LESSON OVERVIEW

Lesson 23
Convert Measurements

MAFS Focus

Domain
Measurement and Data

Cluster
1. Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

Standards
4.MD.1.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), . . .*

Additional Standards
4.OA.3.5, 4.NBT.2.5 (See page B3 for full text.)

Standards for Mathematical Practice (SMP)
2 Reason abstractly and quantitatively.

5 Use appropriate tools strategically.

6 Attend to precision.

8 Look for and express regularity in repeated reasoning.

Lesson Objectives

Content Objectives
- Identify the units of measurement within a measurement system.
- Convert measurements from a larger unit to a smaller unit within the same system.
- Use a conversion table showing equivalent measurements within the same system.

Language Objectives
- List the units of measurement within a given system in order of size.
- Draw diagrams to visually represent the relationship between units of measure.
- Describe the multiplicative relationship between different-sized units verbally or with equations.
- Create tables to show equivalent measurements.

Prerequisite Skills
- Recognize the relationship between two factors in a multiplication equation as a multiplicative comparison.
- Understand multiplication as repeated addition.
- Understand that larger units can be subdivided into smaller units.
- Understand that the same unit can be repeated to determine the measure.
- Understand the relationship between the size of a unit and the number of units needed.

Lesson Vocabulary
- **convert** (units) to write an equivalent measurement using a different unit
- **metric system** the measurement system that measures length based on meters, liquid volume based on liters, and mass based on grams
- **customary system** the measurement system commonly used in the United States that measures length in inches, feet, yards, and miles; liquid volume in cups, quarts, pints, and gallons; and weight in ounces and pounds

Learning Progression

In previous grades students worked with common measurement units and gained the understanding that the number of units needed to describe an object's length depends on the size of the unit used.

In this lesson students express the relationship between two measurement units using multiplication. For example, an object's length in meters multiplied by 100 gives the length in centimeters. Students use bar models, tables, and equations to illustrate the multiplicative relationship and convert from the larger unit to the smaller unit. This is an application of the Grade 4 understanding of multiplication as a comparison.

In Grade 5 students will convert from smaller units to larger units.

Lesson Pacing Guide

Whole Class Instruction

Day 1
45–60 minutes

Toolbox: Interactive Tutorial*
Conversions From a Larger Unit to a Smaller Unit

Introduction
- Use What You Know *10 min*
- Find Out More *20 min*
- Reflect *5 min*

Practice and Problem Solving
Assign pages 249–250.

Day 2
45–60 minutes

Modeled and Guided Instruction
Learn About Converting Units of Weight and Mass
- Model It/Model It *15 min*
- Connect It *20 min*
- Try It *10 min*

Practice and Problem Solving
Assign pages 251–252.

Day 3
45–60 minutes

Modeled and Guided Instruction
Learn About Converting Units of Liquid Volume
- Picture It/Model It *15 min*
- Connect It *20 min*
- Try It *10 min*

Practice and Problem Solving
Assign pages 253–254.

Day 4
45–60 minutes

Guided Practice
Practice Converting Measurements
- Example *5 min*
- Problems 15–17 *15 min*
- Pair/Share *15 min*
- Solutions *10 min*

Practice and Problem Solving
Assign pages 255–256.

Day 5
45–60 minutes

Independent Practice
Practice Converting Measurements
- Problems 1–6 *20 min*
- Quick Check and Remediation *10 min*
- Hands-On or Challenge Activity *15 min*

Toolbox: Lesson Quiz
Lesson 23 Quiz

*We continually update the Interactive Tutorials. Check the Teacher Toolbox for the most up-to-date offerings for this lesson.

Small Group Differentiation

Teacher-Toolbox.com

Reteach
Ready Prerequisite Lessons *45–90 min*

Grade 3
- Lesson 22 Liquid Volume
- Lesson 23 Mass

Teacher-led Activities
Tools for Instruction *15–20 min*

Grade 3 *(Lessons 22 and 23)*
- Measuring Capacity in Liters
- Estimating Mass

Grade 4 *(Lesson 23)*
- Find Equivalent Measurements

Student-led Actvities
Math Center Activities *30–40 min*

Grade 3 *(Lessons 22 and 23)*
- 3.33 Use Measurement Vocabulary
- 3.34 Solve Measurement Problems

Grade 4 *(Lesson 23)*
- 4.41 Using Tables to Convert Measurements
- 4.42 Measurement Conversions

Personalized Learning

i-Ready.com

Independent
i-Ready Lessons* *10–20 min*

Grade 3 *(Lessons 22 and 23)*
- Solve Problems About Liquid Volume
- Solve Problems About Mass

Introduction

At A Glance

Students read a word problem and answer a series of questions to explore comparing an amount of time given in minutes to an amount given in seconds. Then students use a model to visualize the relationship between units of measure. They explore using multiplication to convert from a larger unit to a smaller unit.

Step By Step

- Work through **Use What You Know** as a class.
- Tell students that this page models how to compare two measurements, each given with a different unit.
- Have students read the problem at the top of the page.
- Ask students to explain why the two measurements must be in the same unit to solve the problem. [In order to compare, the size of the units must be the same.]
- Ask students to explain how they found the number of seconds in 3 minutes. [Add 60 three times or multiply 60 by 3.]
- Point out that adding 60 five times and multiplying 60 by 5 results in the same answer.
- Ask students to explain their answers for the remaining questions.

▶ Mathematical Discourse 1 and 2

Use What You Know

You have used basic units of measure like hours and minutes. Now you will learn how to express the same measurement using different units to solve problems. Take a look at this problem.

Lydia heard the announcer on TV say, "We'll be back in 240 seconds." It takes Lydia 5 minutes to wash the dishes. Does Lydia have enough time to wash dishes during the commercial break?

1 minute = 60 seconds

a. Why can't you compare 5 minutes and 240 seconds without making some kind of change? The units are different.

b. There are 60 seconds in each minute.

How many seconds are in 2 minutes? 120 seconds

In 3 minutes? 180 seconds

c. How many seconds does it take Lydia to do the dishes? Show how to add or multiply to find the answer.

60 + 60 + 60 + 60 + 60 = 300, or 5 × 60 seconds = 300 seconds

d. Is this more or less than the time the commercial takes?

300 seconds is longer than 240 seconds.

e. Does Lydia have enough time to wash the dishes during the commercial? No

▶ Mathematical Discourse

1 *When you convert a number of minutes to seconds, why will there be more seconds than minutes?*

Minutes are a larger unit than seconds. Each minute has 60 seconds, so the number of seconds will be 60 times the number of minutes.

2 *How do you convert from a larger unit to a smaller unit?*

Multiply the number of larger units by the number of smaller units in one larger unit.

Find Out More

On the previous page, you used the fact that there are 60 seconds in 1 minute to find that there are 300 seconds in 5 minutes.

When you compare seconds and minutes, seconds are the smaller unit and minutes are the larger unit. You can multiply to **convert** from a larger unit to a smaller unit within the same system of measurement. You just need to know how many smaller units make up one of the larger units.

The bar model below shows that there are 60 seconds in 1 minute.

5 minutes

1 minute	1 minute	1 minute	1 minute	1 minute
60 seconds	60 seconds	60 seconds	60 seconds	60 seconds

300 seconds

It also shows that 5 groups of 1 minute equals 5 groups of 60 seconds. So, the number of seconds in 5 minutes is 5 × 60 seconds, or 300 seconds. You can use a model like the one above to show the relationship between any pair of larger and smaller units in the same measurement system.

Reflect

1 The bar model below shows there are 60 minutes in 1 hour.

1 hour	1 hour	1 hour	1 hour
60 minutes	60 minutes	60 minutes	60 minutes

Explain why you would multiply 60 by 4 to find how many minutes are in 4 hours.

Multiply 60 by 4 because there are 60 minutes in one hour and you need to find the number of minutes in 4 hours.

Step By Step

- Read **Find Out More** as a class.
- Have students identify which unit is larger: minutes or seconds [minutes].
- Point out that since it takes 60 seconds to make 1 minute, minutes is a larger unit than seconds. Be aware that some students may incorrectly identify seconds as the larger unit because they are considering the numbers 60 and 1. They may mistakenly believe that since 60 is greater than 1, seconds are a larger unit than minutes.
- Explain the bar model to students. Show students that there are 5 minutes in all and each of those minutes represents 60 seconds.
- Discuss how repeated addition or multiplication can be used to determine that there are 300 seconds in 5 minutes.

Hands-On Activity

Real-World Connection

Ready Mathematics PRACTICE AND PROBLEM SOLVING

Assign *Practice and Problem Solving* **pages 249–250** after students have completed this section.

Hands-On Activity

Use rulers and yardsticks to understand converting units

Materials: rulers and yardsticks

- Place students in groups. Distribute 1 yardstick and 3 rulers to each group.
- Have students write a sentence using words to describe how inches relate to feet. [*There are 12 inches in 1 foot.*]
- Have students line up the 3 rulers with the yardstick and then write a sentence using words to describe how feet relate to yards. [*There are 3 feet in 1 yard.*]
- Have students measure the width of the classroom, to the nearest yard, using the yardstick. Then have them write an equation that could be used to find this width in feet. [Possible equation: 8 × 3 = 24 feet]

Real-World Connection

Have students think of some occupations that might require conversions from one unit to another.

Examples: house builder, pharmacist, chef, engineer

Modeled and Guided Instruction

At A Glance

Students use a bar model and a table to compare measures given in ounces and pounds. Then students revisit this problem.

Step By Step

- Read the problem at the top of the page as a class.

Model It

- Read **Model It**. Have students identify which unit is larger: pound or ounce. [pound]
- Point out that it takes 16 ounces to make 1 pound.
- Explain that there are 12 pounds shown in the bar model and each of those pounds represents 16 ounces.

Model It

- Discuss how the table in **Model It** is different from the bar model. Guide students to see that as the number of pounds increases by 1, the number of ounces increases by 16.
- Have students come up with a multiplication expression that can be used to find the number of ounces in 12 pounds. [12 × 16]

▶ Mathematical Discourse 1 and 2

▶ Real-World Connection

Learn About **Converting Units of Weight and Mass**

Read the problem below. Then explore different ways to convert from a larger unit to a smaller unit.

Wanda is shopping for a pet carrier for her cat. One small carrier can hold 240 ounces. Her cat weighs 12 pounds. Can the carrier hold her cat?

Model It **You can use a bar model to convert from a larger unit to a smaller unit.**

The bar model shows that there are 16 ounces in 1 pound.

12 pounds (lb)

1 lb	1 lb	1 lb	1 lb	1 lb	1 lb	1 lb	1 lb	1 lb	1 lb	1 lb	1 lb
16 oz	16 oz	16 oz	16 oz	16 oz	16 oz	16 oz	16 oz	16 oz	16 oz	16 oz	16 oz

192 ounces (oz)

Find the number of ounces in 12 pounds: 12 × 16 = 192.

Model It **You can use a table to convert from a larger unit to a smaller unit.**

This table shows how many ounces are in different numbers of pounds.

Pounds (lb)	1	2	3	4	5	6	7	8	9	10	11	12
Ounces (oz)	16	32	48	64	80	96	112	128	144	160	176	192

The number of ounces in each column is equal to the number of pounds multiplied by 16.

252

▶ Mathematical Discourse

1 *How can you use the table to find the number of ounces in 13 pounds?*

Multiply 13 by 16 or add 16 to 192.

2 *Could you use these models to find out how many seconds are in 3 minutes?*

Student responses should show understanding that you can use a table or a bar model to show the number of seconds in each minute, but that there are 60 seconds in 1 minute, not 16. So they would need to modify the tables to use multiples of 60.

▶ Real-World Connection

Have students think of items that are measured in the units given below. This will help them form benchmarks that can be used when they need to determine which unit of measure is the larger of two. Have volunteers share their lists.

Length: millimeter, centimeter, meter, kilometer, inch, foot, yard, mile [*Examples:* running distance in kilometers, picture frame in inches]

Mass: gram, kilogram [*Examples:* sugar in grams, dogs in kilograms]

Weight: ounce, pound [*Examples:* box of paper clips, people in pounds]

Capacity: milliliter, liter, cup, pint, quart, gallon [*Examples:* bottles of juice in liters, ice cream in pints]

Connect It

Now you will solve the problem from the previous page by writing an expression.

2 The bar model shows that 1 pound equals how many ounces? 16 ounces

3 What do you multiply the number of pounds by to find the number of ounces?

Multiply by 16.

4 Write an expression that shows how to convert any number of pounds to ounces. Use *P* to stand for the number of pounds. $P \times 16$

5 Use the expression to solve the problem from the previous page. Can the carrier hold the cat? Show your work. 12 × 16 ounces = 192 ounces; 192 ounces is less than 240 ounces. The carrier can hold the cat.

6 Describe how to convert from a larger unit to a smaller unit.

Multiply the number of larger units by the number of smaller units there are in each one of the larger units.

Try It

Use what you just learned to solve these problems. Show your work on a separate sheet of paper.

7 Steve buys 14 ounces of kiwis and 2 pounds of peaches. How many more ounces do the peaches weigh than the kiwis? 18 ounces

8 An empty suitcase has a mass of 2 kilograms. Draw a bar model to find its mass in grams. (1 kilogram = 1,000 grams) 2,000 grams

1 kg	1 kg
1,000 g	1,000 g

253

Concept Extension

Help students see fractional relationships in conversions.

- Draw a rectangle on the board and tell students that it represents 1 pound. Ask: *How many ounces are in 1 pound?* [16]
- Divide the rectangle into 16 equal parts and ask: *What unit of measurement does each part show?* [1 ounce]
- Shade one of the parts. Ask: *What fraction of the 1 pound is 1 ounce?* $\left[\frac{1}{16}\right]$
- Repeat with other equivalent measurements, such as 1 foot = 12 inches and 1 hour = 60 minutes.

Step By Step

Connect It

- Have students explain their answer to problem 3. Be sure to elicit responses that reference what is seen in the bar model and what is observed in the patterns in the table.
- If students seem confused that going from a larger unit to a smaller unit requires multiplication instead of division, reinforce that it takes more of the smaller units to make up the larger unit.
- When discussing problem 4, explain that it is helpful to choose a meaningful letter to represent the measurement. In this case, *P* is chosen because it is the first letter in the word *pounds*.

Concept Extension

Try It

7 Solution

18 ounces; Students may draw a bar model showing that there are 16 ounces in 1 pound or may multiply the number of pounds of peaches by 16. Once both measures are in ounces, they can subtract to find the difference in the weights.

Error Alert Students who wrote 32 ounces converted the peaches to ounces correctly but forgot to subtract the weight of the kiwis to find the difference.

8 Solution

2,000 grams; Students should draw a bar model showing that there are 1,000 grams in 1 kilogram.

Ready **Mathematics** PRACTICE AND PROBLEM SOLVING

Assign *Practice and Problem Solving* **pages 251–252** after students have completed this section.

Modeled and Guided Instruction

At A Glance

Students use a drawing and a table to convert a measure given in liters to a measure in milliliters. Then students revisit this problem.

Step By Step

- Read the problem at the top of the page as a class.

Picture It

- Read **Picture It**. Have a volunteer name the larger unit of measure. [liter]
- Have students explain how they know there are 1,000 milliliters in 1 liter by looking at the picture. [The 1-L mark is lined up with the 1,000-mL mark.]

Model It

- Read **Model It**. Have a volunteer explain the pattern shown in the table. [As the number of liters increase by 1, the number of milliliters increase by 1,000.]
- Guide students to see how they could extend the table to 10 liters by adding 1,000 mL each time or by multiplying 10 by 1,000.

▶ Mathematical Discourse 1–4

▶ Concept Extension

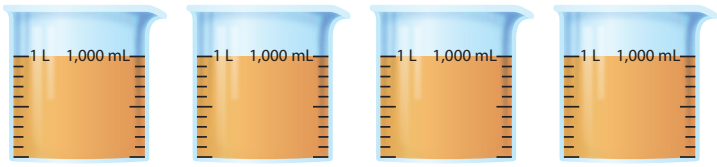
Learn About **Converting Units of Liquid Volume**

Read the problem below. Then explore different ways to convert from a larger unit to a smaller unit of liquid volume.

Julie made 4 liters of orange juice. How many milliliters of orange juice did Julie make?

Picture It **You can use a picture to help convert from a larger unit to a smaller unit of liquid volume.**

Each beaker shows that 1 liter (L) is equal to 1,000 milliliters (mL).



4 liters is equal to 4,000 milliliters.

Model It **You can use a table to help convert from a larger unit to a smaller unit of liquid volume.**

The table below shows there are 1,000 milliliters in one liter. It also shows how many milliliters are in 2, 3, 4, and 5 liters.

Liters (L)	1	2	3	4	5
Milliliters (mL)	1,000	2,000	3,000	4,000	5,000

4 liters = 4,000 milliliters

▶ Mathematical Discourse

1 *How many milliliters are in 1 liter?*
1,000

2 *How many millimeters do you think there are in 1 meter?*
1,000

3 *What pattern do you notice in these two unit conversions?*
Adding "milli-" to the beginning of a unit name means there are 1,000 of the smaller "milli-" units in the larger unit.

4 *What other patterns do you know about in metric conversions?*
Adding "kilo-" to a unit name means there is one of the larger "kilo-" units for 1,000 of the smaller units. For example, 1 kilogram is equivalent to 1,000 grams.

Connect It **Now you will solve the problem from the previous page using an equation.**

9 Look at the picture of the beakers. How many milliliters are in 1 liter? 1,000 mL

10 Look at the number pairs in each column of the table. Each number of milliliters is how many times the number of liters?

The number of milliliters is 1,000 times the number of liters.

Write an equation to describe the relationship between each pair of numbers in the table. liters × 1,000 = milliliters

11 Use the equation to find the number of milliliters in 4 liters. 4 × 1,000 = 4,000

How many milliliters of orange juice did Julie make? 4,000 mL

12 Explain why the number of milliliters is always greater than the number of liters for each number pair in the table.

A milliliter is a smaller unit than a liter, so it takes many more milliliters than liters to represent the same liquid volume.

Try It **Use what you just learned to solve these problems. Show your work on a separate sheet of paper.**

13 Awan bought 3 liters of apple juice. He plans to drink all of it in 6 days, drinking the same amount each day. How many milliliters will Awan drink each day?

500 milliliters

14 Aliya made 8 quarts of punch for a party. Make a table or write an equation to find the number of cups of punch she has. (1 quart = 4 cups) 32 cups

Possible equation: $Q \times 4 = C$; $Q = 8$, so $8 \times 4 = 32$.

255

Concept Extension

Find smaller units from larger units.

- Show students 1 empty gallon-size jug and 4 quart-size jugs filled with water.
- Tell students there are 4 quarts in 1 gallon.
- Empty one of the quart-size jugs into the 1-gallon container and leave the empty container in sight.
- Ask: *How much of the gallon container is filled?* $\left[\frac{1}{4}\right]$
- Repeat previous steps with the other quart-size jugs until the 1-gallon jug is full.
- Ask: *How can you find the number of quart-size jugs that would be needed to fill 3 gallon jugs?* [Multiply 3 × 4 or add 3 four times.]

Step By Step

Connect It

- Have students explain their answer to problem 11. Ask: *Why do you multiply by 1,000 when converting from liters to milliliters?* [because there are 1,000 milliliters in 1 liter]
- Reinforce that converting from a larger unit to a smaller unit means finding the number of smaller units that make up the larger unit.

SMP TIP **Repeated Reasoning**
Point out to students that there is repeated reasoning involved when converting from a larger unit to a smaller unit. The number given in the larger unit will always be multiplied by the number of smaller units that make up one larger unit. *(SMP 8)*

- Ensure students can answer problem 12 before moving on to the rest of the lesson.

Try It

13 Solution
500 milliliters; Students need to convert the number of liters to milliliters and then divide the converted amount by 6. This will give the amount Awan will drink per day.

14 Solution
32 cups; Students should make a table or write an equation such as $C = 8 \times 4$ to find the number of cups in 8 quarts.

Error Alert Students who wrote 2 cups divided the number of quarts by the number of cups in a quart instead of multiplying.

Ready Mathematics PRACTICE AND PROBLEM SOLVING

Assign *Practice and Problem Solving* **pages 253–254** after students have completed this section.

Guided Practice

At A Glance

Students use models, tables, or multiplication equations to solve word problems that involve converting from a larger unit of measure to a smaller unit of measure.

Step By Step

- Ask students to solve the problems individually and label units in their calculations.
- **Pair/Share** When students have completed each problem, have them Pair/Share to discuss their solutions with a partner or in a group.

Solutions

Example A drawing and an expression are used to show that there are 100 centimeters in 1 meter. Students can multiply the number of centimeters in 1 meter (100) by the number of meters (5) to find the number of centimeters.

15 Solution
80 ounces; 48 ounces; There are 16 ounces in 1 pound. Students could evaluate the expression 5×16, and then subtract 32 ounces (2 pounds).
DOK 1

Practice Converting Measurements

Study the example below. Then solve problems 15–17.

Example

A shed is 5 meters long. How many centimeters long is the shed?

Look at how you could show your work using a picture and an expression.

Think: 5 meters = ? centimeters

The drawing of a meter stick shows that 100 centimeters is equal to 1 meter.

$100 \times m$
$100 \times 5 = 500$

Solution 500 centimeters

The student substituted 5 for m: $100 \times 5 = 500$.

Pair/Share
How else could you solve this problem?

15 A bag of potatoes weighs 5 pounds. The bag is placed on a scale. The unit on the scale is ounces. What weight does the scale show?

Show your work.

Possible student work:
$5 \times 16 = 80$

Solution **80 ounces**

There are 16 ounces in 1 pound.

Two pounds of potatoes are taken out of the bag. What weight does the scale show now?

Show your work.

Possible student work:
$2 \times 16 = 32$
$80 - 32 = 48$

Solution **48 ounces**

Pair/Share
How could you use a table to solve this problem?

Teacher Notes

16 It took Miguel 7 minutes 38 seconds to run one mile. It took Jorja 9 minutes 13 seconds to run one mile. How many more seconds did it take Jorja to run one mile than Miguel?

There are 60 seconds in 1 minute.

Show your work.

Possible student work:

Miguel: 7 × 60 = 420 seconds

420 + 38 = 458 seconds

Jorja: 9 × 60 = 540 seconds

540 + 13 = 553 seconds

553 − 458 = 95 seconds

Pair/Share
Does your answer seem reasonable?

Solution **95 seconds**

17 Aaron is 63 inches tall. In order to ride a roller coaster at an amusement park, a person must be 5 feet tall. Is Aaron tall enough to ride a roller coaster? How many inches shorter or taller is he than 5 feet? Circle the letter of the correct answer.

Remember there are 12 inches in 1 foot.

(A) Yes. He is 3 inches taller than 5 feet.

B Yes. He is 13 inches taller than 5 feet.

C No. He is 7 inches shorter than 5 feet.

D No. He is 17 inches shorter than 5 feet.

Tina chose **A** as the correct answer. How did she get that answer?

Tina multiplied to find the minimum height:

5 feet × 12 inches = 60 inches. Aaron is 3 inches taller than

60 inches, so he can ride a roller coaster.

Pair/Share
How can you check your answer?

Teacher Notes

Solutions

16 Solution

95 seconds; Students could convert both times to seconds and then subtract.

DOK 2

17 Solution

A; Aaron is 3 inches taller than 60 inches.

Explain to students why the other three answer choices are not correct:

B is not correct because 1 ft = 12 inches, not 10 inches.

C is not correct because 12 × 5 = 60, not 70.

D is not correct because 1 ft = 12 inches, not 16 inches.

DOK 3

Ready **Mathematics**
PRACTICE AND PROBLEM SOLVING

Assign *Practice and Problem Solving* **pages 255–256** after students have completed this section.

Independent Practice

At A Glance

Students convert from a larger unit of measurement to a smaller unit of measurement to solve problems that might appear on a mathematics test.

Solutions

1 Solution

C; Subtract the mass of the remaining watermelon (2,500 grams) from the converted mass (6,000 grams).

DOK 2

2 Solution

a. **No**; b. **Yes**; c. **Yes**; d. **Yes**

DOK 2

3 Solution

See completed table on the Student Book page. Multiply the number of book lengths by 8 inches to find the actual number of inches.

DOK 2

Quick Check and Remediation

- Ask students to find the number of inches in 12 feet if there are 12 inches in 1 foot. [144 inches]
- For students who are still struggling, use the chart to guide remediation.
- After providing remediation, check students' understanding. Tell students there are 8 pints in 1 gallon, and then ask them to explain their thinking while finding the number of pints in 4 gallons. [32 pints]
- If a student is still having difficulty, use *Ready Instruction*, Grade 3, Lesson 6.

If the error is . . .	Students may . . .	To remediate . . .
1 inch	have divided the number of feet by 12.	Demonstrate with a ruler why when converting from feet to inches you multiply the number of feet (the larger unit) by how many inches (smaller unit) make up one foot.
120 inches	have thought there are 10 inches in a foot.	Remind students that each system of measurement (customary or metric) has its own unique equivalent measurements. Provide a table of equivalent measures as a reference.
36 inches	have confused a feet-to-inches conversion with a yards-to-feet conversion.	Remind students to consider the units carefully to be sure they know how many of the smaller units make up each larger unit. Provide a table of equivalent measures as a reference.
other answers	be struggling with computation.	If students struggle with the computation, allow them to practice with smaller numbers, and use a calculator as needed for computation with larger numbers. Focus on understanding the multiplicative relationships and estimating answers.

Practice Converting Measurements

Solve the problems.

1 Ming bought a watermelon with a mass of 6 kilograms. She cut off the rind. The remaining watermelon had a mass of 2,500 grams. What was the mass of the rind? (1 kilogram = 1,000 grams)

A 15,000 grams
B 4,500 grams
C 3,500 grams
D 500 grams

2 Choose *Yes* or *No* to indicate whether the measurement is equal to 2 yards, 1 foot.

(1 yard = 3 feet and 1 foot = 12 inches)

a. 4 feet	☐ Yes	☒ No
b. 84 inches	☒ Yes	☐ No
c. $2\frac{1}{3}$ yards	☒ Yes	☐ No
d. 1 yard, 2 feet, 24 inches	☒ Yes	☐ No

3 Suzie is measuring furniture for her bedroom, but she doesn't have a tape measure. Instead, she uses her book. She knows that her book is 8 inches long, as shown below.

The table below shows the total number of book lengths that Suzie used to measure each object. Complete the table.

Object	Number of Book Lengths	Number of Inches
Bed	$10\frac{1}{2}$	84
Dresser	6	48
Bookcase	4	32

4 Ramon has an 8-liter jug of water. He fills nine 750-milliliter pitchers with water. How much water is left? (1 liter = 1,000 milliliters)

A 250 mL

B 500 mL

C 1,000 mL

D 1,250 mL

5 Simone jogged 5 kilometers. How many meters did she jog? (1 kilometer = 1,000 meters)

Show your work.

Possible student work using a table:

Kilometers (k)	1	2	3	4	5
Meters (m)	1,000	2,000	3,000	4,000	5,000

Answer Simone jogged 5,000 meters.

6 It took Sophia 1 hour to finish her homework. How many minutes did it take Sophia to finish her homework? How many seconds did it take her? (1 hour = 60 minutes and 1 minute = 60 seconds)

Show your work.

Possible student work:

1 hour = 60 minutes
60 minutes × 60 seconds = 3,600 seconds

Answer It took Sophia 60 minutes to complete her homework.

It took Sophia 3,600 seconds to complete her homework.

Self Check Go back and see what you can check off on the Self Check on page 249.

Solutions

4 Solution
Evaluate the expression 8 × 1,000 to find the number of liters of water Ramon has. Then subtract the amount filled in the pitchers. (8,000 − (9 × 750) = 8,000 − 6,750 = 1,250)
DOK 2

5 Solution
5,000 meters; Multiply 5 × 1,000.
DOK 1

6 Solution
60; 3,600; There are 60 minutes in 1 hour and 60 seconds in 1 minute. Multiply 1 × 60 to find the number of minutes and then multiply 60 × 60 to find the number of seconds in 60 minutes.
DOK 1

▶ Hands-On Activity

Use non-standard units to measure length.

Materials: paperclips (same size), pencils (same size)

- Ask students to measure the length of a pencil using paper clips.
- Have students generate a conversion factor by completing the sentence below.

  1 pencil = ? paper clips
- Ask students to measure the length of a doorway or a window in pencils.
- Have students use their conversion factors to predict the length of the doorway or window in paper clips.
- Have students measure the doorway or window in paper clips and check their predictions.
- Have them write their answers on paper and, after everyone has finished, ask volunteers for answers.

▶ Challenge Activity

Change smaller units to larger units.

Give students a statement showing the relationship between grams and milligrams: 1 g = 1,000 mg.

- Ask students to describe the process of converting grams to milligrams.
  Listen for responses that describe a process of multiplying the number of grams (larger unit) by the number of milligrams (smaller unit) in a gram.
- Ask students to think about what the process would be to convert 3,000 milligrams to grams.
  Because students do not yet divide, they can either use a calculator to divide the number of milligrams (3,000) by 1,000, or use simple reasoning to find the missing factor. [1,000 × ? = 3,000; ? = 3]

LESSON QUIZ

Lesson 23
Convert Measurements

Teacher-Toolbox.com

Overview

Assign the Lesson 23 Quiz and have students work independently to complete it.

Use the results of the quiz to assess students' understanding of the content of the lesson and to identify areas for reteaching. See the Lesson Pacing Guide at the beginning of the lesson for suggested instructional resources.

Tested Skills

Assesses 4.MD.1.1

Problems on this assessment form require students to be able to convert from a larger unit to a smaller unit within the same system, complete a conversion table, express the relationship between two measurement units in the same system using multiplication, and solve word problems involving measurement conversions. Students will also need to be familiar with multiplicative comparisons and understand that larger units can be subdivided into smaller units.

***Ready*® Mathematics**

Lesson 23 Quiz

Solve the problems.

1 How many feet are in different numbers of yards? (1 yard = 3 feet)

Complete the table.

Yards (yd)	2	3	5	8
Feet (ft)				

2 Noah has 102 inches of border for a poster board. He uses 7 feet of the border. How much border is left? (1 foot = 12 inches)

A 84 inches

B 43 inches

C 36 inches

D 18 inches

3 It takes Madison 8 minutes 13 seconds to walk around the track at school. It takes James 7 minutes 31 seconds to walk around the track. How many more seconds does it take Madison to walk around the track than James? (1 minute = 60 seconds)

Show your work.

Answer: _____ seconds

Lesson 23 Quiz continued

4 Angelo cooks 4 kilograms of pasta for dinner. There are 2 kilograms of pasta left after dinner. (1 kilogram = 1,000 grams)

Choose *Yes* or *No* to indicate if the statement is true.

a. During dinner, 2 grams of pasta are eaten. ☐ Yes ☐ No

b. The equation $4 \times 100 = g$ can be used to find the number of grams of pasta Angelo cooks. ☐ Yes ☐ No

c. Angelo cooks 4,000 grams of pasta. ☐ Yes ☐ No

d. There are 200 grams of pasta left after dinner. ☐ Yes ☐ No

5 Aubrey's coach says that she needs to bring 4 liters of water to practice. Aubrey brings 3 bottles that have 400 milliliters of water in each. (1 liter = 1,000 milliliters)

Which explanation correctly tells whether Aubrey brings enough water?

A Aubrey does not bring enough water because she needs $4 \times 10{,}000 =$ 40,000 milliliters of water. She brings 1,200 milliliters of water in all, which is less than the amount she needs.

B Aubrey does not bring enough water because she brings $400 \times 3 =$ 1,200 milliliters of water. The amount of water she brings is less than the 4,000 milliliters of water that she needs.

C Aubrey brings enough water because she brings 400×3 milliliters of water. The amount of water she brings is greater than the 400 milliliters of water that she needs.

D Aubrey brings enough water because she needs $4 \times 10 = 40$ milliliters of water. She brings 1,200 milliliters of water in all, which is greater than the amount that she needs.

Common Misconceptions and Errors

Errors may result if students:

- confuse units or conversion factors.
- think the wrong number of smaller units make up a larger unit (e.g., think a foot is 10 inches).
- complete only part of the problem (e.g., only convert the measurement, without then applying a necessary operation).
- apply the incorrect operation or misapply the correct operation.

***Ready*® Mathematics**

Lesson 23 Quiz Answer Key

1.

Yards (yd)	2	3	5	8
Feet (ft)	**6**	**9**	**15**	**24**

DOK 1

2. D
DOK 2

3. 42
DOK 2

4. **a.** No
b. No
c. Yes
d. No
DOK 2

5. B
DOK 3