11.7 Surface Area

Objective To introduce finding the surface area of prisms, cylinders, and pyramids.

Key Concepts and Skills
- Measure the dimensions of a cylinder in inches and centimeters. [Measurement and Reference Frames Goal 1]
- Use rectangle and triangle area formulas to find the surface area of prisms and cylinders. Apply a formula to calculate the area of a circle. [Measurement and Reference Frames Goal 2]
- Identify and use the properties of prisms, pyramids, and cylinders in calculations. [Geometry Goal 2]

Key Activities
Students find the surface areas of prisms, cylinders, and pyramids by calculating the area of each surface of a solid and then finding the sum.

Ongoing Assessment:
- Informing Instruction See page 892.
- Recognizing Student Achievement Use journal pages 389 and 390. [Measurement and Reference Frames Goals 1 and 2]

Key Vocabulary
surface area

Materials
Math Journal 2, pp. 389 and 390
Study Link 11-6
slate calculator cardboard box
per workstation: 2 cans, tape measure, ruler, triangular prism, square pyramid

Advance Preparation
For Part 1, organize workstations for groups of 4 students (2 partnerships each). Each group will need 2 cans (see Lesson 11-3) and 1 each of the triangular prism and square pyramid models (Math Masters, pages 324 and 326) constructed in Lesson 11-1. Place a cardboard box with the top taped shut near the Math Message.


Plotting and Analyzing Insect Data
Math Journal 2, pp. 390A and 390B
Students plot insect lengths in fractional units on a line plot. They use the line plot to analyze the data.

Math Boxes 11-7
Math Journal 2, p. 391
Students practice and maintain skills through Math Box problems.

Study Link 11-7
Math Masters, p. 341
Students practice and maintain skills through Study Link activities.

ENRICHMENT
Finding the Smallest Surface Area for a Given Volume
Math Masters, p. 342
per partnership: 24 cm cubes
Students find the rectangular prism with the smallest surface area for a given volume.

EXTRA PRACTICE
Finding Area, Surface Area, and Volume
Math Masters, p. 343
Student Reference Book, pp. 196 and 197
Students practice calculating area, surface area, and volume.
Getting Started

Mental Math and Reflexes
Have students write numbers from dictation and mark the indicated digits. Suggestions:

○ 5,824,039 Circle the digit in the thousands place, and put an X through the digit in the hundred-thousands place.
28,794,852 Circle the digit in the ten-thousands place, and put an X through the digit in the hundreds place.
○ 31,092 Circle the digit in the thousandths place, and put an X through the digit in the hundredths place.
158,247,653 Circle the digit in the thousandths place, and put an X through the digit in the hundreds place.
○ 587,624 Circle the digit in the tens place, and put an X through the digit in the ones period.
56,790,244 Circle each digit in the millions period, and put an X through each digit in the ones period.

1 Teaching the Lesson

Math Message Follow-Up
(Math Journal 2, p. 389)

Ask volunteers to use geometry vocabulary to describe the box. The box is a rectangular prism that has six rectangular faces. Then have students explain their solution strategies. If wrapping paper covers each face of the box exactly, the least amount of wrapping paper needed is the sum of the area of each of the six faces. Tell students that the sum of the areas of the faces or the curved surface of a geometric solid is called surface area. If wrapping paper covers each face of the box exactly, the area of paper required is the surface area of the box. If the area of the available wrapping paper is less than the surface area of the box, the paper will not completely cover the box.

Ask a pair of students to measure the length, width, and height of the box to the nearest inch. Have students record these dimensions on the figure in Problem 1 on journal page 389, find and record the areas of the six sides of the box, and add these to find the total surface area. Remind students that opposite sides (top and bottom, left and right, front and back) of the box have the same area. This means that students need to calculate only three different areas.

Finding the Surface Area of a Can
(Math Journal 2, p. 389)

Algebraic Thinking Distribute one can to each partnership. Ask students to imagine that the top lids of their cans have not been removed. Ask: How would you find the surface area of your can?
**Math Journal 2, p. 390**

**Student Page**

**Math Journal 2, p. 390A**

Remind students that in this problem they are finding the area of the surface of their can, not the volume. Give students plenty of time to explore solution strategies among themselves, without your help. Add the areas of the top, bottom, and curved surface to find the total surface area. Ask a volunteer to explain how to find the area of the circular top and bottom. Use the formula $A = \pi \times r^2$. Ask another volunteer to explain how to find the area of the curved surface between the top and bottom of the can. Calculate the circumference of the base using the formula $c = \pi \times d$, and then multiply the circumference by the height of the can.

If students are unable to suggest an approach for finding this area, remind or show them that the label on a food can is shaped like a rectangle if it is cut off and unrolled.

**Ongoing Assessment: Informing Instruction**

Watch for students who seem to have difficulty with visualizing the cutting and unrolling of the can label. Have them use the following procedure to cut a sheet of paper to use as a label for the side of the can:

1. Mark the top and bottom rims of the can at the can’s seam.
2. Lay the can on the sheet of paper with the marks touching the paper. Mark these points on the paper.
3. Roll the can one complete revolution, until the marks touch the paper again. Mark these points on the paper.
4. Connect the four marks on the paper to form a rectangle. Cut out the rectangle.
Finding the Surface Area of a Prism and a Pyramid
(Math Journal 2, p. 390)

Algebraic Thinking Have partners measure each solid constructed in Lesson 11-1 from Math Masters, pages 324 and 326 and record the dimensions on journal page 390. Then have them calculate and record the face areas and total surface area for each solid. Circulate and assist.

Ongoing Assessment: Recognizing Student Achievement

Use journal pages 389 and 390 to assess students’ ability to measure to the nearest 1 inch and 0.1 cm and to find the area of circles, triangles, and rectangles. Students are making adequate progress if they correctly answer Problems 2 and 3 and use rectangle, circle, and triangle area formulas to find the surface area of prisms and cylinders.

[Measurement and Reference Frames Goals 1 and 2]

Ongoing Learning & Practice

Plotting and Analyzing Insect Data
(Math Journal 2, pp. 390A and 390B)

Students plot insect lengths in fractional units on a line plot. They use the line plot to analyze data and solve problems involving addition, subtraction, multiplication, and division with fractions. As needed, review how to make a line plot based on fractional addition, subtraction, multiplication, and division with fractions.

Math Boxes 11.7
(Math Journal 2, p. 391)

Mixed Practice Math Boxes in this lesson are paired with Math Boxes in Lesson 11-5. The skill in Problem 5 previews Unit 12 content.

Study Link 11.7
(Math Masters, p. 341)

Home Connection Students practice using formulas to calculate volume and surface area. If students use calculators, remind them to enter 3.14 for π if necessary.
### Study Link Master

#### Volume and Surface Area

<table>
<thead>
<tr>
<th>Problem</th>
<th>Dimensions (cm)</th>
<th>Surface Area (cm²)</th>
<th>Volume (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2 x 3 x 1</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>3 x 1 x 2</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>3.</td>
<td>12 x 1 x 1</td>
<td>30</td>
<td>8</td>
</tr>
</tbody>
</table>

### Math Masters, p. 341

###的不同化选项

#### 寻找最小的表面积

(数学大师, p. 342)

**代数性思维**将应用学生对体积和表面积的理解，将用给定的体积来找到矩形柱形的不同尺寸。合作伙伴使用在形状中的尺寸来确定一个棱柱的尺寸，该棱柱将有最小的表面积。

当学生完成学习后，讨论任何困难或疑问。

#### 找出面积、表面积、和体积

(数学大师, p. 343; 学生参考书, pp. 196和197)

学生练习计算面积、表面积和体积各种几何形状。

#### 学生动手练习

#### 学生独立练习
LESSON 11.7

Area, Surface Area, and Volume

Area of rectangle: \( A = l \times w \)

Volume of rectangular prism: \( V = B \times h \)

or \( V = l \times w \times h \)

Circumference of circle: \( c = \pi \times d \)

Area of circle: \( A = \pi \times r^2 \)

Volume of cylinder: \( V = \pi \times r^2 \times h \)

1. Record the dimensions and find the area.

   \[
   \begin{array}{c}
   \text{Length} = 2.5 \text{ ft} \\
   \text{Width} = 5.5 \text{ ft} \\
   \text{Area} = \quad \\
   \text{How many square tiles, each 1 ft long on a side, would be needed to fill the rectangle?} \\
   \text{Number} = \\
   \end{array}
   \]

2. Record the dimensions and find the volume.

   \[
   \begin{array}{c}
   \text{Length of base} = 4 \text{ cm} \\
   \text{Width of base} = 5 \text{ cm} \\
   \text{Area of base} = \\
   \text{Height of prism} = 2 \text{ cm} \\
   \text{Number of 1-centimeter unit cubes needed to fill the box:} \\
   \text{Volume} = \\
   \end{array}
   \]

3. Rectangular prism

   \[
   \begin{array}{c}
   \text{Length of base} = 8 \text{ cm} \\
   \text{Width of base} = 5 \text{ cm} \\
   \text{Height of prism} = 7 \text{ cm} \\
   \text{Volume} = \\
   \text{Surface area} = \\
   \end{array}
   \]

4. Cylinder

   \[
   \begin{array}{c}
   \text{Diameter} = 7 \text{ ft} \\
   \text{Height} = 9 \text{ ft} \\
   \text{Volume} = \\
   \text{Surface area} = \\
   \end{array}
   \]