Getting Ready to Teach Unit 8

Learning Path in the Common Core Standards

In Grade 4, students used multiplication to convert larger units to smaller units within the same measurement system. In this unit, students use both multiplication and division to convert within the same system. This is the first grade level in which students convert smaller units to larger units.

Students worked with the perimeter and area of rectangles in earlier grades. At this grade level, they work with the key concept of volume, exploring the concept using hands-on unit cubes, and progressing in their work to using a formula.

Students also have previous experience identifying geometric figures by their properties. In Grade 5, students draw as well as sort and classify polygons by their attributes. They begin to formulate the idea of a hierarchy of quadrilateral properties.

Visual models and real world situations are used throughout the unit to illustrate important concepts.

Help Students Avoid Common Errors

Math Expressions gives students opportunities to analyze and correct errors, explaining why the reasoning was flawed.

In this unit we use Puzzled Penguin to show typical errors that students make. Students enjoy teaching Puzzled Penguin the correct way, and explaining why this way is correct and why the error is wrong. The following common errors are presented to students as letters from Puzzled Penguin and as problems in the Teacher Edition that were solved incorrectly by Puzzled Penguin:

- **Lesson 1:** Not doubling length and width when finding perimeter of a rectangle
- **Lesson 9:** Counting only visible unit cubes when counting is used to find volume
- **Lesson 16:** Not recognizing characteristics of polygons

In addition to Puzzled Penguin, there are other suggestions listed in the Teacher Edition to help you watch for situations that may lead to common errors. As part of the Unit Test Teacher Edition pages, you will find a common error and prescription listed for each test item.

Converting Measurements

Lessons 1 2 3 4 5 6

Metric Units of Measure Generally speaking, it is simpler to convert one metric unit of measure to another than it is to convert one customary unit of measure to another. Converting customary units requires multiplying or dividing by a wide variety of numbers. Converting metric units requires only multiplying or dividing by a power of 10. Powers of 10 include 10^1 or 10, 10^2 or 100, 10^3 or 1,000, and so on.

Multiplying or dividing by a power of 10 produces a result that is the same as shifting the digits in the measurement a number of places to the left or the right.

Dividing by:

10^1 shifts the digits 1 place to the right.

10^2 shifts the digits 2 places to the right.

10^3 shifts the digits 3 places to the right.

And so on.

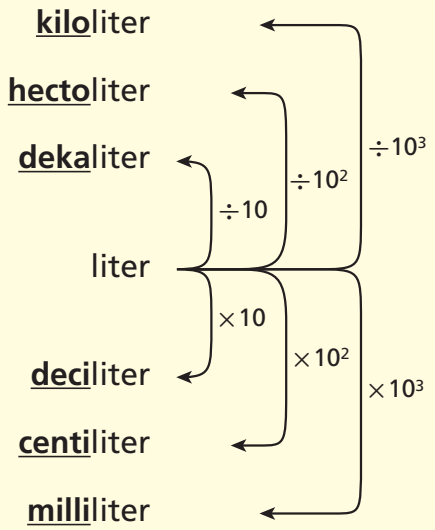
Multiplying by:

10^1 shifts the digits 1 place to the left.

10^2 shifts the digits 2 places to the left.

10^3 shifts the digits 3 places to the left.

And so on.



Generalizations When completing the activities in Lessons 1–3, students should develop an understanding of the following generalizations for converting metric units of measure.

- Multiplication is used to convert a larger unit to a smaller unit.
- Division is used to convert a smaller unit to a larger unit.

Once students become familiar with the relationships that metric units of measure share (i.e., How are meters related to kilometers and millimeters?), they often can perform a variety of metric conversions using only mental math.

Metric Units of Length The metric units of length students work with and convert in this unit include millimeters (mm), centimeters (cm), decimeters (dm), meters (m), dekameters (dam), hectometers (hm), and kilometers (km).

In the metric system, the meter is the basic unit of length. The relationships shown below—comparing 1 meter to other metric units of length and 1 of other metric units of length to meters—are used by students to perform conversions.

Metric Units of Length	
1 dekameter (dam) = 10 meters	1 meter = 0.1 dekameter
1 hectometer (hm) = 100 meters	1 meter = 0.01 hectometer
1 kilometer (km) = 1,000 meters	1 meter = 0.001 kilometer
1 meter = 10 decimeters (dm)	0.1 meter = 1 decimeter
1 meter = 100 centimeters (cm)	0.01 meter = 1 centimeter
1 meter = 1,000 millimeters (mm)	0.001 meter = 1 millimeter

Initially, students use guided examples to convert, and progress to conversions with no guidance.

Example 1 Convert to a Smaller Unit

2 km = _____ m

Step 1: Choose multiplication because we will need more of the smaller units.

Step 2: Multiply by 1,000 because 1,000 m = 1 km.

2 km = 2,000 m (2 × 1,000 = 2,000)

Example 2 Convert to a Larger Unit

50 cm = _____ m

Step 1: Choose division because we will need fewer of the larger units.

Step 2: Divide by 100 because 100 cm = 1 m.

50 cm = 0.5 m (50 ÷ 100 = 0.5)

Complete.

1. 15 m = _____mm **2.** 877 cm = _____ m **3.** 450 m = _____ km

4. 2.39 m = _____ cm **5.** 2,040 mm = _____ m **6.** 8.6 km = _____ m

Two-Step and Multistep Problems Exercises and problems in Lesson 1 range from straightforward conversions (such as those shown on the previous page) to multistep problems in real world contexts.

14. Natasha ran 3.1 kilometers. Tonya ran 4 meters more than half as far as Natasha. How many meters did Tonya run? 1,554 meters

24. Mattie is making a collar for her dog. She needs to buy some chain, a clasp, and a name tag. She wants the chain to be 40 centimeters long. A meter of the chain costs \$9.75. The clasp is \$1.29, and the name tag is \$3.43. How much will it cost to make the collar? Estimate to check if your answer is reasonable.

\$8.62; Estimate: $(\frac{1}{2} \times \$10) + \$1 + \$3 = \$9$

Liquid Volume and Mass As with length, the concepts of liquid volume and mass in Lessons 2 and 3 are introduced with charts that show the relationships between the basic units, liters and grams, and the other units of liquid volume and mass.

Metric Units of Liquid Volume	
1 dekaliter (daL) = 10 liters	1 liter = 0.1 dekaliter
1 hectoliter (hL) = 100 liters	1 liter = 0.01 hectoliter
1 kiloliter (kL) = 1,000 liters	1 liter = 0.001 kiloliter
1 liter = 10 deciliters (dL)	0.1 liter = 1 deciliter
1 liter = 100 centiliters (cL)	0.01 liter = 1 centiliter
1 liter = 1,000 milliliters (mL)	0.001 liter = 1 milliliter

Metric Units of Mass	
1 dekagram (dag) = 10 grams	1 gram = 0.1 dekagram
1 hectogram (hg) = 100 grams	1 gram = 0.01 hectogram
1 kilogram (kg) = 1,000 grams	1 gram = 0.001 kilogram
1 gram = 10 decigrams (dg)	0.1 gram = 1 decigram
1 gram = 100 centigrams (cg)	0.01 gram = 1 centigram
1 gram = 1,000 milligrams (mg)	0.001 gram = 1 milligram

For these concepts, students again use guided examples to convert, and progress to conversions with no guidance and then to solving multistep problems in real world contexts.

Customary Units of Measure Although the strategies of using multiplication to change to a smaller unit and using division to change to a larger unit are the same for both metric and customary conversions, computations for customary conversions are more complicated because they do not involve powers of 10. In other words, performing customary conversions is not as simple as shifting digits to the left or to the right. For example, changing millimeters (the smallest metric unit of length) to kilometers (the largest unit) simply involves shifting the digits six places to the right (i.e., dividing by 10^6 or 1,000,000). The related customary conversion of inches to miles would typically involve first dividing by 12 to find the number of feet, then dividing by 5,280 to change the number of feet to miles. Metric conversions by comparison are very straightforward.

Length, Liquid Volume, and Weight To successfully convert customary units of length, liquid volume, and weight in Lessons 4–6, students must know a wide range of customary relationships.

Customary Units of Length	
1 foot (ft) = 12 inches (in.)	1 yard (yd) = 3 feet = 36 inches
1 mile (mi) = 1,760 yards = 5,280 feet	

Customary Units of Liquid Volume
1 gallon (gal) = 4 quarts (qt) = 8 pints (pt) = 16 cups (c)
$\frac{1}{4}$ gallon = 1 quart = 2 pints = 4 cups
$\frac{1}{8}$ gallon = $\frac{1}{2}$ quart = 1 pint = 2 cups

Customary Units of Weight	
1 pound (lb) = 16 ounces (oz)	1 ton (T) = 2,000 pounds

As with metric conversions, students initially use guided examples to convert customary units.

Example 1 Convert to a Smaller Unit

15 yd = _____ ft

Step 1: Choose multiplication because we will need more of the smaller units.

Step 2: Multiply by 3 because 3 ft = 1 yd.

15 yd = 45 ft (15 × 3 = 45)

Example 2 Convert to a Larger Unit

104 pt = _____ gal

Step 1: Choose division because we will need fewer of the larger units.

Step 2: Divide by 8 because 8 pt = 1 gal

104 pt = 13 gal (104 ÷ 8 = 13)

Complete.

1. $\frac{1}{2}$ yd = _____ ft **2.** _____ T = 14,000 lb **3.** _____ oz = $5\frac{1}{4}$ lb

4. _____ yd = 144 in. **5.** $2\frac{1}{2}$ qt = _____ pt **6.** _____ gal = 48 qt

7. What fraction of 1 quart is 1 cup?

8. What fraction of 1 gallon is 3 pints?

Two-Step and Multistep Problems Word problems related to customary length, liquid volume, and weight in Lessons 4–6 include real world contexts.

11. A $\frac{1}{4}$-lb package of sunflower seeds costs 79¢. An 8-ounce package costs $1.59. Which package represents the lower cost per ounce?

the $\frac{1}{4}$-lb package

16. A serving size for a glass of pineapple-orange punch is $\frac{1}{2}$ cup. Liam needs to make 72 servings of punch. He will use 8 pints of pineapple juice. The rest is orange juice. How many pints of orange juice does he need to make the punch?

10 pints