Practice
Three-Dimensional Figures

Identify each figure. Then name the bases, faces, edges, and vertices.

1.

2.

3.

4.

5.

6.
Homework Practice
Three-Dimensional Figures

Identify each figure. Then name the bases, faces, edges, and vertices.

1. [Diagram of a triangular pyramid]

2. [Diagram of a pentagonal pyramid]

3. [Diagram of a rectangular prism]

4. Describe the shape resulting from a vertical, angled, and horizontal cross section of a rectangular prism.

5. Describe the shape resulting from a vertical, angled, and horizontal cross section of a triangular prism.

6. Describe the shape resulting from a vertical, angled, and horizontal cross section of a cone.
ARCHITECTURE  For Exercises 1–4, refer to the drawing of a wooden table.

Each square has a side length of 5 inches.

1. Draw and label the top, front, and side views of the table.
2. Find the height of the table in inches.
3. Find the area of the table top.
4. Find the area of the wood that is touching the floor.

5. **PUBLIC SPEAKING**  A pedestal used in an auditorium is shaped like a rectangular prism that is 1 unit high, 5 units wide, and 5 units long. Sketch the pedestal using isometric dot paper.

6. **PETS**  Dora has four pet fish that she keeps in an aquarium. The aquarium is shaped like a triangular prism that is 4 units high. Sketch what this aquarium might look like using isometric dot paper.
The Five Platonic Solids

There are only five regular convex solids. They are called the Platonic Solids and are shown here.

1. Write the name of each Platonic Solid under its net.

2. Complete this chart for the Platonic Solids.

<table>
<thead>
<tr>
<th>Solid</th>
<th>Tetrahedron</th>
<th>Hexahedron</th>
<th>Octahedron</th>
<th>Icosahedron</th>
<th>Dodecahedron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Faces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Edges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Vertices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Write an equation relating the number of faces, edges, and vertices of the Platonic Solids. This equation is called Euler’s Formula and is true for all simple polyhedra.
**Reteach**

**Volume of Prisms and Cylinders**

The volume $V$ of a prism or a cylinder is the area of the base $B$ times the height $h$, or $V = Bh$.

### Example 1

Find the volume of the rectangular prism.

$$V = Bh$$  Volume of a prism
$$V = (b \cdot w)h$$  The base is a rectangle, so $B = b \cdot w$.
$$V = (8 \cdot 5)4$$  $b = 8$, $w = 5$, $h = 4$
$$V = 160$$  Simplify.

The volume is 160 cubic centimeters.

### Example 2

Find the volume of the cylinder. Round to the nearest tenth if necessary.

$$V = \pi r^2h$$  Volume of a cylinder
$$V = \pi \cdot 5^2 \cdot 25$$  Replace $r$ with 5 and $h$ with 25.
$$V \approx 1,963.5$$  Simplify. Use a calculator.

The volume is about 1,963.5 cubic feet.

### Exercises

Find the volume of each solid. Round to the nearest tenth if necessary.

1. 

![Rectangular prism with dimensions 2 in. x 9 in. x 6 in.]

2. 

![Cylinder with dimensions 4 m x 12 m x 10 m]

3. 

![Rectangular prism with dimensions 11 yd x 5 yd x 10 yd]

4. 

![Rectangular prism with dimensions 11 mm x 3 mm x 3 mm]

5. 

![Cylinder with dimensions 6.3 ft x 9 ft]

6. 

![Rectangular prism with dimensions 7 m x 5.8 m x 4.1 m]
Skills Practice
Volume of Prisms and Cylinders

Find the volume of each solid. Round to the nearest tenth if necessary.

1. 5 m
   9 m
   7 m

2. 4 in.
   13 in.

3. 4 cm
   10 cm
   6.3 cm

4. 14 yd
   3.2 yd

5. 10 \( \frac{1}{2} \) mi
   12 mi

6. 4 ft
   5 ft
   13 \( \frac{1}{3} \) ft

7. rectangular prism: base, 6 in.; width, 4 in.; height, 13 in.

8. triangular prism: base of triangle, 9 cm; altitude, 1 cm; height of prism, 15 cm

9. rectangular prism: base, 3.6 mm; width, 4 mm; height, 15.5 mm

10. triangular prism: base of triangle, 6 yd; altitude, 5.9 yd; height of prism, 12 yd

11. cylinder: diameter, 8 m; height, 16.2 m
Find the volume of each solid. Round to the nearest tenth if necessary.

1. \( \text{cylinder: } \text{radius, } 4 \text{ m; height, } 5 \text{ m} \)

2. \( \text{rectangular prism: base, } 7 \text{ in.; width, } 3 \text{ in.; height, } 2 \text{ in.} \)

3. \( \text{triangular prism: base, } 11 \text{ cm; width, } 7 \text{ cm; height, } 4 \text{ cm} \)

4. \( \text{triangular prism: base, } 2.1 \text{ yd; width, } 1.1 \text{ yd; height, } 0.8 \text{ yd} \)

5. \( \text{cylinder: radius, } 10 \text{ ft; height, } 4.2 \text{ ft} \)

6. \( \text{cylinder: diameter, } 3 \text{ mm; height, } 3 \text{ mm} \)

7. \( \text{rectangular prism: base, } 10 \text{ meters; width, } 5 \text{ meters; height, } 5 \text{ meters} \)

8. \( \text{triangular prism: base of triangle, } 8 \text{ inches; altitude, } 8 \text{ inches; height of prism, } 6 \text{ inches} \)

9. \( \text{cylinder: radius, } 7 \text{ feet; height, } 4 \text{ feet} \)

10. \( \text{cylinder: diameter, } 6.4 \text{ centimeters; height, } 4.9 \text{ centimeters} \)

11. **ALGEBRA** Find the base of the triangle of a triangular prism with a height of 8 yards, altitude of 4 yards, and a volume of 16 cubic yards.

12. **ALGEBRA** Find the height of a cylinder with a diameter of 5 meters and a volume of 49.1 cubic meters.

13. **WATER TANK** About 7.5 gallons of water occupy one cubic foot. About how many gallons of water are in a cylindrical water tank with dimensions shown in the figure?
Problem-Solving Practice

Volume of Prisms and Cylinders

1. CAMPING A tent used for camping is shown below. Find the volume of the tent.

2. CONSTRUCTION The dimensions of a new tree house are shown below. How many cubic feet of space will the tree house contain?

3. FOAM The figure below shows a piece of foam packaging. Find the volume of the foam.

4. DONATIONS Anderson is donating some outgrown clothes to charity. The dimensions of the box he is using are shown below. How many cubic feet of clothes will fit in the box?

5. FARM LIFE A trough used for watering horses is shown in the figure. The trough is half of a cylinder. How many cubic feet of water will the trough hold? Round to the nearest tenth.

6. FARM LIFE If the volume of the water in the trough in Exercise 5 decreases by 5.6 cubic feet per day, after how many days will the trough be empty? Round to the nearest tenth if necessary.
Puzzling Patterns

In these visual puzzles, the challenge is to choose the one pattern that could be folded up into the box shown. You are not allowed to make any extra cuts in the patterns. The trick is that the six faces of the box must be arranged in the correct order.

Circle the letter of the pattern that could be used to make each box.

1. A.  
   B.  
   C.  

2. A.  
   B.  
   C.  

3. A.  
   B.  
   C.  

4. A.  
   B.  
   C.  

5. A.  
   B.  
   C.  

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Scientific Calculator Activity

Volume

The volume of a sphere can be found using \( V = \frac{4}{3} \pi r^3 \).

Suppose you buy a baseball packed in a cubic box. What percent of the volume of the box is air space (the space around the ball)? The answer is about 48%.

**Example**

A ball is packed inside a cube so that the ball touches the sides of the cube. Find the volume of the air space around the ball.

Find the volume of the cube. The side length of the cube is 4 inches. The formula is \( V = s^3 \). Use the \( \frac{1}{3} \) key.

**Enter: \( 4 \ \frac{1}{3} \) ENTER 64**

The volume of the cube is 64 in\(^3\).

Find the volume of the ball. The radius is 2 inches.

The formula is \( V = \frac{4}{3} \pi r^3 \).

**Enter: \( 4 \ \frac{1}{3} \ \pi \ \times \ \times \ 2 \ \frac{1}{3} \) ENTER 33.51032164**

The volume of the ball is about 33.5 in\(^3\).

The air takes up a volume of about (64 – 33.5) in\(^3\) or 30.5 in\(^3\).

**Exercises**

Find the volume of the air space in each container below to the nearest tenth.

1. ![Diagram 1]
   - 8 in.

2. ![Diagram 2]
   - 3 in.
   - 6 in.

3. ![Diagram 3]
   - 5 in.
   - 20 in.
Find the volume of the pyramid.

\[ V = \frac{1}{3} Bh \]

Volume of a pyramid

\[ V = \frac{1}{3} \cdot (3.6)^2 \cdot 9 \]

Replace \( B \) with \((3.6)^2\) and \( h \) with 9.

\[ V = 38.88 \]

Multiply.

The volume is 38.88 cubic meters.

Find the volume of the cone.

\[ V = \frac{1}{3} \pi r^2 h \]

Volume of a cone

\[ V = \frac{1}{3} \cdot \pi \cdot 5^2 \cdot 10 \]

Replace \( r \) with 5 and \( h \) with 10.

\[ V \approx 261.8 \]

Simplify. Use a calculator.

The volume is about 261.8 cubic feet.

Find the volume of each solid. Round to the nearest tenth.

1. Pyramid

2. Cone

3. Sphere

4. Pyramid

5. Cone

6. Sphere
Find the volume of each solid. Round to the nearest tenth if necessary.

1. \( \text{cone: diameter, 10 centimeters; height, 12 centimeters} \)

2. \( \text{triangular pyramid: triangle base, 20 millimeters; triangle height, 22 millimeters; pyramid height, 14 millimeters} \)

3. \( \text{sphere: radius 8 inches} \)

4. \( \text{cone: radius, 9.7 feet; height, 18 feet} \)
Find the volume of each solid. Round to the nearest tenth if necessary.

1. \[ \text{Volume of a pyramid} = \frac{1}{3} \times \text{base area} \times \text{height} \]
   - Base: \(3 \text{ ft} \times 3 \text{ ft}\)
   - Height: \(5 \text{ ft}\)
   - Volume: \(\frac{1}{3} \times 9 \times 5 = 15 \text{ cubic feet}\)

2. \[ \text{Volume of a sphere} = \frac{4}{3} \pi r^3 \]
   - Radius: \(2.6 \text{ cm}\)
   - Volume: \(\frac{4}{3} \pi (2.6)^3 = 43.4 \text{ cubic cm}\)

3. \[ \text{Volume of a pyramid} = \frac{1}{3} \times \text{base area} \times \text{height} \]
   - Base: \(2\frac{2}{3} \text{ yd} \times 4 \frac{1}{3} \text{ yd}\)
   - Height: \(3 \text{ yd}\)
   - Volume: \(\frac{1}{3} \times 29 \times 3 = 30 \text{ cubic yards}\)

4. \[ \text{Volume of a sphere} = \frac{4}{3} \pi r^3 \]
   - Radius: \(4.2 \text{ in.}\)
   - Volume: \(\frac{4}{3} \pi (4.2)^3 = 226.2 \text{ cubic inches}\)

5. \[ \text{Volume of a cone} = \frac{1}{3} \pi r^2 h \]
   - Radius: \(10 \text{ mm}\)
   - Height: \(18 \text{ mm}\)
   - Volume: \(\frac{1}{3} \pi (10)^2 (18) = 1885 \text{ cubic mm}\)

6. \[ \text{Volume of a cone} = \frac{1}{3} \pi r^2 h \]
   - Radius: \(5 \text{ in.}\)
   - Height: \(10 \text{ in.}\)
   - Volume: \(\frac{1}{3} \pi (5)^2 (10) = 261.8 \text{ cubic inches}\)

7. \[ \text{Volume of a triangular prism} = \text{base area} \times \text{height} \]
   - Base: \(6 \text{ mm} \times 8 \text{ mm} \times 8 \text{ mm}\)
   - Height: \(2 \text{ mm}\)
   - Volume: \(\frac{1}{2} \times 48 \times 2 = 48 \text{ cubic mm}\)

8. \[ \text{Volume of a rectangular prism} = \text{length} \times \text{width} \times \text{height} \]
   - Length: \(4 \text{ ft}\)
   - Width: \(5 \text{ ft}\)
   - Height: \(3 \text{ ft}\)
   - Volume: \(120 \text{ cubic feet}\)

9. \[ \text{Volume of a rectangular prism} = \text{length} \times \text{width} \times \text{height} \]
   - Length: \(1.5 \text{ yd}\)
   - Width: \(2 \text{ yd}\)
   - Height: \(0.9 \text{ yd}\)
   - Volume: \(27 \text{ cubic yards}\)

10. **PYRAMIDS** The Great Pyramid has an astounding volume of about 84,375,000 cubic feet above ground. At ground level the area of the base is about 562,500 square feet. What is the approximate height of the Great Pyramid?

For more examples, go to glencoe.com.
1. **DESSERT** Find the volume of the ice cream cone shown below. Round to the nearest tenth if necessary.

2. **SOUVENIRS** On a trip to Egypt, Myra bought a small glass pyramid as a souvenir. Find the volume of the glass used to make the pyramid. Round to the nearest tenth.

3. **AUTO REPAIR** A funnel used to fill the transmission on a car is shown below. Find the volume of the funnel. Round to the nearest tenth.

4. **ART** An artist created a commemorative marker in the shape of a triangular pyramid. Find the volume of the stone used to make the marker. Round to the nearest tenth.

5. **FARMING** The top of a silo is a cone, as shown in the figure. Find the volume of the cone. Round to the nearest tenth.

6. **TENNIS BALLS** Find the volume of the tennis balls packed tightly in the can.
Two Truncated Solids

To create a truncated solid, you could start with an ordinary solid and then cut off the corners. Another way to make such a shape is to use the patterns on this page.

The Truncated Octahedron

1. Two copies of the pattern at the right can be used to make a **truncated octahedron**, a solid with 6 square faces and 8 regular hexagonal faces.

   Each pattern makes half of the truncated octahedron. Attach adjacent faces using glue or tape to make a cup-shaped figure.

The Truncated Tetrahedron

2. The pattern below will make a **truncated tetrahedron**, a solid with 8 polygonal faces: 4 hexagons and 4 equilateral triangles.

Solve.

3. Find the surface area of the truncated octahedron if each polygon in the pattern has sides of 3 inches.

4. Find the surface area of the truncated tetrahedron if each polygon in the pattern has sides of 3 inches.

---

**Area Formulas for Regular Polygons**

\( s \) is the length of one side.

- Triangle: \( A = \frac{s^2 \sqrt{3}}{4} \)
- Hexagon: \( A = \frac{3s^2 \sqrt{3}}{2} \)
- Octagon: \( A = 2s^2(\sqrt{2} + 1) \)
You can use a spreadsheet to calculate the volumes of pyramids and cones.

**Example 1**  
Use a spreadsheet to find the volume of the cone to the right.

**Step 1** Recall that the formula for the volume of a cone is 
$$V = \frac{1}{3} \pi r^2 h.$$  

**Step 2** In cell A1, enter the radius of the cone and in cell B1, enter the height of the cone.

**Step 3** In cell C1, enter an equals sign followed by 
$$\frac{1}{3} \pi r^2 h.$$ Then press ENTER to return the volume of the cone.

The volume of the cone is 56.54867 cubic inches.

**Example 2**  
Use a spreadsheet to find the volume of a pyramid with base 16 square inches and height of 7 inches.

**Step 1** Recall that the formula for the volume of a pyramid is 
$$V = \frac{1}{3} Bh.$$  

**Step 2** In cell A2, enter the base of the pyramid and in cell B2, enter the height of the pyramid.

**Step 3** In cell C2, enter an equals sign followed by 
$$\frac{1}{3} Bh.$$ Then press ENTER to return the volume of the pyramid.

The volume of the pyramid is 37.33333 cubic inches.

**Exercises**

Use a spreadsheet to find the volumes of each solid. Round to the nearest tenth if necessary.

1. pyramid: base, 3 m$^2$; height, 10 m  
2. pyramid: base, 15 cm$^2$; height, 6 cm

3. cone: radius, 2 mm; height, 5 mm  
4. cone: radius, 9 in.; height 8 in.

5. Extend your spreadsheet to find the volume of a sphere. Find the volume of a sphere with a radius of 4 feet.
1. You will need two $8\frac{1}{2}$ by 11 inch pieces of paper and tape.
   
   a. Find the area of one rectangular piece of paper. This will be the area of the sides of the cylinder.
   
   b. Fold and tape the paper so that it forms a cylinder with no overlap.
   
   c. Use the circular end of the cylinder to trace two circles on the other piece of paper. Measure the diameter of each and find the area of each circle.
   
   d. Cut out the circles and tape them to the ends of the open cylinder to form a closed cylinder. What is the total area of your cylinder?
   
   e. Do you always get the same cylinder by using the method in Exercises 1a to 1d? Explain.
   
2. Write a method for finding the area of all the surfaces of a cylinder given the measures of its height and the diameter of one of its bases. Use your method to check the area in Exercise 1.
   
3. WRITE MATH Describe how to use a net to make a cylinder.
Reteach

**Surface Area of Prisms and Cylinders**

The lateral area $L$ of a prism is the perimeter $P$ of the base times the height $h$ of the prism, or $L.A. = Ph$. The total surface area $S.A.$ of a prism is the lateral surface area $L$ plus the area of the two bases $2B$, or $S.A. = L.A. + 2B$ or $S.A. = Ph + 2B$.

**Example 1** Find the lateral and total surface areas of the rectangular prism.

<table>
<thead>
<tr>
<th>Perimeter of Base</th>
<th>Area of Base</th>
<th>Lateral Surface Area</th>
<th>Total Surface Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P = 2b + 2h$</td>
<td>$B = bh$</td>
<td>$L.A. = Ph$</td>
<td>$S.A. = L.A. + 2B$</td>
</tr>
<tr>
<td>$P = 2(5) + 2(3)$</td>
<td>$B = 5(3)$</td>
<td>$L.A. = 16(7)$ or 112</td>
<td>$S.A. = 112 + 2(15)$ or 142</td>
</tr>
</tbody>
</table>

Use this information to find the lateral and total surface areas.

The lateral surface area is 112 square feet and the total surface area of the prism is 142 square feet.

The lateral area $L.A.$ of a cylinder with height $h$ and radius $r$ is the circumference of the base times the height, or $L.A. = 2\pi rh$. The surface area $S.A.$ of a cylinder with height $h$ and radius $r$ is the lateral area plus the area of the two bases, or $S.A. = L.A. + 2\pi r^2$ or $S.A. = 2\pi rh + 2\pi r^2$.

**Example 2** Find the lateral and total surface areas of the cylinder. Round to the nearest tenth.

<table>
<thead>
<tr>
<th>Lateral Surface Area</th>
<th>Total Surface Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L.A. = 2\pi rh$</td>
<td>$S.A. = L.A. + 2\pi r^2$</td>
</tr>
<tr>
<td>$L.A. = 2 \cdot \pi(5)(9)$</td>
<td>$S.A. = 282.7 + 2 \cdot \pi(5)^2$</td>
</tr>
<tr>
<td>$L.A. \approx 282.7$</td>
<td>$S.A. \approx 439.8$</td>
</tr>
</tbody>
</table>

The lateral area is about 282.7 square meters, and the surface area of the cylinder is about 439.8 square meters.

**Exercises** Find the lateral and total surface areas of each solid. Round to the nearest tenth if necessary.

1. [Image of a rectangular prism with dimensions 4 yd, 2 yd, 5 yd]
2. [Image of a cylinder with radius 3 cm, height 5 cm]
3. [Image of a rectangular prism with dimensions 8 in, 7 in, 4 in]
Find the lateral and total surface areas of each solid. Round to the nearest tenth if necessary.

1. 6 ft
   2 ft
   4 ft

2. 3 in.
   6 in.

3. 5 mm
   3 mm
   4 mm
   7 mm

4. 7 yd
   8 yd
   10 yd

5. 5 cm
   6.1 cm
   6.1 cm
   5 cm

6. 8 m
   4 m
   10 m

7. 12 mi
   5 mi
   13 mi
   5 mi

8. 11 km
   6 km
   5.7 km

9. 10.4 ft
   9 ft
   5 ft

10. cube: edge base, 11 m

11. rectangular prism: base, 9 cm; width, 13 cm; height, 18.4 cm

12. cylinder: diameter, 28 in.; height, 12.6 in.

13. cube: edge base, 11 m

14. rectangular prism: base, 9 cm; width, 13 cm; height, 18.4 cm

15. cylinder: radius, 9.4 mm; height, 15 mm

16. cylinder: diameter, 28 in.; height, 12.6 in.
Find the lateral and total surface areas of each solid. Round to the nearest tenth if necessary.

1. 

2. 

3. 

4. 

5. 

6. 

7. **ALGEBRA** A rectangular prism has height 4 millimeters and width 5 millimeters. If the total surface area is 166 square millimeters, what is the base of the prism?

8. **WATER** A cylindrical-shaped water storage tank with diameter 60 feet and height 20 feet needs to be painted on the outside. If the tank is on the ground, find the surface area that needs painting.

9. **CONCRETE** Find the total surface area of the hollow concrete casing shown, including the interior.

For more examples, go to glencoe.com.
Problem-Solving Practice
Surface Area of Prisms and Cylinders

1. **BAKING** The top and sides of the cake shown below are to be covered in frosting. Calculate the area that will be covered with frosting.

   ![Cake](image)

2. **GIFTS** A birthday gift is placed inside the box shown below. What is the minimum amount of wrapping paper needed to wrap this gift?

   ![Gift](image)

3. **FARMING** Phil is planning to shingle the roof on his barn shown below. How many square feet will he be shingling?

   ![Roof](image)

4. **FARMING** Refer to Exercise 3. If one package of shingles covers 325 square feet, how many packages will Phil need to buy?

5. **LIGHT SHOW** A mirrored cylinder used in a light show is shown below. Only the curved side of the cylinder is covered with mirrors. Find the area of the cylinder covered in mirrors. Round to the nearest tenth.

   ![Cylinder](image)

6. **SOUP** Emily has the flu, so she decides to make chicken noodle soup. How many square inches of metal were used to make Emily's can of soup? Round to the nearest tenth.
Sliced Solids

In the diagrams on this page, a plane slices through a solid figure. The intersection of the plane with the solid is called a cross section. The drawings for each problem show a sliced solid and the dimensions of the resulting cross section.

Find the surface areas of the two solids that result from the slice. Round to the nearest tenth.

1. One-fourth of the cube is sliced off the top.

2. One-third of the prism is sliced off the back.

3. The cube is sliced in half.

4. The cylinder is sliced in half.

5. The cylinder is sliced in half.

6. The prism is sliced in half.
B

10-3

TI-73 Activity

Surface Area of Prisms

Use the Equation Solver to work with formulas involving surface area.

Example

A prism has sides that measure 14 cm, 18 cm, and 10 cm. Find the surface area of the prism.

Step 1
Choose Equation Solver.

Step 2
Enter the equation. Use \[ \text{TEXT} \] to enter the variables.

(If an equation is already there, press \[ \text{CLEAR} \].)

\[ \text{S} = 2 \times L \times H + 2 \times L \times W + 2 \times W \times H \]

Step 3
Enter the values for L, H, and W.

Step 4
In the Solve row, choose S. (Ignore any current value of S.)

Step 5
Read the value of S in the second row.

The surface area of this prism is 1,144 cm\(^2\).

Exercises

Find the surface area of each prism.

1. 

2. 

3. 

4. 

5. 

6. 

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1. One way to make a cone is to start with a net of a cone. This will have two touching circles that are certain radii. Describe this method.

2. Another way to make a cone is to use only one circle. Using a compass, draw a large circle and then cut it out.
   
a. Use a protractor to mark a central angle of 90° on your circle. Cut the circle along the central angle. You will have two parts, one with an angle of 90° and one with an angle of 270°.
   
b. Fold and tape each part from Exercise 2a into a cone with no overlap.
   
c. Compare and contrast the height and radii of your two cones.

3. Describe how your method in Exercise 2 will change if you want the base of your cone to have a certain circumference instead of a certain central angle.

4. Describe how to make a cone with a certain height.
Reteach

Surface Area of Pyramids and Cones

The lateral surface area $L.A.$ of a regular pyramid is half the perimeter $P$ of the base times the slant height $\ell$, or $L.A. = \frac{1}{2}P\ell$. The total surface area of a regular pyramid is the lateral area $L.A.$ plus the area of the base $B$, or $S.A. = L.A. + B$ or $S.A. = \frac{1}{2}P\ell + B$.

Example 1  Find the lateral and total surface areas of the square pyramid.

<table>
<thead>
<tr>
<th>Lateral Surface Area</th>
<th>Total Surface Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L.A. = \frac{1}{2}P\ell, \ P = 16, \ \ell = 5$</td>
<td>$S.A. = 40 + 4^2$</td>
</tr>
<tr>
<td>$L.A. = 16 \cdot 5$</td>
<td>$S.A. = 56$</td>
</tr>
</tbody>
</table>

The lateral and total surface areas of the pyramid are 40 and 56 square feet.

Example 2  Find the lateral and total surface areas of the cone. Round to the nearest tenth.

<table>
<thead>
<tr>
<th>Lateral Surface Area</th>
<th>Total Surface Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L.A. = \pi rl$</td>
<td>$S.A. = L.A. + \pi r^2$</td>
</tr>
<tr>
<td>$L.A. = \pi \cdot 3 \cdot 5 \quad r = 3, \ \ell = 5$</td>
<td>$S.A. = 47.1 + \pi \cdot 3^2$</td>
</tr>
<tr>
<td>$L.A. \approx 47.1$</td>
<td>$S.A. \approx 75.4$</td>
</tr>
</tbody>
</table>

The lateral and total surface areas of the cone are about 47.1 and 75.4 square centimeters.

Exercises

Find the lateral and total surface areas of each solid. Round to the nearest tenth.

1. 

2. 
Skills Practice

Surface Area of Pyramids and Cones

Find the lateral and total surface areas of each solid. Round to the nearest tenth if necessary.

1. 3 m
   \[ \text{4 m} \]
   \[ \text{4 m} \]

2. 7 yd
   \[ \text{5 yd} \]
   \[ \text{5 yd} \]
   \[ \text{5 yd} \]
   \[ A = 10.8 \text{ yd}^2 \]

3. 28 cm
   \[ \text{52 cm} \]

4. 9 m
   \[ \text{8 m} \]
   \[ \text{8 m} \]

5. 36 m
   \[ \text{30 m} \]

6. 32 in.
   \[ \text{12 in.} \]

7. 11.5 yd
   \[ \text{7 yd} \]
   \[ \text{7 yd} \]

8. 11.3 cm
   \[ \text{8 cm} \]

9. square pyramid: base side length, 4 cm; slant height, 7.3 cm

10. cone: radius, 5 yd; slant height, 12.7 yd
Homework Practice

Surface Area of Pyramids and Cones

Find the lateral and total surface areas of each solid. Round to the nearest tenth if necessary.

1. 
   ![Pyramid diagram with dimensions 2.1 cm, 2.1 cm, 4.2 cm]

2. 
   ![Cone diagram with dimensions 15 ft, 15 ft]

3. 
   ![Pyramid diagram with dimensions 3 yd, 2.6 yd, 3 yd]

4. 
   ![Cone diagram with dimensions A = 9π in², 6 in.]

5. 
   ![Pyramid diagram with dimensions 20 mm, 16 mm, 16 mm]

6. 
   ![Cone diagram with dimensions 12 cm, 5 cm]

7. **ALGEBRA** A cone has a lateral surface area of $20\pi$ square yards. If the slant height is 2 yards, what is the total surface area of the cone?

8. **PYRAMIDS** When the Great Pyramid was built, the slant height was about 610 feet and the length of the base was about 750 feet. Find the approximate lateral surface area of the Great Pyramid when it was built.
Problem-Solving Practice
Surface Area of Pyramids and Cones

1. **ROOFS** A farmer is planning to put new roofing material on the pyramidal roof of a work shed as shown below. Calculate the number of square feet of roofing material needed. Round to the nearest tenth.

   ![Diagram of a pyramid roof]

2. **TRAFFIC CONES** A 12-inch highway traffic cone is a “truncated cone”. That is, a small cone is cut off the top. Calculate the lateral area of the truncated cone. Round to the nearest tenth.

   ![Diagram of a truncated cone]

3. **HOBBIES** When the butterfly net shown below is fully extended, it forms the shape of a pyramid with a slant height of 26 inches. The sides of the square base are 12 inches. Calculate the amount of mesh material needed to make the butterfly net.

   ![Diagram of a butterfly net]

4. **HORTICULTURE** The local college has a greenhouse that is shaped like a square pyramid, as shown below. The lateral faces of the greenhouse are made of glass. Find the surface area of the glass on the greenhouse.

   ![Diagram of a greenhouse]

5. **ART** Find the surface area of the sculpture shown below.

   ![Diagram of a sculpture]

6. **COSTUMES** The top of a costume hat is shaped like a triangular pyramid, as shown below. How much black felt is needed to cover the sides of the pyramid?

   ![Diagram of a triangular pyramid hat]
Two Three-Dimensional Puzzles

In the nets on this page, segments of equal length are marked in the same way.

1. Make three copies of this pattern. Use 2 inches for each side of the central square. Fold each pattern to make a pyramid. Put the three pyramids together to make a cube. Make a sketch of the result.

2. Make four copies of this pattern. Use 6 inches for the base of the figure. Fold each pattern to make a solid. Put the four solids together to make a regular tetrahedron. Make a sketch of the result.

Solve.

3. Find the surface area of the cube in Exercise 1.

4. Find the volume of each of the three pyramids in Exercise 1.

5. Find the surface area of the tetrahedron in Exercise 2. You will need to measure an altitude for one of the faces.
Finding the surface area of a cone can be done by creating a graphing calculator program that prompts you to enter the radius and the slant height. The output will be the total surface area.

The following keystrokes are needed to create and store the program in your calculator's memory. First you will name the program SACONE.

Next you will enter the program lines.

Now you can execute your program. Suppose you want to find the total surface area of a cone with a radius of 5 inches and slant height 10 inches. Press the PRGM button and look for the program name SACONE. Arrow down to highlight the name and press ENTER. You will now see the program name SACONE on the viewing screen. Press ENTER and then enter the number 5. Press ENTER again and input 10. Press ENTER again. The number 235.619449 will appear on the viewing screen. By rounding to the nearest tenth, you get 235.6 square inches.

Use the program SACONE to find the surface area of each cone. Round to the nearest tenth.

1. radius = 8 ft  slant height = 4 ft
2. radius = 4.2 cm  slant height = 4.2 cm
3. radius = 3.1 in.  slant height = 1.8 in.
1. How is the area of the base of a prism or cylinder related to the volume?

2. Why are formulas useful in finding area and volume?

3. How are the volumes of cones and pyramids related to the volumes of cylinders and prisms?
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