Main Idea

Convert units of measure between dimensions including area and volume.
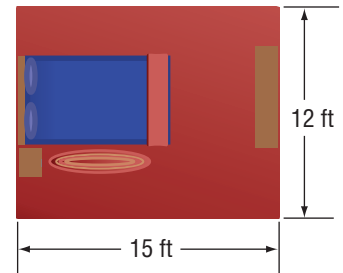
Convert Units of Area and Volume

CARPETING Jonathan is carpeting his bedroom. It is 15 feet long and 12 feet wide. While shopping, he notices carpet is sold in square yards.

1. How many feet are in one yard?
2. How many yards long is the room?
3. How many yards wide is the room?
4. What is the area of the room in square yards?

You can use the formula for the area of a square, $A = s^2$, to find the number of square feet in one square yard.

EXAMPLES   Convert Area Measurements

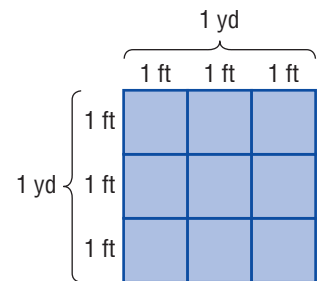**1** **Convert one square yard to square feet.**

A square yard is a square with a side length of one yard. You know that one yard is equal to three feet. So, one square yard is a square with side length three feet.

$A = s^2$ Write the formula.

$A = 3^2$ Replace s with 3.

$A = 9$ Simplify.

So, one square yard is equal to 9 square feet.

2 **Convert one square meter to square centimeters.**

A square meter is a square with a side length of one meter. You know that one meter is equal to 100 centimeters. So, one square meter is a square with side length 100 centimeters.

$A = s^2$ Write the formula.

$A = 100^2$ Replace s with 100.

$A = 10,000$ Simplify.

So, one square meter is equal to 10,000 square centimeters.

Lesson 9-1 Convert Measurements   **517**

Complete.

a. $1 \text{ ft}^2 = \blacksquare \text{ in}^2$ **b.** $1 \text{ cm}^2 = \blacksquare \text{ mm}^2$

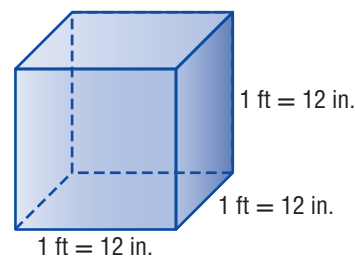You can use the formula for the volume of a prism, $V = bwh$, to convert cubic units.

Study Tip

Formulas Since a cube has three equal dimensions, volume can also be found with the formula $V = s^3$, where s is the length of a side.

EXAMPLE   Convert Volume Measurements

3   **Convert one cubic foot to cubic inches.**

A cubic foot is a cube with a side length of one foot or 12 inches.

$V = bwh$ Write the formula.

$V = 12 \cdot 12 \cdot 12$ Replace b, w, and h with 12.

$V = 1{,}728$ Simplify.

So, one cubic foot is equal to 1,728 cubic inches.

1 ft = 12 in.
1 ft = 12 in.
1 ft = 12 in.

✓ **CHECK Your Progress**

Complete.

c. $1 \text{ yd}^3 = \blacksquare \text{ ft}^3$ **d.** $1 \text{ cm}^3 = \blacksquare \text{ mm}^3$

The table gives several common measurement conversions for square units and cubic units.

Key Concept   Measurement Conversions

	Customary Units	Metric Units
Area	$1 \text{ ft}^2 = 144 \text{ in}^2$	$1 \text{ m}^2 = 10{,}000 \text{ cm}^2$
	$1 \text{ yd}^2 = 9 \text{ ft}^2$	$1 \text{ cm}^2 = 100 \text{ mm}^2$
Volume	$1 \text{ ft}^3 = 1{,}728 \text{ in}^3$	$1 \text{ m}^3 = 1{,}000{,}000 \text{ cm}^3$
	$1 \text{ yd}^3 = 27 \text{ ft}^3$	$1 \text{ cm}^3 = 1{,}000 \text{ mm}^3$

Each relationship in the Key Concept box can be written as a unit ratio. To convert square or cubic units, use the unit ratio or its reciprocal.

Convert Measurements

Study Tip

Formulas The formula for finding the area of a rectangle is $A = b \cdot w$.

④ **CONSTRUCTION** **A roof is 25 feet by 35 feet. How many square yards is the roof? Round to the nearest tenth.**

The area of the roof is 25 feet × 35 feet or 875 square feet. Use the reciprocal of the unit ratio $\dfrac{9 \text{ ft}^2}{1 \text{ yd}^2}$ to find the number of square yards.

$875 \text{ ft}^2 = 875 \text{ ft}^2 \cdot \dfrac{1 \text{ yd}^2}{9 \text{ ft}^2}$ Multiply by $\frac{1 \text{ yd}^2}{9 \text{ ft}^2}$.

$= 875 \cancel{\text{ft}^2} \cdot \dfrac{1 \text{ yd}^2}{9 \cancel{\text{ft}^2}}$ Divide out common units, leaving the desired unit, yards.

$= \dfrac{875 \text{ yd}^2}{9}$ or 97.2 yd^2 Divide.

The roof is 97.2 square yards.

✓ **CHECK Your Progress**

e. CEREAL A cereal box holds 320 cubic inches of cereal. How many cubic feet is this? Round to the nearest tenth.

The metric system also relates length, mass, and capacity.

Key Concept **Length, Mass, and Capacity**

Words	**Symbols**
1 milliliter has the same volume as 1 cubic centimeter.	1 mL = 1 cc
1 milliliter of water is approximately 1 gram.	1 mL ≈ 1 g

EXAMPLE **Convert Volume to Capacity**

⑤ **Convert one cubic meter to milliliters.**

A cubic meter is a cube with a side length of one meter or 100 centimeters. Use 1 cc = 1 mL to convert the rates.

$V = b \cdot w \cdot h$ Write the formula.

$V = 100 \cdot 100 \cdot 100$ Replace b, w, and h with 100.

$V = 1{,}000{,}000$ Simplify.

So, one cubic meter is equal to 1,000,000 milliliters.

✓ **CHECK Your Progress**

Complete.

f. $17{,}000 \text{ mm}^3 = \blacksquare \text{ mL}$ **g.** $150 \text{ cc} = \blacksquare \text{ L}$

Examples 1 and 2
(p. 517)

Complete.

1. $3 \text{ ft}^2 = \blacksquare \text{ in}^2$
2. $4 \text{ yd}^2 = \blacksquare \text{ ft}^2$
3. $720 \text{ in}^2 = \blacksquare \text{ ft}^2$
4. $3.2 \text{ m}^2 = \blacksquare \text{ cm}^2$
5. $900 \text{ mm}^2 = \blacksquare \text{ cm}^2$
6. $8 \text{ cm}^2 = \blacksquare \text{ mm}^2$

Examples 3 and 4
(pp. 518–519)

Complete.

7. $0.2 \text{ ft}^3 = \blacksquare \text{ in}^3$
8. $4,320 \text{ in}^3 = \blacksquare \text{ ft}^3$
9. $1.5 \text{ yd}^3 = \blacksquare \text{ ft}^3$
10. $5,600 \text{ mm}^3 = \blacksquare \text{ mL}$
11. $4.1 \text{ m}^3 = \blacksquare \text{ cm}^3$
12. $2 \text{ cm}^3 = \blacksquare \text{ mL}$

Example 5
(p. 519)

13. **FENCING** A playground is surrounded by chain-link fencing. The dimensions of the playground are 52 feet by 37 feet. How many square yards does the fencing surround? Round to the nearest tenth if necessary.
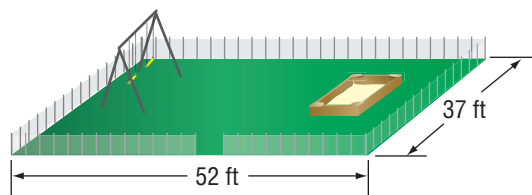
14. **SCUBA DIVING** Maria is using a cylindrical oxygen tank while scuba diving. It holds 80 cubic inches of air. How many cubic feet of air is she using? Round to the nearest hundredth if necessary.

Practice and Problem Solving

● = **Step-by-Step Solutions** begin on page R1.
Extra Practice begins on page EP2.

Examples 1 and 2
(p. 517)

Complete. Round to the nearest hundredth if necessary.

15. $11.5 \text{ ft}^2 = \blacksquare \text{ in}^2$
16. $1,396.8 \text{ in}^2 = \blacksquare \text{ ft}^2$
17 $216 \text{ ft}^2 = \blacksquare \text{ yd}^2$
18. $14 \text{ yd}^2 = \blacksquare \text{ ft}^2$
19. $7.5 \text{ m}^2 = \blacksquare \text{ cm}^2$
20. $980 \text{ cm}^2 = \blacksquare \text{ m}^2$
21. $5.4 \text{ cm}^2 = \blacksquare \text{ mm}^2$
22. $597 \text{ mm}^2 = \blacksquare \text{ cm}^2$
23. $1 \text{ mi}^2 = \blacksquare \text{ ft}^2$

Examples 3 and 4
(pp. 518–519)

Complete. Round to the nearest hundredth if necessary.

24. $3 \text{ yd}^3 = \blacksquare \text{ ft}^3$
25. $11,232 \text{ in}^3 = \blacksquare \text{ ft}^3$
26. $6.06 \text{ ft}^3 = \blacksquare \text{ in}^3$
27. $280.8 \text{ ft}^3 = \blacksquare \text{ yd}^3$
28. $6,750 \text{ mm}^3 = \blacksquare \text{ cm}^3$
29. $0.45 \text{ m}^3 = \blacksquare \text{ mL}$
30. $7.7 \text{ cm}^3 = \blacksquare \text{ mm}^3$
31. $973,000 \text{ mL} = \blacksquare \text{ m}^3$
32. $1 \text{ yd}^3 = \blacksquare \text{ in}^3$

Example 5
(p. 519)

33. **SPORTS** Including the end zones, a football field is 360 feet long by 160 feet wide. What is the area of a football field in square yards?

34. **GARDENING** Tabitha has a small garden. If the garden has an area of 1,512 square inches, what is the area of the garden in square feet?

35. **APPLIANCES** A refrigerator has 25.3 cubic feet of space. How many cubic yards is this?

36. PARADE A cartoon character was depicted as a balloon in a parade. The balloon contained 2,443 cubic yards of air. How many cubic feet is this?

37. MEDICINE A specific medicine states that a dose is 2 teaspoons. If a teaspoon is equal to 5 milliliters, how many cubic centimeters is the dose?

38. How many square yards are in one square mile?

39. One square yard is equal to how many square inches?

40. BOXES Two boxes are shown.

    a. What is the difference of their volume, in cubic feet?

    b. How many times greater is the volume of Box A than Box B?

    c. What conclusion can you draw about the volume of a prism after its dimensions are halved?

Box A: 14 in., 12 in., 15 in.
Box B: 7 in., 6 in., 7.5 in.
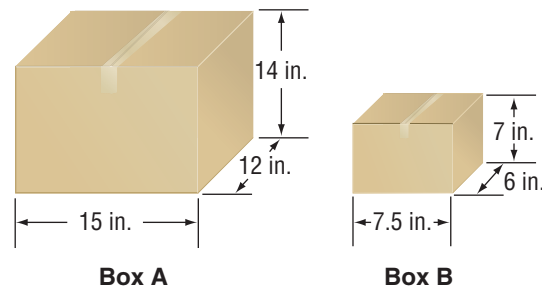
41 SWIMMING POOL The world's largest swimming pool is located in Chile and has a volume of 250,000 cubic meters. How many cubic yards is this? (*Hint*: 1 meter = 1.1 yards)

42. DOSAGES A liquid allergy medication comes in a bottle containing 4 fluid ounces. How many 5 cubic-centimeter doses are in the bottle? (*Hint*: 1 fl oz = 29.5 mL)

H.O.T. Problems

43. REASONING Alberto measured his bedroom for new carpet. The room is 169 square feet. When he got to the carpet store, all of the prices were given in square yards. Explain how he would convert his calculations to square yards to determine the cost.

44. CHALLENGE The Art Club is tiling a wall 8 feet tall by 10 feet long. Each tile is a 3-inch square and costs $0.59. What is the cost of tiling the wall?

45. FIND THE ERROR Seth is converting the volume of his shed from cubic feet to cubic inches. Find his mistake and correct it.

$$8{,}640 \text{ ft}^3 = 8{,}640 \text{ ft}^3 \times \frac{1 \text{ ft}^3}{1{,}728 \text{ in}^3}$$
$$= \frac{8{,}640 \text{ ft}^3}{1{,}728 \text{ in}^3}$$
$$= 5 \text{ in}^3$$

**46. Write MATH** Compare and contrast one mile with one square mile.

47. Which of the following measurements is NOT equivalent to the other three?

    A. 400,000,000 cm²

    B. 4,000 m²

    C. 0.04 km²

    D. 40,000,000,000 mm²

48. **GRIDDED RESPONSE** Two students were asked to design a dog run with an area of 36 feet. The first student made a 9-foot-long by 4-foot-long run. The second student made a square run that was 6 feet on each side. How many more feet of fence will the first student need than the second?

49. **EXTENDED RESPONSE** A freight container has the dimensions shown below.
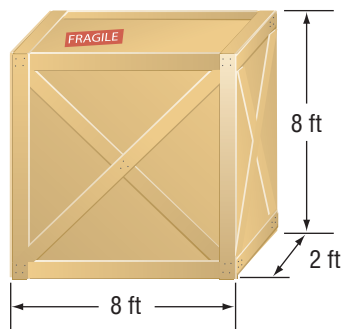
Part A What is the volume of the container in cubic feet?

Part B What is the volume of the container in cubic inches?

Part C What is the volume of the container in cubic meters? Round to the nearest tenth if necessary.

Spiral Review

Complete. Round to the nearest tenth if necessary. (Lesson 9-1E)

50. 24 mi/h = ■ ft/s   **51.** 39 kg/min = ■ g/s   **52.** 8.3 m/h = ■ yd/min

53. **WEIGHTLIFTING** A barbell weighs 10 pounds. What is its mass in kilograms? (Lesson 9-1D)

54. **STORAGE** The jar shown is used to store marinara sauce. What is the volume of marinara sauce that can be stored? (Lesson 8-1C)

55. **FISHERY** The table shows the population of various fish kept at a fishery. (Lesson 6-3B)

Fishery Population		
Fish	**Month 1**	**Month 2**
Herring	2,300	2,250
Cod	1,250	1,450
Flounder	4,900	4,725

    a. What was the percent of increase of cod from Month 1 to Month 2?

    b. What was the percent of change of herring from Month 1 to Month 2?

    c. Which fish had the greatest percent of change?