In Topic D, students explore multiplication as a method for expressing equivalent measures. For example, they multiply to convert between meters and centimeters or ounces and cups with measurements in both whole number and decimal form (5.MD.1). These conversions offer opportunity for students to not only apply their new found knowledge of multi-digit multiplication of both whole and decimal numbers, but to also reason deeply about the relationships between unit size and quantity—how the choice of one affects the other.
A Teaching Sequence Towards Mastery of Measurement Word Problems with Whole Number and Decimal Multiplication

Objective 1: Use whole number multiplication to express equivalent measurements. (Lesson 13)

Objective 2: Use decimal multiplication to express equivalent measurements. (Lesson 14)

Objective 3: Solve two-step word problems involving measurement and multi-digit multiplication. (Lesson 15)
Lesson 13

Objective: Use whole number multiplication to express equivalent measurements.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problem (12 minutes)
- Concept Development (26 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

Fluency Practice (12 minutes)

- Divide by 10, 100, and 1,000 5.NBT.2 (2 minutes)
- Multiply Using the Area Model 5.NBT.2 (7 minutes)
- Unit Conversions 5.MD.1 (3 minutes)

Divide by 10, 100, and 1,000 (2 minutes)

Note: This fluency drill will prepare students to use divide by 10 patterns for multi-digit whole numbers in Lesson 16

T: (Write 30 ÷ 10 = _______.) Say the answer.
S: 3.

Repeat the process for the following possible sequence: 300 ÷ 100; 3,000 ÷ 1,000; 5,000 ÷ 1,000; 50 ÷ 10; 500 ÷ 100; 5,000 ÷ 100; 3,000 ÷ 100; 30,000 ÷ 1,000; 50,000 ÷ 1,000; 40 ÷ 10, 400 ÷ 10; 4,000 ÷ 10; 40,000 ÷ 10; 700 ÷ 100; 7,000 ÷ 100; 70,000 ÷ 100; 700,000 ÷ 100; 7,000,000 ÷ 1,000.

Multiply Using the Area Model (7 minutes)

Follow the same process and procedure as G5–M2–Lessons 11 and 12 for the following possible sequence: 5.21 × 34 and 8.35 × 73.

Unit Conversions (3 minutes)

Materials: (S) Personal white boards

Note: Reviewing this fluency will build a foundation for upcoming Module 2 lessons.

A NOTE ON STANDARDS ALIGNMENT:

While students are asked to generalize an equation to express whole number conversions, it is important to note that Lesson 13 is a review of the concepts of 4.MD.1 and 4.MD.2. The reasoning required to convert a measurement expressed in a larger unit to an equivalent measure of a smaller unit is a concept that is difficult to master for many students. If students are fluent with these whole number conversions, it may be advisable to combine Lessons 13 and 14 with a heavier emphasis on the decimal multiplication and conversions found in Lesson 14.
Lesson 13:

Use whole number multiplication to express equivalent measurements.

T:  (Write 1 ft = ___ in.) 1 foot is the same as how many inches?
S: 12 inches.

Repeat the process for the following possible sequence: 2 ft, 3 ft, 4 ft, 10 ft, 5 ft, 7 ft.
T:  (Write 100 cm = ___ m.) 100 centimeters is the same as how many meters?
S: 1 meter.

Repeat the process and procedure for 200 cm, 300 cm, 600 cm, 800 cm, 400 cm.

Application Problem (12 minutes)

Preparation: Cuts pieces of string in four different colors. There should be enough pieces so that individual or pairs of students have one string.

- Blue strings—to the nearest foot. Pieces measure 1 ft, 2 ft, 3 ft, and 4 ft.
- Red strings—to the nearest inch. Pieces measure 12 in, 24 in, 36 in, and 48 in.
- Yellow string—to the nearest meter. Pieces measure 1 m, 2 m, 3 m, and 4 m.
- Green string—to the nearest centimeter. Pieces measure 100 cm, 200 cm, 300 cm, and 400 cm.

Procedure: Pass out one piece of string for every one or two students. Tell students that every string has an exact match, and after they measure their string, they will find their string’s match. Instruct students to measure their piece of string using the unit specified by the color of their string.

After all pairs have successfully measured, they should find the student(s) who have the different color string with the exact same string length as theirs, such that the student with the blue string measuring 1 foot, should find the student(s) with the red string measuring 12 inches. Students should compare and discuss their measurements. Prompt students to explain how the same sized piece of string could have two different measurements. Record the results.

After results are recorded, discuss. Among the observations students might make, be sure that the following are included:

- There are 12 inches in 1 foot and 100 centimeters in 1 meter, when comparing quantity.
- There are always _____ times as many smaller units as larger units. (A generalized equation such as ___ft × 12 = _____ inches might be recorded.)
- Multiplication converts larger units (feet and meters) to smaller ones (inches and centimeters).

Note: Today’s Application Problem provides a practical, hands-on way for students to experience the conversion reasoning necessary for today’s lesson.

Concept Development (26 minutes)

Begin lesson by distributing a copy of and posting the appended Grade 5 Math Reference Sheet for all to see. A copy of the Reference Sheet can be found below and on page 14 of the Test Guide at http://www.engageny.org/sites/default/files/resource/attachments/grade-5-math-guide_0.pdf.
Lesson 13: Use whole number multiplication to express equivalent measurements.

T: Turn and talk with your neighbor. How might this document help us solve problems?
S: (Share.)

T: Today we’ll be using this Reference Sheet to help us convert between various units of measure. Discuss with a partner the types of measurement units you see on this sheet?
S: (Should notice the units of length, weight, and volume/capacity.)

T: Divide your white boards into three sections labeled Length, Weight, and Volume/Capacity. Talk in groups about which units are used for each type of measurement and record those units in the appropriate section of your white board.
S: (Work and record.)
T: (Circulate and check for accuracy.)

Problem 1

15 feet = _____ inches

T: Post 15 feet = _____ inches on board. How can we use the patterns we just saw in our Application Problem to help us convert from feet to inches? Turn and talk.
S: (Share.)

T: Visualize the tape measure we just used to measure in feet and inches. How many inches did we see in each foot?
S: 12.
T: Let’s draw a number line to show what we saw. (Draw the first two or three.) You draw your own number line.

1 ft 2 ft 3 ft …15 ft
-------------|-------------|-------------|-------------|
12 in 24 in 36 in …180 in

S: (Draw.)
T: (Point to the number line.) If one foot, or one unit, is equal to 12 inches, how can I find what 15 feet is equal to? Turn and share.
S: I can add 12 inches 15 times. I can skip count by twelves 15 times. I’ll multiply 12 times 15. If one unit is 12 inches, then 10 units is 120 in, and 5 units more would be 60 in, so that’s 180 inches.
T: I heard repeated addition, skip counting, and multiplication. If I wanted to express this conversion as a multiplication equation, what would it look like? Write it down on your board. Would this method work for any situation in which I wanted to name feet as inches?
S: (Write 15 ft × 12 = 120 in.)
T: We just converted from feet to inches. Which unit is larger, feet or inches?
S: Feet.
T: Think back to our Application Problem. Remind me why we need so many inches to make just 15 feet. Tell your neighbor.
S: Inches are a smaller unit; we need more of them to make the larger units, feet.

Repeat the sequence with 150 ft and 152 ft asking students to use what they just found about 150 ft to help them convert 152 ft. (Use 1,800 inches and simply add 24 more inches, or multiply as before.) Then instruction may continue with 21 ft and 210 ft if necessary.

**Problem 2**

3 tons 140 pounds = _____ pounds.

T: (Post on the board: 3 tons 140 pounds = _____ pounds.) Let’s use our thinking about multiplication to solve this one. Tell your neighbor which part of the Reference Sheet will help us solve this one.

S: 1 ton = 2,000 pounds.

T: How is this problem slightly different from the first one we solved?

S: (Should recognize that we are converting tons and pounds to pounds.)

T: Let’s start with the 3 tons. Work with your partner to draw a double number line showing tons and pounds.

S: (Draw.)

T: Look at your drawing. How many pounds are equal to 3 tons?

S: 6,000 pounds.

T: Are we finished? Have we found a weight equal to what we started with?

S: No.

T: Why not?

S: We have 140 more pounds.

T: Turn and talk. What do we need to do with those 140 pounds?

S: (Share.)

T: 3 tons 140 pounds equals how many pounds altogether?

S: 6,140 pounds.

Repeat with other compound units: 42 ft 9 in, for example.

**Problem 3**

_____ ounces = 9 pounds 11 ounces.

T: (Post _____ ounces = 9 pounds 11 ounces.) Look at your Reference Sheet. Tell your neighbor the conversion factor that you’ll be using to solve this problem.

S: (Look and share.)

T: For this problem, work in pairs. One of you should draw a double number line while your partner uses multiplication and addition to solve. Check your partner’s work as you go.

S: (Work.)

T: (Circulate and check work.)

T: How many ounces are equal to 9 pounds 11 ounces?

S: 155 ounces.
Lesson 13
NYS COMMON CORE MATHEMATICS CURRICULUM

Lesson Objective: Use whole number multiplication to express equivalent measurements.

Problem 4
155 gallons = _____ quarts = _____ pints

T: (Post 155 gallons = _____ quarts = _____ pints on the board.) Use your Reference Sheet to help you solve independently. If you like, you may draw a double number line.

S: (Work.)

T: 155 gallons equals how many quarts? Find the number of quarts mentally.

S: 100 gallons is 400 quarts, 50 gallons is 200 quarts and 5 gallons is 20 quarts. So, 155 gallons is 620 quarts.

T: Find the number of pints in 620 quarts mentally.

S: There are 2 pints in every quart so just double every place value. 1,240 pints.

Repeat with compound units:
57 gallons 1quarts = _______ quarts
63 quarts 3 pints = _______ pints

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Use whole number multiplication to express equivalent measurements.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief.
Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- Explain the term conversion factor.
- In the conversion you completed for Problem 1, explain your thought process as you worked. Why did you choose to multiply when converting these units? How did you decide what to multiply by?
- Convert 15 meters into centimeters. (Students convert to 1500 cm.) Look back at the conversions in Problem 1. 15 feet is equal to 180 inches. Both of these conversions start with 15 units. Explain how 15 units could be equal to two different amounts—180 and 1500.
- How did the Application Problem connect to today’s lesson?
- Can you name some real life situations in which measurement conversion might be useful and/or necessary?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 13: Use whole number multiplication to express equivalent measurements.

Name __________________________________________ Date ____________________

1. Complete the chart below with the measurement equivalents.

<table>
<thead>
<tr>
<th>Feet</th>
<th>Inches</th>
<th>Centimeters</th>
<th>Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2</td>
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<tr>
<td>3</td>
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<tr>
<td>10</td>
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<tr>
<td>12</td>
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<td>12</td>
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<tr>
<td>40</td>
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<td>40</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td></td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

2. Explain how to convert feet to inches. Draw a number line or tape diagram to support your explanation.

3. Explain how to convert meters to centimeters. Draw a number line or tape diagram to support your explanation.
Lesson 13 Problem Set

4. Convert. Use your Reference Sheet to remind you of the conversion factors. Show your work.
   a. 27 ft = _____ in
d. 7 kg = _____ g
g. 3 km 85 m = _____ m
   b. _____ oz = 54 lb
e. 4 mi = _____ yd = _____ ft
   h. 2 qt = _____ pt = _____ fl oz
   c. _____ pt = 21 qt
   f. _____ L = 9 kL
   i. _____ oz = 24 lb 15 oz

5. Emily’s pet snake is 5 feet long. Kristen’s snake is 50 inches long. Kristen says her snake is much longer because 50 is so much bigger than 5. Is Kristen right? Why or why not?

6. Ben helps his dad make chicken soup. Their recipe makes 15 cups of soup. If they each eat 2 cups and freeze the rest, will the leftovers fit in a 64-ounce container?
1. Convert.
   a. \(37 \text{ L} = \underline{\quad} \text{ mL}\)

   b. \(\underline{\quad} \text{ qt} = 61 \text{ gal}\)

   c. \(45 \text{ kg} = \underline{\quad} \text{ g}\)
Name ___________________________________________  Date __________________

1. Complete the chart below with the measurement equivalents.

<table>
<thead>
<tr>
<th>Liters</th>
<th>Milliliters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quarts</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
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<td>4</td>
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<tr>
<td>10</td>
<td></td>
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<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

2. Convert.
   a. 18 yd = _____ ft
   b. _____ oz = 23 lb
   c. _____ cm = 64 m
   d. 72 kl = _____ L
   e. 2 mi = _____ yd = _____ ft
   f. _____ g = 35 kg
   g. 5 km 14 m = _____ m
   h. 31 gal = _____ qt = _____ pt
   i. _____ fl oz = 56 c
3. Jesse needs 13 gallons of paint to finish painting the exterior of his barn. If he uses 10 quarts of the paint for the doors, how many quarts will be left for the siding on the barn?

4. Ms. Lane’s laptop stays on for 6 hours without being plugged in, and Mr. Trevor’s laptop stays powered for 400 minutes. Whose laptop lasts longer?

5. The food pantry distributes 10-oz bags of rice. If three 5-lb bags are donated to the pantry, how many 10-ounce bags can be made?
Lesson 13: Use whole number multiplication to express equivalent measurements.

Date: 7/4/13

Grade 5 Mathematics Reference Sheet

**FORMULAS**

Right Rectangular Prism

| Volume = lwh |
| Volume = Bh |

**CONVERSIONS**

- 1 centimeter = 10 millimeters
- 1 meter = 100 centimeters = 1,000 millimeters
- 1 kilometer = 1,000 meters
- 1 gram = 1,000 milligrams
- 1 kilogram = 1,000 grams
- 1 pound = 16 ounces
- 1 ton = 2,000 pounds
- 1 cup = 8 fluid ounces
- 1 pint = 2 cups
- 1 quart = 2 pints
- 1 gallon = 4 quarts
- 1 liter = 1,000 milliliters
- 1 kiloliter = 1,000 liters
- 1 mile = 5,280 feet
- 1 mile = 1,760 yards
Lesson 14

Objective: Use decimal multiplication to express equivalent measurements.

Suggested Lesson Structure

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency Practice</td>
<td>12 minutes</td>
</tr>
<tr>
<td>Application Problem</td>
<td>8 minutes</td>
</tr>
<tr>
<td>Concept Development</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Student Debrief</td>
<td>10 minutes</td>
</tr>
<tr>
<td><strong>Total Time</strong></td>
<td><strong>60 minutes</strong></td>
</tr>
</tbody>
</table>

Fluency Practice (12 minutes)

- Divide Multiples of 10  
  5.NBT.2 (3 minutes)
- Unit Conversions  
  5.MD.1 (6 minutes)
- Decompose Decimals  
  5.NBT.3 (3 minutes)

Divide by Multiples of 10 (3 minutes)

Materials: (S) Personal white boards

Note: This review fluency drill will prepare students to approximate quotients with two-digit divisors in Lesson 17.

T: (Write 420 ÷ 10 = _____.) Say the division sentence.
S: 420 ÷ 10 = 42.

T: (Write 42 ÷ 2 = _____ below 420 ÷ 10 = 42.)
Say the division sentence.
S: 42 ÷ 2 = 21.

T: (Write 420 ÷ 20 = _____ below 42 ÷ 2 = 21.)
Say 420 ÷ 20 as a three-step division sentence, taking out the ten.
S: 420 ÷ 10 ÷ 2 = 21.

Direct students to solve using the same method for 960 ÷ 30 and 680 ÷ 20.
Lesson 14
NYS COMMON CORE MATHEMATICS CURRICULUM

Unit Conversions (6 minutes)

Materials: (S) Personal white boards

T: 1 meter is how many centimeters?
S: 100 centimeters.
T: (Write $1 \text{ m } 50 \text{ cm} = \underline{\phantom{00}} \text{ cm}$.) 1 meter and 50 centimeters is the same as how many centimeters?
S: 150 centimeters.

Repeat the process for the following possible sequence: 1 m 5 cm, 2 m, 2 m 30 cm, 2 m 70 cm, 2 m 7 cm, 2 m 90 cm, 4 m 8 cm.

T: 1 foot is the same as how many inches?
S: 12 inches.
T: (Write $1 \text{ ft } 1 \text{ in} = \underline{\phantom{0}} \text{ in}$.) On your boards, write the conversion.
S: (Write $1 \text{ ft } 1 \text{ in} = 13 \text{ in}$.)

Repeat the process for the following possible sequence: 1 ft 2 in, 1 ft 3 in, 1 ft 10 in, 1 ft 8 in, 2 ft, 2 ft 1 in, 2 ft 10 in, 2 ft 6 in, 3 ft, 3 ft 10 in, 3 ft 4 in.

T: 12 inches is the same as what single unit.
S: 1 foot.
T: (Write $13 \text{ in} = \underline{\phantom{00}} \text{ ft } \underline{\phantom{0}} \text{ in}$.) On your boards, write the conversion.
S: (Students write $13 \text{ in} = 1 \text{ ft } 1 \text{ in}$.)

Repeat the process for the following possible sequence: 14 in, 22 in, 24 in, 34 in, 25 in, 36 in, 46 in, 40 in, 48 in, 47 in, 49 in, 58 in.

Decompose Decimals (3 minutes)

Materials: (S) Personal white boards

Note: This fluency drill will review concepts learned in Module 1 and help students apply their place value understanding to decimal division in the latter topics of the module.

T: (Project 3.184.) Say the number.
S: 3 and 184 thousandths.
T: How many tenths are in 3.184?
S: 31 tenths.
T: (Write $3.184 = 31 \text{ tenths} \underline{\phantom{000}} \text{ hundredths}$.) On your boards, write the number, taking out the tenths.
S: (Write $3.184 = 31 \text{ tenths} 84 \text{ hundredths}$.)

Repeat the process for hundredths. Follow the same process for 6.723 and 9.246.
Application Problem (3 minutes)

Emma’s class is preparing for a field trip to the Statue of Liberty. In math class, they are researching Lady Liberty’s size. Help Emma finish this table.

<table>
<thead>
<tr>
<th>The Statue of Liberty’s…</th>
<th>Convert to Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>…mouth is 3 feet wide.</td>
<td></td>
</tr>
<tr>
<td>…head is 10 feet from ear to ear.</td>
<td></td>
</tr>
<tr>
<td>…height is 111 feet.</td>
<td></td>
</tr>
</tbody>
</table>

Note: This Application Problem uses an interesting context to connect yesterday’s lesson, today’s fluency activity, and the current lesson.

Application Problem (5 minutes)

Preparation: Make different bags of beans and/or rice, labeled in four different colors. Make enough bags so that every pair of students has one bag. If possible, get some scales. If you do not have access to scales, label the red and yellow bags with their weights.

- Blue bags—to the nearest ounce. Bags weigh 16 oz, 24 oz, 12 oz, and 10 oz.
- Red bags—to the nearest pound. Bags weigh 1 lb, 1.5 lb, 0.75 lb, and 0.625 lb.
- Yellow bags—to the nearest kilogram. Bags weigh 1 kg, 1.2 kg, 0.45 kg, and 0.274 kg.
- Green bags—to the nearest gram. Bags weigh 1,000 g, 1,200 g, 450 g, and 274 g.

Procedure: Pass out one bag for every two students. Tell students that every bag has an exact match. If you do have access to scales, instruct students to measure the weight of their bag using the unit specified by the bag’s color. After students determine the weight and discuss what the weight means with their partner, each pair finds their bag’s match. If you do not have scales, students work in their new groups of four to determine the weight of the unknown bags based on the known weight.

After all pairs have successfully found their match, students should compare and discuss their measurements. Prompt students to explain how the same sized bag could have two different measurements. Record the results.
After results are recorded, discuss as a group what the findings teach us:

- There are 16 ounces in every pound and 1,000 grams in every kilogram.
- We must multiply to convert from large units (pounds and kilograms) to smaller ones (ounces and grams). (Generalized conversion equations might be recorded as well.)
- We need more of a smaller unit and less of a larger unit to make the same amount.

Note: Today’s Application Problem provides a practical, hands-on way for students to see the conversion reasoning necessary for the lessons in this topic.

**Concept Development (30 minutes)**

**Problem 1**

7.43 kilometers = _____ meters

T: (Post 7.43 kilometers = _____ meters on board.) Turn and talk about how this problem is different than the ones we solved yesterday.

S: (Share.)

T: Yesterday, we converted from large units to smaller units using multiplication. How will we solve this one? Turn and talk.

S: We’ll multiply again. It’s larger units to smaller ones.
   → We’ll multiply 7.43 times 1,000 to find the number of meters. → Since one kilometer equals 1,000 meters, we’ll multiply by 1,000.

T: Work with a partner to solve this problem on your personal boards.

S: (Work.)

T: (Point to 7.43 kilometers = _____ meters.) Say the sentence and fill in the missing number.

S: 7.43 kilometers = 7430 meters. (Fill in the blank as students respond.)

T: Let’s look at our conversion. Does our solution make sense? Turn and talk.

S: It makes sense. The digits all shifted. → 1 kilometer equals 1,000 meters, and 7 km equals 7,000 m, so I know my answer must be a little bit more than 7,000 m.
Problem 2

1.8 miles = _____ yards

T: (Post 1.8 miles = _____ yards on the board.) Tell your neighbor which part of the Reference Sheet will help us solve this one.
S: 1 mile = 1,760 yards.
T: If we think of 1.8 as 18, what will we need to remember about the size of our product?
S: It will be 10 times as much as the actual product. → We will need to adjust our product. We will need to divide it by 10.
T: Ok, now work independently to solve this conversion.
S: (Work.)
T: Turn and tell your neighbor how you solved.
S: (Share.)
T: Say the multiplication sentence you used to solve, beginning with 1.8.
S: 1.8 times 1,760 yards = 3,168 yards.

Problem 3

0.83 kilograms = _____ grams = _____ milligrams

T: (Post 0.83 kilograms = _____ grams = _____ milligrams on the board.) Use your Reference Sheet to help you solve independently.
S: (Work.)
T: 0.83 kilograms equals how many grams?
S: 830 grams.
T: 830 grams equals how many milligrams?
S: 830,000 milligrams.
T: What did you multiply to convert from kilograms to grams?
S: 1,000.
T: What did you multiply to convert from grams to milligrams?
S: 1,000.
T: If we needed to convert from kilograms to milligrams, could we have done it one step? What would we multiply by?
S: Yes we could do it in one step. We would multiply the kilograms by 1 million.
T: So, another way to say this, “Kilograms are _______ times as large as milligrams.”
S: 1 million.
T: Which means how many milligrams are in 1 kilogram?
S: 1 million milligrams in 1 kilogram.
T: Use your place value mat to see if multiplying 0.83 kg by 1 million works to give us 830,000 mg.
S: (Work.)
Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Use decimal multiplication to express equivalent measurements.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- What do you notice about Problem 1(g)? How is it different than the other conversions? How did this difference affect how you solved?
- Look back at the chart and your work in Problem 3(d). What do you think about the size of the Statue of Liberty? How does this question help you realize how big she is?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
1. Convert. Use your Reference Sheet to help you remember the conversion factors.

   a. \(4.5 \text{ km} = \underline{\quad} \text{ m}\)

   b. \(\underline{\quad} \text{ fl oz} = 2.75 \text{ c}\)

   c. \(\underline{\quad} \text{ mL} = 4.85 \text{ L}\)

   d. \(8.25 \text{ g} = \underline{\quad} \text{ mg}\)

   e. \(3.25 \text{ gal} = \underline{\quad} \text{ qt}\)

   f. \(\underline{\quad} \text{ pt} = 16.5 \text{ qt}\)

   g. \(0.5 \text{ mi} = \underline{\quad} \text{ ft}\)

   h. \(7.9 \text{ m} = \underline{\quad} \text{ cm}\)

   i. \(\underline{\quad} \text{ oz} = 4.5 \text{ lb}\)

2. Cassidy figured out that she makes $0.75 every minute at her job. She works 7 hours 15 minutes every day.

   a. How many minutes does she work in 4 days?

   b. How much will Cassidy earn in 4 days?
3. Emma can’t believe how huge the Statue of Liberty is. She finds more information about Lady Liberty. Help Emma fill in the rest of the chart and then answer the questions.

<table>
<thead>
<tr>
<th>The Statue of Liberty’s</th>
<th>CUSTOMARY UNITS</th>
<th>METRIC UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feet</td>
<td>Inches</td>
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<tr>
<td>Nose</td>
<td>4 ft 6 in</td>
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</tr>
<tr>
<td>Index Finger</td>
<td>8 ft</td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>17 ft 3 in</td>
<td></td>
</tr>
<tr>
<td>Eye</td>
<td>2 ft 6 in</td>
<td></td>
</tr>
</tbody>
</table>


a. Emma is 52 inches tall. Which of Lady Liberty’s body parts above is the closest to Emma’s height? What is the difference between these two measurements in inches?

b. Emma’s eye is 4 cm wide. How many of Emma’s eyes lined up end to end would it take to stretch all the way across one of Lady Liberty’s eyes?

c. The length of Emma’s neighborhood block is 0.19 km. About how many of the statue’s heads would it take to cover the length of her block?

d. Measured in meters, Lady Liberty’s index finger is 4 times as long as Emma’s leg. What is the length of Emma’s leg in meters?
Lesson 14 Exit Ticket

Name __________________________ Date ________________

1. Convert. Use your Reference Sheet if necessary.
   
a. \(3.9 \text{ km} = \underline{\quad} \underline{\quad} \underline{\quad} \underline{\quad} \text{ m}\)

b. \(\underline{\quad} \underline{\quad} \underline{\quad} \underline{\quad} \text{ lb} = 2.4 \text{ tons}\)

c. \(13.5 \text{ qt} = \underline{\quad} \underline{\quad} \underline{\quad} \underline{\quad} \text{ pt}\)
Lesson 14 Homework

Name ____________________________________________________________ Date ________________

1. Convert. Use your Reference Sheet if necessary.
   a. 2.7 kL = ______ L   d. 9.13 kg = _____ g   g. 1.3 tons = _____ lb
   b. _____ fl oz = 4.25 c   e. 4.75 gal = ______ qt   h. 0.75 mi = ______ yd
   c. _____ m = 1.45 km   f. _____ pt = 12.5 qt   i. _____ oz = 8.5 lb

2. Jennifer wants to convert 7.85 meters to centimeters, but she does not have paper, pencil, or a calculator. Describe a method she can use.

3. A standard hot tub holds 2.3 kiloliters of water. After filling up two of nine hot tubs, Johnson’s water service truck empties. How many liters of water are still needed to fill the remaining tubs?
Lesson 15

Objective: Solve two-step word problems involving measurement and multi-digit multiplication.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Concept Development (38 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

**Fluency Practice (12 minutes)**

- Sprint: Convert Inches to Feet and Inches 5.MD.1 (9 minutes)
- Divide by Multiples of 10 and 100 5.NBT.2 (3 minutes)

**Sprint: Convert Inches to Feet and Inches (9 minutes)**

Materials: (S) Convert Inches to Feet and Inches Sprint

**Divide by Multiples of 10 and 100 (3 minutes)**

Note: This review fluency drill will prepare students to approximate quotients with two-digit divisors in Lesson 17.

Follow the same process and procedure as G5–M2–Lesson 9 for the following possible sequence: 480 ÷ 20; 690 ÷ 300; 8,480 ÷ 400; 6,480 ÷ 20.

**Concept Development (38 minutes)**

Materials: (T/S) Problem Set, pencils

Note: This lesson omits the Application Problem component since the entire lesson is devoted to problem solving. Problems for this section are found in this lesson’s Problem Set

**Problem 1**

Liza’s cat had six kittens! When Liza and her brother weigh all the kittens together, they weigh 4 pounds 2 ounces. Since all the kittens are about the same size, how many ounces does each kitten weigh?
T: We will work Problem 2 on your Problem Set together. (Project Problem 2 on the board.) Let’s read the word problem aloud.

S: (Read chorally.)

T: Now, let’s re-read the problem sentence by sentence and draw as we go.

S: (Read the first sentence.)


S: I can draw 6 units representing 6 kittens.

T: Read the next sentence. (Students read.) What is the important information and how can we show that in our drawing?

S: The total weight for all 6 kittens equal to 4 pounds 2 ounces. We can draw 6 equal units with the total of 4 pounds 2 ounces. \( \rightarrow \) We can write that 6 units equals 4 pounds 2 ounces.

T: Let’s read the question.

T: What are we trying to find? What is missing in our drawing?

S: One kitten’s weight, in ounces.

T: I’ll put a question mark in one of our 6 units, to show what we are trying to find.

T: How do we solve this problem? Turn and talk.

S: We have to divide. \( \rightarrow \) We have use the total weight and divide by 6 to get 1 kitten’s weight. \( \rightarrow \) We first have to convert the 4 lb 2 oz into ounces, and then we can divide by 6.

T: We were given the total weight of 4 lb 2 oz. Let’s convert it into ounces. Work with a partner.

T: What is the total weight in ounces?

S: 66 oz.

T: Have we answered the question?

S: No. We need to divide the total weight of 66 oz by 6 to find the weight of 1 kitten.

T: Solve.

T: Say the division sentence with the answer.

S: 66 oz \( ÷ \) 6 = 11 oz.

T: Express your answer in a sentence.

S: Each kitten weighs 11 oz.

**Problem 2**

Holly is buying orange juice for the class party. There are 24 people coming, and she figures each person will drink 1.75 cups.

a. How many fluid ounces of juice will she need?

b. If she buys five 59-ounce containers, will she have enough juice?
T: (Have students read the problem chorally, in pairs, or in silence.) Now that you’ve read, what can you draw?

S: There are 24 units and each unit equal to 1.75 cups. → I won’t draw 24 units because that’s too many units, but I can use dot, dot, dot to represent a total of 24 units.

T: Go ahead and draw and label your tape diagrams.

S: (Work.)

T: How many people are coming?

S: 24 people.

T: So, we’ll have 24 total units. What is happening with those 24 people? How much are they drinking?

S: 1.75 cups each.

T: So each one of those 24 units are equal to 1.75 cups.

T: I’ll draw the first 3 units of 1.75 cups, and then dot, dot, dot up to the 24th unit of 1.75 cups. Look back at your drawing and make sure it shows the same information as mine.

S: (Check and fix if necessary.)

T: Re-read quietly Part (a) with a partner. (Allow time for student to read.)

T: What is Part (a) asking?

S: We have to find the total fluid ounces of juice needed for the party.

T: Is this a one-step or multi-step problem? Turn and share.

S: Multi-step because we were given cups and have to find the answer in fluid ounces. → We can solve by first converting the 1.75 cups into fluid ounces, and then multiply by 24. → We can first multiply 1.75 cups by 24, and then we can convert to fluid ounces.

T: Work together to complete the first step by finding the total juice in cups.

T: Say the multiplication sentence starting with 1.75 cups.

S: 1.75 cups × 24 = 42 cups.

T: We haven’t answered the question yet. Now finish solving Part (a) by converting the total cups into fluid ounces by multiplying by 8.

T: 42 cups is equal to how many fluid ounces?

S: 336 fluid ounces.

T: Use 336 fluid ounces, to answer the question.

S: She will need 336 fluid ounces of juice for the party.

T: Let’s read Part (b) together.

T: In order to know if she’ll have enough we’ll need to figure out how many ounces are in five 59-ounce containers. Work independently to figure that out. (Allow time for students to solve.)

T: Tell me the multiplication sentence starting with 5.
Lesson 15

NYS COMMON CORE MATHEMATICS CURRICULUM

5•2

Lesson 15:
Solve two-step word problems involving measurement and multi-digit multiplication.

Date: 7/4/13

S: 5 × 59 ounces = 295 ounces.

T: Without calculating, can we answer this question? Turn and talk.

S: 295 is less than 336, so she doesn’t have enough juice for the party. → Since five 59-ounce containers equal to 295 fluid ounces, but she needs 336 fluid ounces.

T: Does she have enough juice for the party?

S: No, she does not have enough juice because 295 fluid ounces is less than 336 fluid ounces.

T: Complete Problems 1, 4, 5, and 6 on the Problem Set independently or in pairs.

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Solve two-step word problems involving measurement and multi-digit multiplication.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson. You may choose to use any combination of the questions below to lead the discussion.

- Look back at Problem 4(b). Would it have been possible to answer Part (b) prior to answering Part (a)? Did you need to convert to pounds first and then subtract or was there another way to solve? (Students could have compared

---

NYS COMMON CORE MATHEMATICS CURRICULUM

Lesson 15 Problem Set

4. A concrete operator unloaded the following cargo:
   - 5 pallets of lumber, each pallet weighs 1.2 tons.
   - 2 pallets of concrete, each pallet weighs 6.4 tons.
   a. How many pounds of cargo were unloaded?
   \[
   \begin{align*}
   \text{5 pallets of lumber} & \quad 5 \times 2,000 = 10,000 \\
   \text{2 pallets of concrete} & \quad 2 \times 6,400 = 12,800
   \end{align*}
   \]
   Total cargo unloaded = 12,800 + 10,000 = 22,800 tons

   b. Which load of cargo was heavier, the lumber or the concrete? How many pounds heavier?
   \[
   \begin{align*}
   \text{Lumber} & \quad 10,000 \times 2,000 = 20,000 \text{ tons}
   \text{Concrete} & \quad 12,800 \times 6,400 = 81,920 \text{ tons}
   \end{align*}
   \]
   Concrete was 61,920 tons heavier

5. A punch recipe calls for 2 cups of ginger ale, 3 plants of orange juice, 1 cup of pineapple juice, 2 cups of lemonade, and 8 ounces of lime juice. Anto plans to make a double recipe. How many fluid ounces will there be in a double recipe of punch?
   \[
   \begin{align*}
   \text{1 batch} & \quad 2 \text{ cups} \times 12 \text{ oz} = 24 \text{ oz} \\
   \text{2 cups} & \quad 5 \times 16 \text{ oz} = 80 \text{ oz} \\
   \text{8 ounces} & \quad 1 \times 12 \text{ oz} = 12 \text{ oz}
   \end{align*}
   \]
   \[
   \begin{align*}
   \text{Double recipe} & \quad (24 + 72 + 24 + 80 + 12) \times 2 = 310 \text{ oz}
   \end{align*}
   \]
Lesson 15

Solve two-step word problems involving measurement and multi-digit multiplication.

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 15 Sprint

A  
Write in feet and inches.

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Lesson 15: Solve two-step word problems involving measurement and multi-digit multiplication.
Date: 7/4/13

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<tr>
<td>22</td>
<td>12 in = ft in</td>
<td>44</td>
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Solve.
1. Liza’s cat had six kittens! When Liza and her brother weigh all the kittens together, they weigh 4 pounds 2 ounces. Since all the kittens are about the same size, how many ounces does each kitten weigh?

2. Holly is buying orange juice for the class party. There are 24 people coming, and she figures each person will drink 1.75 cups.
   a. How many fluid ounces of juice will she need?
   b. If she buys five 59-ounce containers, will she have enough juice?

3. Josie is 1.4 m tall. Her sister is 54 cm shorter.
   a. Find Josie’s sister’s height in meters.
   b. How tall are Josie and her sister combined, in meters?
4. A crane operator unloaded the following cargo:
   ▪ 5 pallets of lumber. Each pallet weighs 7.3 tons.
   ▪ 9 pallets of concrete. Each pallet weighs 4.8 tons.
   
   a. How many pounds of cargo were unloaded?

   b. Which load of cargo was heavier, the lumber or the concrete? How many pounds heavier?

5. A punch recipe calls for 2 quarts of ginger ale, 3 pints of orange juice, 2 pints of pineapple juice, 1 cup of lemon juice, and 3 ounces of lime juice. Edna plans to make a double-recipe. How many fluid ounces will there be in a double-recipe of punch?
6. Use the table below to answer the questions that follow.

<table>
<thead>
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<th>Location</th>
<th>Distance</th>
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</thead>
<tbody>
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<td>Cibo Deli</td>
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<tr>
<td>W.F. Library</td>
<td>15,840 feet</td>
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<tr>
<td>Elementary School</td>
<td>5,280 yards</td>
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<tr>
<td>Youth Ball Field</td>
<td>1 mile 880 yards</td>
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</tbody>
</table>

a. If Akun travels from his house to the Youth Ball Field and back, how many miles did he travel?

b. Which two locations are equidistant from Akun’s house?

c. Three days a week, Akun walks to school. After school, the bus drops him off at the library to do his homework. He walks home afterwards. How far, in feet, does Akun walk on those three days?
Solve.

1. While training for an Ironman competition, Johnson swam 0.86 km, biked for 22.4 km, and ran 4.25 km.
   a. Johnson completed this routine twice a week. How far did Johnson travel in one week while training, in meters?
   b. The following week Johnson decided to work harder. He still trained twice a week, but he doubled the length of his swim and his biking and tripled the amount he ran. How much further did he travel this week than he did in the first week, in meters?
Lesson 15: Solve two-step word problems involving measurement and multi-digit multiplication.

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Solve.

1. Jocelyn borrowed 3.75 kg of flour from her grandmother to bake 3 batches of cookies and 2 cakes. Each cookie recipe called for 225 grams of flour. Each cake recipe needed 1.2 kg of flour. After baking, how much flour was Jocelyn able to return to her grandmother?

2. The new athletic facility on the downtown campus measures 0.74 km by 0.4 km. How many square meters is the facility?

3. It is recommended that athletes drink a minimum of 0.24 L of water for every 20 minutes of athletic activity. John plays tennis for 3 hours. His water bottle holds 1,500 mL. Will he have enough water to meet the minimum requirement? If so, how much water will he have left? If not, what is the least amount of water he will need to put in his bottle when it is empty? Express your answer in liters.
4. A Rottweiler gave birth to 3 puppies. The first puppy weighed 5.1 kg. The second weighed 206 g less than the first. The third puppy weighed 0.2 kg more than the second.
   a. What is the total weight of the litter in grams?
   b. How much more did the heaviest puppy weight than the lightest one?
   c. The mother weighed 4 times the total weight of her litter. What was her weight in kilograms?

5. A courier charges $6.25 to ship a 2 lb-package. For each ounce over 2 lb, they charge an additional $0.35 per ounce.
   a. How much would it cost to ship a package weighing 4 lb 6 oz?
   b. Which would be less expensive? Sending two packages weighing 2 lb 4 oz each, or combining them into one package weighing 4 lb 8 oz? What is the difference in price?