

A Story of Units®

Eureka Math™

Grade 4, Module 2

Teacher Edition

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Grade 4 • Module 2

Unit Conversions and Problem Solving with Metric Measurement

OVERVIEW

The idea of a mixed unit shows up in varied contexts. For instance, students have become accustomed to thinking of 250 as the mixed units of 2 hundreds 5 tens. Mixed units are also used in the context of 2 hr 5 min, \$2.50, 2 km 5 m, 2' 5", and $2\frac{5}{8}$ (hours and minutes, dollars and cents, kilometers and meters, feet and inches, ones and eighths). While the context and the units may vary greatly, there are many common threads present in any mixed unit calculation. Consider the connections and similarities between the following equalities:

2 thousands	437 ones	=	2,437 ones
2 kilometers	437 meters	=	2,437 meters
2 kilograms	437 grams	=	2,437 grams
2 liters	437 milliliters	=	2,437 milliliters

In order to explore the process of working with mixed units, Module 2 focuses on length, mass, and capacity in the metric system¹ where place value serves as a natural guide for moving between larger and smaller units.

In Topic A, students review place value concepts while building fluency with decomposing, or converting from larger to smaller units (**4.MD.1**). They learn the relative sizes of measurement units, building off prior knowledge of grams and kilograms from Grade 3 (**3.MD.2**) and meters and centimeters from Grade 2 (**2.MD.3**). Conversions between the units are recorded in a two-column table. Single-step problems involving addition and subtraction of metric units provide an opportunity to practice mental math calculations as well as the addition and subtraction algorithms established in Module 1. Students reason by choosing to convert between mixed and single units before or after the computation (**4.MD.2**). Connecting their familiarity with both metric units and place value, the module moves swiftly through each unit of conversion, spending only one day on each type. This initial understanding of unit conversions allows for further application and practice, such as multiplying and dividing metric units, throughout subsequent modules.

In Topic B, students continue to build off their measurement work from previous grade levels. They solidify their understanding of the relationship between metric units and the place value chart and apply unit conversions to solve and reason about multi-step word problems (**4.MD.2**). Applying the skills learned in Module 1, students discover and explore the relationship between place value and conversions. The beauty of both the place value and measurement systems is the efficiency and precision permitted by the use of different size units to express a given quantity. As students solve word problems by adding and subtracting

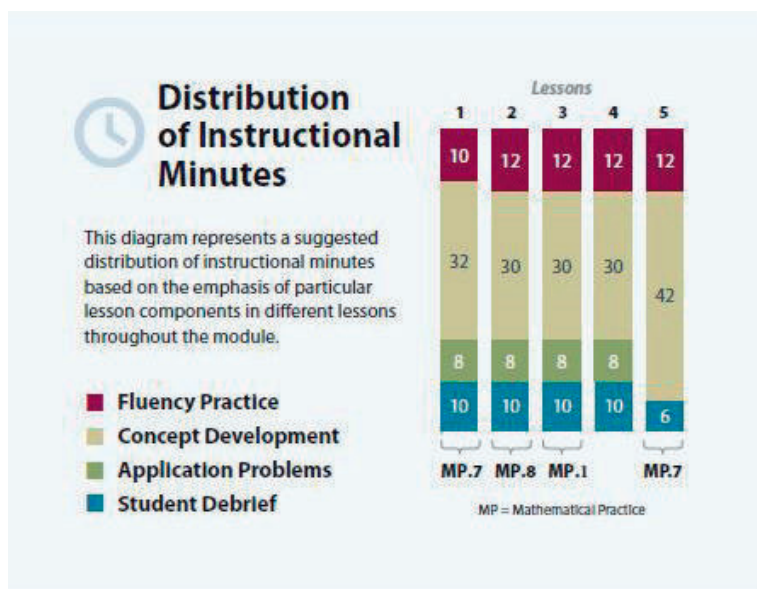
¹Pounds, ounces, time, and money are covered in Module 7.

metric units, their ability to reason in parts and wholes is taken to the next level. This is important preparation for multi-digit operations and for manipulating fractional units in future modules. Tape diagrams and number lines serve as models throughout the module to support the application of the standard algorithm to word problems.

Notes on Pacing for Differentiation

Although composed of just five lessons, Module 2 has great importance in the Grade 4 sequence of modules. Module 2, along with Module 1, is paramount in setting the foundation for developing fluency with the manipulation of place value units, a skill upon which Module 3 greatly depends. Teachers who have taught Module 2 prior to Module 3 have reportedly moved through Module 3 more efficiently than colleagues who have omitted it. Module 2 also sets the foundation for work with fractions and mixed numbers in Module 5. Therefore, it is not recommended to omit any lessons from Module 2.

To help with the pacing of Module 3's Topic A, consider replacing the Convert Units fluencies in Module 2, Lessons 1–3, with area and perimeter fluencies. Also, consider incorporating Problem 1 from Module 3, Lesson 1, into the fluency component of Module 2, Lessons 4 and 5.



Focus Grade Level Standards

Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.²

- 4.MD.1³** 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), ...*
- 4.MD.2⁴** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

Foundational Standards

- 2.NBT.1** Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as a special case:
- 100 can be thought of as a bundle of ten tens—called a “hundred.”
- 2.MD.5** Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.
- 3.MD.2** Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (L). (Excludes compound units such as cm^3 and finding the geometric volume of a container.) Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (Excludes multiplicative comparison problems, i.e., problems involving notions of “times as much.”)
- 4.OA.3** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
- 4.NBT.4** Fluently add and subtract multi-digit whole numbers using the standard algorithm.

²4.MD.3 is addressed in Module 3.

³Pounds, ounces, and time are addressed in Module 7. This is a non-tested standard, but expressing metric measurements of length, mass, and capacity from larger to smaller units strengthens the upcoming modules.

⁴Time and money are addressed in Module 7. This is a non-tested standard, but the contexts of operating on distance, volume, and mass strengthen the upcoming modules.

Focus Standards for Mathematical Practice

- MP.1** **Make sense of problems and persevere in solving them.** Students use place value knowledge to convert larger units to smaller units before adding and subtracting. They fluently add and subtract metric units of length, weight, and capacity using the standard algorithm. Tape diagrams and number lines help students conceptualize a problem before it is solved and are used to assess the reasonableness of an answer.
- MP.7** **Look for and make use of structure.** Students use knowledge of place value and mixed units to find patterns when converting from a larger unit to a smaller unit. They recognize that 1 thousand equals 1,000 ones and relate that to 1 kilometer equals 1,000 meters. Using this pattern, they might extend thinking to convert smaller to larger units when making a conversion chart.
- MP.8** **Look for and express regularity in repeated reasoning.** Students find that metric unit conversions share a relationship on the place value chart. For example, 1,000 ones equals 1 thousand, 1,000 g equals 1 kg, 1,000 mL equals 1 L, and 1,000 m equals 1 km. Knowing and using these conversions and similarities allows for quick and easy conversion and calculation.

Overview of Module Topics and Lesson Objectives

Standards	Topics and Objectives	Days
4.MD.1 4.MD.2	A Metric Unit Conversions Lesson 1: Express metric length measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric length. Lesson 2: Express metric mass measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric mass. Lesson 3: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity.	3
4.MD.1 4.MD.2	B Application of Metric Unit Conversions Lesson 4: Know and relate metric units to place value units in order to express measurements in different units. Lesson 5: Use addition and subtraction to solve multi-step word problems involving length, mass, and capacity.	2
	End-of-Module Assessment: Topics A–B (assessment $\frac{1}{2}$ day, return $\frac{1}{2}$ day, remediation or further applications 1 day)	2
Total Number of Instructional Days		7

Terminology

New or Recently Introduced Terms

- Convert (express a measurement in a different unit; rename units)
- Kilometer (km, a unit of measure for length)
- Mass (the measure of the amount of matter in an object)
- Milliliter (mL, a unit of measure for liquid volume)
- Mixed units (e.g., 3 m 43 cm)

Familiar Terms and Symbols⁵

- =, <, > (equal to, less than, greater than)
- Algorithm (a step-by-step procedure to solve a particular type of problem)
- Capacity (the maximum amount that something can contain)
- Distance (the length of the line segment joining two points)
- Equivalent (equal)
- Kilogram (kg), gram (g) (units of measure for mass)
- Larger or smaller unit (used in a comparison of units)
- Length (the measurement of something from end to end)
- Liter (L) (unit of measure for liquid volume)
- Measurement (dimensions, quantity, or capacity as determined by comparison with a standard)
- Meter (m), centimeter (cm) (units of measure for length)
- Mixed units (e.g., 2 tens 4 ones, 2 kilometers 34 meters)
- Simplifying strategy (a mental math or recorded method for making a problem easier to solve)
- Table (used to represent data)
- Times as much as (e.g., 1 hundred is 10 times as much as 1 ten)
- Weight (the measurement of how heavy something is)

Suggested Tools and Representations

- Balance scale, weights (masses)
- Centimeter ruler, meter stick
- Liter containers with millimeter scale
- Number line
- Tape diagram
- Two-column table

⁵These are terms and symbols students have used or seen previously.

Scaffolds⁶

The scaffolds integrated into *A Story of Units* give alternatives for how students access information as well as express and demonstrate their learning. Strategically placed margin notes are provided within each lesson elaborating on the use of specific scaffolds at applicable times. They address many needs presented by English language learners, students with disabilities, students performing above grade level, and students performing below grade level. Many of the suggestions are organized by Universal Design for Learning (UDL) principles and are applicable to more than one population. To read more about the approach to differentiated instruction in *A Story of Units*, please refer to “How to Implement *A Story of Units*.”

Assessment Summary

Type	Administered	Format	Standards Addressed
End-of-Module Assessment Task	After Topic B	Constructed response with rubric	4.MD.1 4.MD.2

⁶Students with disabilities may require Braille, large print, audio, or special digital files. Please visit the website www.p12.nysed.gov/specialed/aim for specific information on how to obtain student materials that satisfy the National Instructional Materials Accessibility Standard (NIMAS) format.



Topic A

Metric Unit Conversions

4.MD.1, 4.MD.2

Focus 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. <i>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), ...</i>
	4.MD.2 ²	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
Instructional Days:	3	
Coherence -Links from:	G2–M2	Addition and Subtraction of Length Units
	G3–M2	Place Value and Problem Solving with Units of Measure
-Links to:	G5–M1	Place Value and Decimal Fractions
	G5–M2	Multi-Digit Whole Number and Decimal Fraction Operations

In order to explore the process of working with mixed units, Module 2 focuses on length, mass, and capacity in the metric system,³ where place value serves as a natural guide for moving between larger and smaller units. In Topic A, students review place value concepts while building fluency with decomposing, or converting from larger to smaller units (**4.MD.1**). They learn the relative sizes of measurement units, building off prior knowledge of grams and kilograms from Grade 3 (**3.MD.2**) and meters and centimeters from Grade 2 (**2.MD.3**). Conversions between the units are recorded in a two-column table, beginning in Lesson 1. Recording the unit conversions in a table allows students to notice patterns when converting from a smaller unit to a larger unit (e.g., 200 centimeters is the same as 2 meters because 1 meter is equal to 100 centimeters). Single-step problems involving addition and subtraction of metric units provide an

¹Pounds, ounces, and time are addressed in Module 7. This is a non-tested standard, but expressing metric measurements of length, mass, and capacity from larger to smaller units strengthens the upcoming modules.

²Time and money are addressed in Module 7. This is a non-tested standard, but the context of operating on distance, volume, and mass strengthens the upcoming modules. This module only focuses on addition and subtraction. Multiplication and division are addressed in future modules.

³Pounds, ounces, time, and money are covered in Module 7.

opportunity to practice simplifying strategies (e.g., mental math strategies) as well as the addition and subtraction algorithm established in Module 1 (4.NBT.4). Students practice reasoning by choosing to convert mixed units to a single unit before or after the computation (4.MD.2).

$$2 \text{ km } 608 \text{ m} + 3 \text{ km } 412 \text{ m}$$

Algorithms

$$\begin{array}{r} 2 \text{ km } 608 \text{ m} \\ + 3 \text{ km } 412 \text{ m} \\ \hline 5 \text{ km } 1020 \text{ m} \\ \quad \quad \quad \uparrow \\ \quad \quad \quad 1 \text{ km } 20 \text{ m} \\ 6 \text{ km } 20 \text{ m} = 6,020 \text{ m} \end{array}$$

OR

$$\begin{array}{r} 2,608 \text{ m} \\ + 3,412 \text{ m} \\ \hline 6,020 \text{ m} = 6 \text{ km } 20 \text{ m} \end{array}$$

Simplifying Strategies

$$\begin{aligned} 2 \text{ km} + 3 \text{ km} &= 5 \text{ km} \\ 608 \text{ m} + 412 \text{ m} &= 600 \text{ m} + 420 \text{ m} \\ &\quad \quad \quad \uparrow \\ &\quad \quad \quad 8 \qquad \quad \quad = 1,020 \text{ m} \\ 5 \text{ km} + 1 \text{ km } 20 \text{ m} &= 6 \text{ km } 20 \text{ m} \end{aligned}$$

OR

$$\begin{array}{r} 2,608 \text{ m} + 3,412 \text{ m} \\ \begin{array}{l} \swarrow \quad \downarrow \quad \searrow \\ 2,000 \quad 600 \quad 8 \end{array} \quad \begin{array}{l} \swarrow \quad \downarrow \quad \searrow \\ 3,000 \quad 400 \quad 12 \end{array} \\ 5,000 \text{ m} + 1,000 \text{ m} + 20 \text{ m} = 6,020 \text{ m} \end{array}$$

Word problems provide a context in which to apply the conversions and include the addition and subtraction of mixed units. Connecting students' familiarity with both metric units and place value, the module moves swiftly through each unit of conversion, spending only one day on each type of measurement. This initial understanding of unit conversions allows for further application and practice, such as when multiplying and dividing metric units, throughout subsequent modules.

A Teaching Sequence Toward Mastery of Metric Unit Conversions

Objective 1: Express metric length measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric length.

(Lesson 1)

Objective 2: Express metric mass measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric mass.

(Lesson 2)

Objective 3: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity.

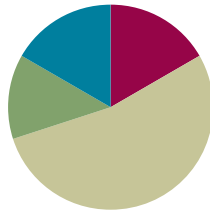
(Lesson 3)

Lesson 1

Objective: Express metric length measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric length.

Suggested Lesson Structure

■ Fluency Practice	(10 minutes)
■ Application Problem	(8 minutes)
■ Concept Development	(32 minutes)
■ Student Debrief	(10 minutes)
Total Time	(60 minutes)



A NOTE ON STANDARDS ALIGNMENT:

In this lesson and the entire module, students convert metric length units in the context of addition and subtraction problems involving mixed units. This lesson builds on the content of **2.MD.5** and **3.MD.2**.

On some occasions, students work beyond the **4.MD.1** and **4.MD.2** standards by converting from a smaller unit to a larger unit. They do this by creating a connection between units of measures related to place value.

If students are not ready for the conversions up, have them work in small groups to further develop the number sense necessary for understanding these conversions, and always accept answers in the smaller unit.

Fluency Practice (10 minutes)

- Convert Units **4.MD.1** (2 minutes)
- Meter and Centimeter Number Bonds **4.MD.1** (8 minutes)

Convert Units (2 minutes)

Note: Isolated review builds fluency with conversion so that students can use this skill as a tool for solving word problems.

T: (Write $100 \text{ cm} = \underline{\quad} \text{ m}$.) 100 centimeters is the same as how many meters?

S: 1 meter.

Repeat the process with the following possible sequence: 200 cm, 300 cm, 800 cm, and 500 cm.

T: (Write $1 \text{ m} = \underline{\quad} \text{ cm}$.) How many centimeters are in 1 meter?

S: 100 centimeters.

Repeat the process with the following possible sequence: 2 m, 3 m, 7 m, 4 m, and 9 m.

Meter and Centimeter Number Bonds (8 minutes)

Materials: (S) Personal white board

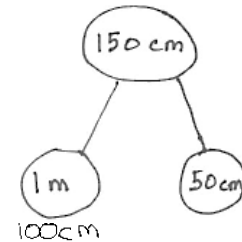
Note: This fluency activity prepares students to add and subtract meters and centimeters later in the lesson.

T: (Project a number bond with 150 cm written as the whole and 1 m as one of the parts.) How many centimeters are in 1 meter?

S: 100 centimeters.

T: (Beneath 1 m, write 100 cm.) On your personal white boards, write a number bond filling in the unknown part.

S: (Write a number bond with a whole of 150 cm and parts of 1 m and 50 cm.)



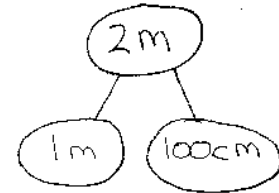
Repeat the process with wholes of 180 cm, 120 cm, 125 cm, 105 cm, and 107 cm.

T: (Project a number bond with 2 m written as the whole, 1 m as one of the parts, and ___ cm as the other part.) Fill in the unknown part.

S: (Write a number bond with 2 m as the whole, 1 m as one of the parts, and 100 cm as the other part.)

T: Show a number bond with a whole of 3 meters and pull out 100 centimeters. Name the other part in meters.

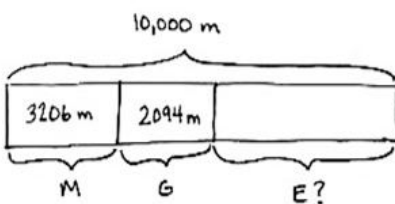
S: (Draw a number bond with 3 m as the whole, 100 cm as one of the parts, and 2 m as the other part.)



Repeat the process with the following possible sequence: 5 meters, 8 meters, 9 meters, and 10 meters.

Application Problem (8 minutes)

Martha, George, and Elizabeth sprint a combined distance of 10,000 meters. Martha sprints 3,206 meters. George sprints 2,094 meters. How far does Elizabeth sprint? Solve using an algorithm or a simplifying strategy.



(A)

$$\begin{array}{r} 3206 \\ +2094 \\ \hline 5300 \end{array}$$

$$\begin{array}{r} 10,000 \\ -5,300 \\ \hline 4,700 \end{array}$$

(B)

$$3,206 + 2,094 = 5,300$$

$$3,000 \quad 206 \quad 2,000 \quad 94$$

$$10,000 - 5,300 = 4,700$$

$$4,000 \quad 700$$

Elizabeth sprinted 4,700 meters.

Note: This Application Problem builds on Grade 4 Module 1 Lesson 19. Note that Solution A models the standard algorithm, whereas Solution B records a simplifying strategy using number bonds. A number bond demonstrates part-whole relationships and is a way to record completing a whole or taking part from a whole. This Application Problem leads to the Concept Development of this lesson because the problem involves the metric unit of a meter.

Concept Development (32 minutes)

Materials: (T) Staples, ruler, meter stick, teacher-made poster with metric units (shown below)
(S) Personal white board

Problem 1: Understand 1 centimeter, 1 meter, and 1 kilometer in terms of concrete objects.

Begin with a five-minute discussion about the length of a centimeter, meter, and kilometer.

- Use familiar, concrete examples such as a staple, the height of a countertop, and the distance to a local landmark that you know to be about 1 **kilometer**.
- Have students measure the size of concrete examples that are given using centimeters or meters.
- Display a chart such as the one shown below.
- Add other examples to the chart, such as the width of a fingernail, the width of a door, the distance of two and a half laps around a running track, the length of a base ten cube, the height of a stack of five pennies, the outstretched arms of a child, and the distance around a soccer field four times. Show a meter stick to reference the exact size of a centimeter and a meter.

Metric Units of Length

Centimeter	meter	kilometer
length of staple	height of countertop	distance from the school to the train station



NOTES ON MULTIPLE MEANS OF REPRESENTATION:

English language learners may benefit from further discussion of concrete items that are about the same length as a centimeter, meter, or kilometer. Write examples on index cards of items that are a centimeter, a meter, or a kilometer in length. Have students place them in the appropriate columns of a chart. Provide students with blank index cards so they can create their own cards to add to the chart.



NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Ask students where they have heard the prefix *kilo-* before. As they learned in Grade 3, 1 kilogram equals 1,000 grams, so 1 kilometer equals 1,000 meters. Ask how many bytes are in 1 kilobyte.

Problem 2: Compare the sizes and note relationships between meters and kilometers as conversion equivalencies.

Use a two-column table, as pictured to the right, to support the following sequence.

T: 1 km = 1,000 m. How many meters are in 2 km? 3 km? 7 km? 70 km?

S: 2,000 m, 3,000 m, 7,000 m, 70,000 m.

T: Write $2,000 \text{ m} = \underline{\hspace{1cm}}$ km on your personal white board. If 1,000 m equals 1 km, 2,000 m equals how many kilometers?

MP.7

S: 2 kilometers.

Repeat for 8,000 m, 10,000 m, and 9,000 m.

T: Compare kilometers and meters.

S: A kilometer is a longer distance because we need 1,000 meters to equal 1 kilometer. \rightarrow 1 kilometer is 1,000 times as much as 1 meter.

T: (Display $1 \text{ km } 500 \text{ m} = \underline{\hspace{1cm}}$ m.) Let's **convert**, or rename, 1 km 500 m to meters. 1 kilometer is equal to how many meters?

S: 1,000 meters.

T: 1,000 meters plus 500 meters is 1,500 meters. (Fill in the blank.)

T: (Display $1 \text{ km } 300 \text{ m} = \underline{\hspace{1cm}}$ m.) 1 kilometer 300 meters is equal to how many meters?

S: 1,300 meters.

Repeat with 5 km 30 m. (Anticipate the incorrect answer of 530 m.)

T: 2,500 meters is equal to how many kilometers? How do you know?

S: 2 km 500 m. We made two groups of 1,000 meters, so we have 2 kilometers and 500 meters.

Repeat with 5,005 m.

Problem 3: Add mixed units of length using the algorithm or simplifying strategies.

Display horizontally: $5 \text{ km} + 2,500 \text{ m}$.

T: Talk for one minute with your partner about how to solve this problem.

S: We can't add different units together. \rightarrow We can convert the kilometers to meters before adding. 5 kilometers equals 5,000 meters, so $5,000 \text{ m} + 2,500 \text{ m} = 7,500 \text{ m}$. \rightarrow I'm going to rename 7,500 m to 7 km 500 m.

T: Renaming 7,500 m to 7 km 500 m created a **mixed unit**. Mixed units can be helpful when using a simplifying strategy.

T: Are you going to use the algorithm or a simplifying strategy to solve?

S: Simplifying strategy.

T: Why?

Distance	
km	m
1	1,000
2	<u>2,000</u>
3	<u>3,000</u>
7	<u>7,000</u>
70	<u>70,000</u>

S: There is no regrouping. → The units are easy to combine. → It's just like adding place value units.

$$5 \text{ km} + 2,500 \text{ m}$$

$$5 \text{ km} + 2 \text{ km } 500 \text{ m} = 7 \text{ km } 500 \text{ m}$$

$$5,000 \text{ m} + 2,500 \text{ m} = 7,500 \text{ m} = 7 \text{ km } 500 \text{ m}$$

T: When we added meters, the answer was 7,500 m. When we added mixed units, the answer was 7 km 500 m. Are these answers equal? Why or why not?

S: It is the same amount because $7 \text{ km} = 7,000 \text{ m}$ and $7,000 \text{ m} + 500 \text{ m} = 7,500 \text{ m}$.

T: (Display horizontally: $1 \text{ km } 734 \text{ m} + 4 \text{ km } 396 \text{ m}$.) Simplifying strategy or the algorithm? Discuss with a partner.

S: Simplifying strategy, because 7 hundred plus 3 hundred is 1 thousand. 1 thousand meters equals 1 kilometer. $96 + 34$ is easy, since the 4 gets 96 to 100. 6 kilometers, 130 meters. → But there are three renamings, and the sum of the meters is more than a thousand. My head is spinning. → I'm going to try it mentally and then check with the algorithm.

T: Choose the way you want to do it. You will have two minutes. If you finish before the two minutes are up, try solving it a different way. Let's have two pairs of students work at the board, one pair using the algorithm and one pair recording a simplifying strategy.

After two minutes, review the student work on the board, which hopefully includes strategies such as those below. If not, gently supplement or provide alternative solutions as shown below. Solutions A and B use the algorithm. Solutions C and D are simplifying strategies.

<p>(A)</p> $\begin{array}{r} 1 \text{ km } 734 \text{ m} \\ + 4 \text{ km } 396 \text{ m} \\ \hline 5 \text{ km } 1130 \text{ m} \\ \hline \begin{array}{l} 1 \text{ km} \quad 130 \text{ m} \\ 6 \text{ km } 130 \text{ m} \end{array} \end{array}$	<p>(B)</p> $\begin{array}{r} 1734 \text{ m} \\ + 4396 \text{ m} \\ \hline 6130 \text{ m} \\ \hline 6 \text{ km } 130 \text{ m} \end{array}$
--	---

<p>(C)</p> $\begin{array}{l} 1 \text{ km} + 4 \text{ km} = 5 \text{ km} \\ 734 + 396 = 730 + 400 \\ \quad \quad \quad = 1130 \\ \begin{array}{l} 730 \quad 4 \\ 5 \text{ km} + 1 \text{ km } 130 \text{ m} = \\ 6 \text{ km } 130 \text{ m} \end{array} \end{array}$	<p>(D)</p> $\begin{array}{l} 734 + 396 = 1130 \\ \begin{array}{l} 700 \quad 34 \quad 300 \quad 96 \\ 5 \text{ km} + 1 \text{ km } 130 \text{ m} = 6 \text{ km } 130 \text{ m} \end{array} \end{array}$
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NOTES ON MULTIPLE MEANS OF REPRESENTATION:

Students performing below grade level may struggle with the concept of regrouping in order to add or subtract mixed units. Be sure to relate regrouping back to the work done in the fluency activity and in Problem 1. Explicitly show them the connection between the conversions that they learned to make and how that applies to adding and subtracting with mixed units. Consider the following:

We can't add different units together. If I need to convert 5 kilometers to meters, and I know 1 kilometer is equal to 1,000 meters, then 5 kilometers equals 5,000 meters. Now, I can add 5,000 meters and 2,500 meters.

Problem 4: Subtract mixed units of length using the algorithm or simplifying strategies.

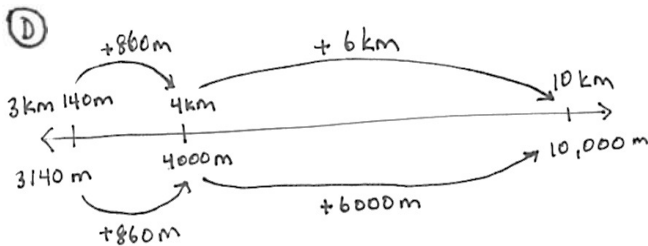
- T: (Display $10 \text{ km} - 3 \text{ km } 140 \text{ m}$ horizontally.) Simplifying strategy or the algorithm? Discuss with a partner.
- S: Oh, for sure, I'm using the algorithm. There are no meters in the number I'm subtracting from. → That's like 10 thousand minus 3 thousand 140. Algorithm for me. → I can do mental math. I'll show you when we solve.
- T: Choose the way you want to do it. You will have two minutes. If you finish before the two minutes are up, try solving it a different way. Let's have two pairs of students work at the board, one pair using the algorithm and one pair recording a simplifying strategy.

After two minutes, review the student work on the board, which hopefully includes strategies such as those below. If not, gently supplement or provide alternative solutions as shown below. Solutions A and B use the algorithms. Solutions C and D are simplifying strategies.

$$\textcircled{A} \begin{array}{r} 9 \text{ km } 1000 \text{ m} \\ - 3 \text{ km } 140 \text{ m} \\ \hline 6 \text{ km } 860 \text{ m} \end{array}$$

$$\textcircled{B} \begin{array}{r} 9 \text{ km } 1000 \text{ m} \\ - 3 \text{ km } 140 \text{ m} \\ \hline 6 \text{ km } 860 \text{ m} \end{array}$$

$$\textcircled{C} \begin{array}{l} 10 \text{ km} - 3 \text{ km } 140 \text{ m} \\ 10 \text{ km} - 3 \text{ km} = 7 \text{ km} \\ 7 \text{ km} - 140 \text{ m} = 6 \text{ km } 860 \text{ m} \\ \swarrow \searrow \\ 6 \text{ km } 1000 \text{ m} \\ \quad 860 \end{array}$$



$$\begin{array}{l} 860 \text{ m} + 6 \text{ km} = 6 \text{ km } 860 \text{ m} \\ 860 \text{ m} + 6000 \text{ m} = 6,860 \text{ m} \end{array}$$

$$\textcircled{E} \begin{array}{c} 3 \text{ km } 140 \text{ m} \xrightarrow{+860 \text{ m}} 4 \text{ km} \xrightarrow{+6 \text{ km}} 10 \text{ km} \\ 860 \text{ m} + 6 \text{ km} = 6 \text{ km } 860 \text{ m} \end{array}$$

- T: Look at Solution A. How did they set up to solve using the algorithm?
- S: They converted everything to meters.
- T: What did they do in Solution B?
- S: They renamed 1 kilometer for 1,000 meters right away.
- T: What happened in Solution C?
- S: They subtracted the 3 kilometers first.
- T: And then?
- S: Subtracted the meters from 1 kilometer after renaming 1 kilometer as 1,000 meters.
- T: Does anyone have a question for the mental math team?



A NOTE ON STANDARDS ALIGNMENT:

The concept of converting the answer into mixed units reaches beyond the fourth-grade standard. For those students working above grade level, acknowledge the conversion. Students working at or below grade level are not expected to convert their answers.

- S: How did you know 1 thousand minus 140 was 860?
- S: We just subtracted 1 hundred and then thought of 40 less than 900. We know 6 tens and 4 tens is 1 hundred, so it wasn't too hard.
- T: What about Solution D?
- S: They used a number line to show a counting up strategy. It's like Solution E. They just represented it in a different way.
- T: And Solution E?
- S: They counted up from 3 km 140 m to 4 km first and then added 6 more km to get to 10 km.
- T: With your partner, take a moment to review the solution strategies on the board. Tell your partner why 6 km 860 m is equal to 6,860 m.
- S: The number line team showed 6 km 860 m is equal to 6,860 m by matching kilometers to meters.
 → You can regroup 6 kilometers as 6,000 meters. → You can regroup 6,000 meters as 6 kilometers.
 → Both are the same amounts, but they are represented using different units, either mixed or a single unit.

Problem 5: Solve a word problem involving mixed units of length using the algorithm or simplifying strategies.

Sam practiced his long jump in P.E. On his first attempt, he jumped 1 meter 47 centimeters. On his second attempt, he jumped 98 centimeters. How much farther did Sam jump on his first attempt than his second?

- T: Take two minutes with your partner to draw a tape diagram to model this problem. (Circulate as students work.)
- T: Your diagrams show a comparison between two values. How can you solve for the unknown?
- S: Subtract 98 cm from 1 m 47 cm.
- T: Will you use the algorithm or a simplifying strategy?

As before, invite two pairs to the board to solve as others work at their desks. Solution A shows the algorithm. Solutions B, C, and D show simplifying strategies.

(A) $1\text{ m} = 100\text{ cm}$
 $1\text{ m } 47\text{ cm} = 100\text{ cm} + 47\text{ cm}$
 $\quad\quad\quad - 98\text{ cm}$
 $\quad\quad\quad \hline 49\text{ cm}$

(B) $1\text{ m } 47\text{ cm} - 98\text{ cm}$
 $\quad\quad\quad 1\text{ m}$
 $\quad\quad\quad \downarrow$
 $100\text{ cm} - 98\text{ cm} = 2\text{ cm}$
 $47\text{ cm} + 2\text{ cm} = 49\text{ cm}$

(C) $147\text{ cm} - 98\text{ cm} = 49\text{ cm}$

(D) $98\text{ cm} \xrightarrow{+2\text{ cm}} 1\text{ m} \xrightarrow{+47\text{ cm}} 1\text{ m } 47\text{ cm}$
 $J = 49\text{ cm}$

Sam jumped 49 cm farther on his first attempt.

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. Some problems do not specify a method for solving. This is an intentional reduction of scaffolding that invokes MP.5, Use Appropriate Tools Strategically. Students should solve these problems using the RDW approach used for Application Problems.

For some classes, it may be appropriate to modify the assignment by specifying which problems students should work on first. With this option, let the purposeful sequencing of the Problem Set guide the selections so that problems continue to be scaffolded. Balance word problems with other problem types to ensure a range of practice. Consider assigning incomplete problems for homework or at another time during the day.

Student Debrief (10 minutes)

Lesson Objective: Express metric length measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric length.

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.

Any combination of the questions below may be used to lead the discussion.

- What pattern did you notice in the equivalences for Problems 1 and 2 of the Problem Set? How did converting 1 kilometer to 1,000 meters in Problem 1(a) help you to solve Problem 2(a)?
- How did solving Problem 2 prepare you to solve Problem 3?
- For Problem 3, Parts (c) and (d), explain how you found your answer in terms of the smaller of the two units. What challenges did you face?

Name Jack Date _____

1. Convert the measurements.

a. 1 km = <u>1,000</u> m	e. 1 m = <u>100</u> cm
b. 4 km = <u>4,000</u> m	f. 3 m = <u>300</u> cm
c. 7 km = <u>7,000</u> m	g. 80 m = <u>8,000</u> cm
d. <u>18</u> km = 18,000 m	h. <u>120</u> m = 12,000 cm

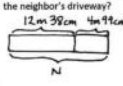
2. Convert the measurements.

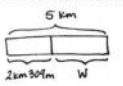
a. 3 km 312 m = <u>3,312</u> m	d. 3 m 56 cm = <u>356</u> cm
b. 13 km 27 m = <u>13,027</u> m	e. 14 m 8 cm = <u>1,408</u> cm
c. 915 km 8 m = <u>915,008</u> m	f. 120 m 46 cm = <u>12,046</u> cm

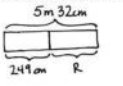
3. Solve.

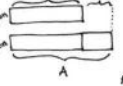
a. $4 \text{ km} - 280 \text{ m} = 3 \text{ km } 720 \text{ m}$ $280 \text{ m} \xrightarrow{+20 \text{ m}} 300 \text{ m} \xrightarrow{+700 \text{ m}} 1 \text{ km} \xrightarrow{+3 \text{ km}} 4 \text{ km}$	b. $1 \text{ m } 15 \text{ cm} - 34 \text{ cm} = 81 \text{ cm}$ $\begin{array}{r} 1 \text{ m } 15 \text{ cm} \\ - 34 \text{ cm} \\ \hline 81 \text{ cm} \end{array}$
c. Express your answer in the smaller unit: $1 \text{ km } 431 \text{ m} + 13 \text{ km } 169 \text{ m} = 14,600 \text{ m}$ $\begin{array}{r} 1,431 \text{ m} \\ + 13,169 \text{ m} \\ \hline 14,600 \text{ m} \end{array}$	d. Express your answer in the smaller unit: $231 \text{ m } 31 \text{ cm} - 14 \text{ m } 48 \text{ cm} = 21,683 \text{ cm}$ $\begin{array}{r} 231 \text{ m } 31 \text{ cm} \\ - 14 \text{ m } 48 \text{ cm} \\ \hline 21,683 \text{ cm} \end{array}$
e. $67 \text{ km } 230 \text{ m} + 11 \text{ km } 879 \text{ m} = 79 \text{ km } 109 \text{ m}$ $\begin{array}{r} 67 \text{ km } 230 \text{ m} \\ + 11 \text{ km } 879 \text{ m} \\ \hline 78 \text{ km } 1109 \text{ m} \\ \hline 1000 \text{ m} \end{array}$	f. $67 \text{ km } 230 \text{ m} - 11 \text{ km } 879 \text{ m} = 55 \text{ km } 351 \text{ m}$ $\begin{array}{r} 67 \text{ km } 230 \text{ m} \\ - 11 \text{ km } 879 \text{ m} \\ \hline 55 \text{ km } 351 \text{ m} \end{array}$

Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

4. The length of Carter's driveway is 12 m 38 cm. His neighbor's driveway is 4 m 99 cm longer. How long is the neighbor's driveway?

 $\begin{array}{r} 12 \text{ m } 38 \text{ cm} \\ + 4 \text{ m } 99 \text{ cm} \\ \hline 16 \text{ m } 137 \text{ cm} \\ \hline 160 \text{ cm} \end{array}$
 The neighbor's driveway is 17 m 37 cm long.

5. Enya walked 2 km 309 m from school to the store. Then she walked from the store to her home. If she walked a total of 5 km, how far was it from the store to her home?

 $\begin{array}{r} 2 \text{ km } 309 \text{ m} \\ + 2 \text{ km } 400 \text{ m} \\ + 600 \text{ m} \\ \hline 3 \text{ km} \\ + 2 \text{ km} \\ \hline 5 \text{ km} \end{array}$
 W = 2 km 691 m
 It is 2 km 691 m from the store to Enya's home.

6. Rachael has a rope 5 m 32 cm long that she cut into two pieces. One piece is 249 cm long. How many centimeters long is the other piece of rope?

 $\begin{array}{r} 5 \text{ m } 32 \text{ cm} \\ - 249 \text{ cm} \\ \hline 4 \text{ m } 83 \text{ cm} \\ - 249 \text{ cm} \\ \hline 283 \text{ cm} \end{array}$
 The other piece of rope is 283 cm.

7. Jason rode his bike 529 fewer meters than Allison. Jason rode 1 km 850 m. How many meters did Allison ride?

 $\begin{array}{r} 1 \text{ km } 850 \text{ m} \\ + 529 \text{ m} \\ \hline 1,850 \text{ m} \\ + 529 \text{ m} \\ \hline 2,379 \text{ m} \end{array}$
 Allison rode 2,379 m.

- When adding and subtracting **mixed units** of length, what are two ways that you can solve the problem? Explain to your partner.
- How did solving Problems 1, 2, and 3 help you to solve the rest of the problems on the Problem Set?
- Look at Problem 5 in the Concept Development. How did you draw your tape diagram? Explain to your partner how you solved this problem.
- What new math vocabulary did we use today to communicate precisely?
- How did the Application Problem connect to today's lesson?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

Name _____

Date _____

1. Convert the measurements.

a. $1 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

b. $4 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

c. $7 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

d. $\underline{\hspace{2cm}} \text{ km} = 18,000 \text{ m}$

e. $1 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

f. $3 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

g. $80 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

h. $\underline{\hspace{2cm}} \text{ m} = 12,000 \text{ cm}$

2. Convert the measurements.

a. $3 \text{ km } 312 \text{ m} = \underline{\hspace{2cm}} \text{ m}$

b. $13 \text{ km } 27 \text{ m} = \underline{\hspace{2cm}} \text{ m}$

c. $915 \text{ km } 8 \text{ m} = \underline{\hspace{2cm}} \text{ m}$

d. $3 \text{ m } 56 \text{ cm} = \underline{\hspace{2cm}} \text{ cm}$

e. $14 \text{ m } 8 \text{ cm} = \underline{\hspace{2cm}} \text{ cm}$

f. $120 \text{ m } 46 \text{ cm} = \underline{\hspace{2cm}} \text{ cm}$

3. Solve.

a. $4 \text{ km} - 280 \text{ m}$

b. $1 \text{ m } 15 \text{ cm} - 34 \text{ cm}$

c. Express your answer in the smaller unit:
 $1 \text{ km } 431 \text{ m} + 13 \text{ km } 169 \text{ m}$

d. Express your answer in the smaller unit:
 $231 \text{ m } 31 \text{ cm} - 14 \text{ m } 48 \text{ cm}$

e. $67 \text{ km } 230 \text{ m} + 11 \text{ km } 879 \text{ m}$

f. $67 \text{ km } 230 \text{ m} - 11 \text{ km } 879 \text{ m}$

Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

4. The length of Carter's driveway is 12 m 38 cm. His neighbor's driveway is 4 m 99 cm longer. How long is his neighbor's driveway?

5. Enya walked 2 km 309 m from school to the store. Then, she walked from the store to her home. If she walked a total of 5 km, how far was it from the store to her home?

6. Rachael has a rope 5 m 32 cm long that she cut into two pieces. One piece is 249 cm long. How many centimeters long is the other piece of rope?

7. Jason rode his bike 529 fewer meters than Allison. Jason rode 1 km 850 m. How many meters did Allison ride?

Name _____

Date _____

1. Complete the conversion table.

Distance	
71 km	_____ m
_____ km	30,000 m
81 m	_____ cm
_____ m	400 cm

2. $13 \text{ km } 20 \text{ m} = \underline{\hspace{2cm}} \text{ m}$

3. $401 \text{ km } 101 \text{ m} - 34 \text{ km } 153 \text{ m} = \underline{\hspace{2cm}}$

4. Gabe built a toy tower that measured 1 m 78 cm. After building some more, he measured it, and it was 82 cm taller. How tall is his tower now? Draw a tape diagram to model this problem. Use a simplifying strategy or an algorithm to solve, and write your answer as a statement.

Name _____

Date _____

1. Find the equivalent measures.

a. $5 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

b. $13 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

c. $\underline{\hspace{2cm}} \text{ km} = 17,000 \text{ m}$

d. $60 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

e. $7 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

f. $19 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

g. $\underline{\hspace{2cm}} \text{ m} = 2,400 \text{ cm}$

h. $90 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$

2. Find the equivalent measures.

a. $7 \text{ km } 123 \text{ m} = \underline{\hspace{2cm}} \text{ m}$

b. $22 \text{ km } 22 \text{ m} = \underline{\hspace{2cm}} \text{ m}$

c. $875 \text{ km } 4 \text{ m} = \underline{\hspace{2cm}} \text{ m}$

d. $7 \text{ m } 45 \text{ cm} = \underline{\hspace{2cm}} \text{ cm}$

e. $67 \text{ m } 7 \text{ cm} = \underline{\hspace{2cm}} \text{ cm}$

f. $204 \text{ m } 89 \text{ cm} = \underline{\hspace{2cm}} \text{ cm}$

3. Solve.

a. $2 \text{ km } 303 \text{ m} - 556 \text{ m}$

b. $2 \text{ m} - 54 \text{ cm}$

c. Express your answer in the smaller unit:
 $338 \text{ km } 853 \text{ m} + 62 \text{ km } 71 \text{ m}$

d. Express your answer in the smaller unit:
 $800 \text{ m } 35 \text{ cm} - 154 \text{ m } 49 \text{ cm}$

e. $701 \text{ km} - 523 \text{ km } 445 \text{ m}$

f. $231 \text{ km } 811 \text{ m} + 485 \text{ km } 829 \text{ m}$

Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

4. The length of Celia's garden is 15 m 24 cm. The length of her friend's garden is 2 m 98 cm more than Celia's. What is the length of her friend's garden?

5. Sylvia ran 3 km 290 m in the morning. Then, she ran some more in the evening. If she ran a total of 10 km, how far did Sylvia run in the evening?

6. Jenny's sprinting distance was 356 meters shorter than Tyler's. Tyler sprinted a distance of 1 km 3 m. How many meters did Jenny sprint?

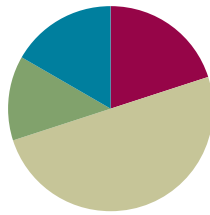
7. The electrician had 7 m 23 cm of electrical wire. He used 551 cm for one wiring project. How many centimeters of wire does he have left?

Lesson 2

Objective: Express metric mass measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric mass.

Suggested Lesson Structure

■ Fluency Practice	(12 minutes)
■ Application Problem	(8 minutes)
■ Concept Development	(30 minutes)
■ Student Debrief	(10 minutes)
Total Time	(60 minutes)



Fluency Practice (12 minutes)

- Convert Units **4.MD.1** (4 minutes)
- Unit Counting **4.MD.1** (4 minutes)
- Add and Subtract Meters and Centimeters **4.MD.2** (4 minutes)

Convert Units (4 minutes)

Materials: (S) Personal white board

Note: Isolated review builds fluency with conversion so that students can use this skill as a tool for solving word problems.

T: (Write $1\text{ m} = \underline{\quad}\text{ cm.}$) 1 meter is how many centimeters?

S: 100 centimeters.

Repeat the process with the following possible sequence: 2 m, 3 m, 9 m, and 6 m.

T: (Write $1,000\text{ g} = \underline{\quad}\text{ kg.}$) 1,000 grams is the same as how many kilograms?

S: 1 kilogram.

Repeat the process with the following possible sequence: 2,000 g, 3,000 g, 7,000 g, and 5,000 g.



A NOTE ON STANDARDS ALIGNMENT:

In Module 2, students convert metric mass units to add and subtract mixed units. This lesson builds on the content of **2.MD.5** and **3.MD.2**.

Occasionally, students work beyond the **4.MD.1** and **4.MD.2** standards by converting from a smaller unit to a larger unit. They do this by creating a connection between metric units and place value units.

Develop students' basic number sense to make these conversions, and always accept answers in the smaller unit.



NOTES ON MULTIPLE MEANS OF REPRESENTATION:

Use color to customize the presentation of the Convert Units activity. Enhance learners' perception of the information by consistently displaying meters in one color (e.g., red), while displaying centimeters in a different color (e.g., green). In addition, use color to distinguish the two parts of the number bond.

T: (Project a number bond with 2 kg written as the whole, 1 kg as one of the parts, and ____ g as the other part.) Fill in the unknown part.

S: (Write a number bond with 2 kg as the whole, 1 kg as one of the parts, and 1,000 g as the other part.)

T: Write the whole as an addition sentence with mixed units.

S: (Write $1 \text{ kg} + 1,000 \text{ g} = 1 \text{ kg} + 1 \text{ kg} = 2 \text{ kg}$.)

Repeat the process with the following possible sequence: $3 \text{ kg} = 2 \text{ kg} + 1,000 \text{ g}$ and $5 \text{ kg} = 4 \text{ kg} + 1,000 \text{ g}$.

Unit Counting (4 minutes)

Note: This fluency activity deepens student understanding of the composition and decomposition of unit conversions, laying a foundation for adding and subtracting meters and centimeters. The numbers in bold type indicate the point at which the direction of the counting changes.

Direct students to count by 50 cm in the following sequence, letting them know with gestures when to change direction in counting:

- 50 cm, 100 cm, 150 cm, 200 cm, 250 cm, **300 cm**, 250 cm, 200 cm, 150 cm, 100 cm, 50 cm.
- 50 cm, 1 m, 150 cm, 2 m, 250 cm, **3 m**, 250 cm, 2 m, 150 cm, 1 m, 50 cm.
- 50 cm, 1 m, 1 m 50 cm, 2 m, 2 m 50 cm, **3 m**, 2 m 50 cm, 2 m, 1 m 50 cm, 1 m, 50 cm.

Add and Subtract Meters and Centimeters (4 minutes)

Materials: (S) Personal white board

Note: Reviewing this concept from Lesson 1 helps students work towards mastery of adding and subtracting meters and centimeters.

T: (Write $540 \text{ cm} + 320 \text{ cm} = \underline{\hspace{2cm}}$.) Say 540 centimeters in meters and centimeters.

S: 5 meters 40 centimeters.

T: (Write 5 m 40 cm below 540 cm.) Say 320 centimeters in meters and centimeters.

S: 3 meters 20 centimeters.

T: (Write 3 m 20 cm below 320 cm.) Add the meters.

S: 5 meters + 3 meters = 8 meters.

T: (Write $5 \text{ m } 40 \text{ cm} + 3 \text{ m } 20 \text{ cm} = \underline{\hspace{2cm}}$.) Add the centimeters.

S: 40 centimeters + 20 centimeters = 60 centimeters.

T: (Write 8 m 60 cm as the sum on the line.) Say the addition sentence in centimeters.

S: 540 centimeters + 320 centimeters = 860 centimeters.

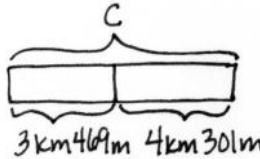
T: (Write $420 \text{ cm} + 350 \text{ cm} = \underline{\hspace{2cm}}$.) On your personal white board, write $420 \text{ cm} + 350 \text{ cm}$ by representing each number of centimeters as meters and centimeters, and then combining meters and centimeters.

S: (Write $4 \text{ m } 20 \text{ cm} + 3 \text{ m } 50 \text{ cm} = 7 \text{ m } 70 \text{ cm}$.)

Repeat the process with the following possible sequence: $650 \text{ cm} - 140 \text{ cm}$ and $780 \text{ cm} - 210 \text{ cm}$.

Application Problem (8 minutes)

The distance from school to Zoie's house is 3 kilometers 469 meters. Camie's house is 4 kilometers 301 meters farther away from Zoie's. How far is it from Camie's house to school? Solve using an algorithm or a simplifying strategy.



Algorithm

$$\begin{array}{r} 3,469 \text{ m} \\ + 4,301 \text{ m} \\ \hline 7,770 \text{ m} \end{array}$$

Simplifying Strategy

$$469 \text{ m} + 301 \text{ m} = 470 \text{ m} + 300 \text{ m} = 770 \text{ m}$$

$\begin{array}{c} \wedge \\ 1 \quad 300 \end{array}$

$$3 \text{ km} + 4 \text{ km} = 7 \text{ km} \quad C = 7 \text{ km} 770 \text{ m}$$

Camie's house is 7,770 meters from school.

Note: This Application Problem reviews Lesson 1. Students express a metric measurement in a larger unit in terms of a smaller unit and model and solve an addition word problem involving kilometers and meters. Be sure to discuss why 7,770 m and 7 km 770 m are the same.

Concept Development (30 minutes)

Materials: (T) 1-liter water bottle, 1,000 small paper clips, dollar bill, dictionary, balance scale, weights (1 kg and 1 g) (S) Personal white board

Problem 1: Convert kilograms to grams.

Display the words *weight* and *mass*.

- T: (Hold up a 1-liter bottle of water.) This bottle of water weighs 1 kilogram. We can also say that it has a **mass** of 1 kilogram. This is what a scientist would say.
- T: (Hold up the dictionary.) This dictionary weighs about 1 kilogram.
- T: (Hold up the paperclip.) The mass of this small paperclip is about 1 gram. A dollar bill weighs about 1 gram, too.
- T: (Write on the board: 1 kilogram = 1,000 grams.) If the mass of this dictionary is about 1 kilogram, about how many small paperclips will be as heavy as this dictionary?
- S: 1,000 paper clips.



NOTES ON TERMINOLOGY:

Mass is a fundamental measure of the amount of matter in an object. While weight is a measurement that depends upon the force of gravity (one would weigh less on the Moon than one does on Earth), mass does not depend upon the force of gravity. We use both words here, but it is not important for students to recognize the distinction at this time.

Take one minute to balance 1 dictionary and 1,000 small paperclips on a scale. Alternatively, use a 1-kilogram mass weight. Also balance 1 small paperclip and a 1-gram weight.

T: Let's use a chart to show the relationship between kilograms and grams.

T: (Display a two-column chart, and fill it in together.)

MP.8 We know that 1 kilogram equals 1,000 grams.

T: How many grams is 2 kilograms?

S: 2,000 g.

T: How many kilograms is 3,000 grams?

S: 3 kg.

Continue up to 10 kilograms.

T: Compare kilograms and grams.

S: A kilogram is heavier because we need 1,000 grams to equal 1 kilogram. → 1 kilogram is 1,000 times as much as 1 gram.

T: (Display 1 kg 500 g = _____ g.) Let's convert 1 kg 500 g to grams. 1 kilogram is equal to how many grams?

S: 1,000 grams.

T: 1,000 grams plus 500 grams is 1,500 grams. (Fill in the blank.)

T: (Display 1 kg 300 g = ____ g.) 1 kg 300 g is equal to how many grams?

S: 1,300 grams.

Repeat with 5 kg 30 g. (Anticipate the incorrect answer of 530 g.)

T: 2,500 grams is equal to how many kilograms?

S: 2 kg 500 g. We made two groups of 1,000 grams, so we have 2 kilograms and 500 grams.

Repeat with 5,005 g.

Problem 2: Add mixed units of mass using the algorithm or a simplifying strategy.

T: (Display 8 kg + 8,200 g horizontally.) Talk for one minute with your partner about how to solve this problem.

S: We can't add different units together. → We can convert the kilograms to grams before adding. We can rename 8 kg to 8,000 g. 8,000 g + 8,200 g = 16,200 g. → We can rename 8,200 g to 8 kg 200 g.

T: Are you going to use the algorithm or a simplifying strategy?

S: A simplifying strategy!

T: Why?

Mass	
kg	g
1	1,000
2	<u>2,000</u>
<u>3</u>	3,000
4	<u>4,000</u>
<u>5</u>	5,000
<u>6</u>	6,000
7	<u>7,000</u>
8	<u>8,000</u>
<u>9</u>	9,000
10	<u>10,000</u>

- S: There is no regrouping. I can add the numbers easily in my head. $8,200 \text{ g} = 8 \text{ kg } 200 \text{ g}$.
 $8 \text{ kg } 200 \text{ g} + 8 \text{ kg} = 16 \text{ kg } 200 \text{ g}$.

$$\begin{aligned} 8 \text{ kg} + 8,200 \text{ g} \\ 8 \text{ kg} + 8 \text{ kg } 200 \text{ g} &= 16 \text{ kg } 200 \text{ g} \\ 8,000 \text{ g} + 8,200 \text{ g} &= 16,200 \text{ g} = 16 \text{ kg } 200 \text{ g} \end{aligned}$$

- T: (Display $25 \text{ kg } 537 \text{ g} + 5 \text{ kg } 723 \text{ g}$ horizontally.) A simplifying strategy or the algorithm? Discuss with your partner.
- S: I think the algorithm because the numbers are too big.
 → There is regrouping and the numbers are not easy to combine. → I think I can use a simplifying strategy.
- T: Choose the way you want to do it. You will have two minutes. If you finish before the two minutes are up, try solving it a different way. Let's have two pairs of students work at the board, one pair using the algorithm, one pair recording a simplifying strategy.



NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Vary your demands and provide supportive tools (e.g., calculators) to students as they meet the challenge of regrouping, conversions, and two methods of solving. Students working below grade level may benefit from mastering one method of solving first. Or, consider altering the degree of difficulty of the computations.

After two minutes, review the student work on the board, which hopefully includes strategies such as those below. If not, gently supplement or provide alternative solutions such as the ones below. Solutions A and B use an algorithm. Solutions C and D are simplifying strategies.

<p>(A)</p> $\begin{array}{r} 25 \text{ kg } 537 \text{ g} \\ + 5 \text{ kg } 723 \text{ g} \\ \hline 30 \text{ kg } 1260 \text{ g} \\ \quad \quad \quad \uparrow \\ \quad \quad \quad 1 \text{ kg } 260 \text{ g} \\ \hline 31 \text{ kg } 260 \text{ g} \end{array}$	<p>(B)</p> $\begin{array}{r} 25,537 \text{ g} \\ + 5,723 \text{ g} \\ \hline 31,260 \text{ g} \end{array}$	<p>(C)</p> $\begin{aligned} 25 \text{ kg} + 5 \text{ kg} &= 30 \text{ kg} \\ 537 \text{ g} + 723 \text{ g} &= 530 \text{ g} + 730 \text{ g} \\ \quad \quad \quad \uparrow \quad \quad \quad \uparrow \\ \quad \quad \quad 530 \text{ g} \quad \quad &= 1,260 \text{ g} \\ \quad \quad \quad \quad \quad \quad \uparrow \\ \quad \quad \quad \quad \quad \quad 1 \text{ kg } 260 \text{ g} \\ 30 \text{ kg} + 1 \text{ kg} + 260 \text{ g} &= 31 \text{ kg } 260 \text{ g} \end{aligned}$	<p>(D)</p> $\begin{aligned} 537 \text{ g} + 723 \text{ g} &= 1,200 \text{ g} + 60 \text{ g} \\ \quad \quad \quad \uparrow \quad \quad \quad \uparrow \\ 500 \quad 37 \quad 700 \quad 23 &= 1,260 \text{ g} \\ \quad \quad \quad \quad \quad \quad \uparrow \\ \quad \quad \quad \quad \quad \quad 1,000 \text{ g} \quad 260 \text{ g} \\ 25 \text{ kg} + 5 \text{ kg} + 1 \text{ kg} + 260 \text{ g} &= 31 \text{ kg } 260 \text{ g} \end{aligned}$
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Note: Students have been learning numerous simplifying strategies since Grade 1. These are only two of the strategies they may have learned. Encourage students to compare their strategies as they work through each problem they solve mentally.

Problem 3: Subtract mixed units of mass using the algorithm or a simplifying strategy.

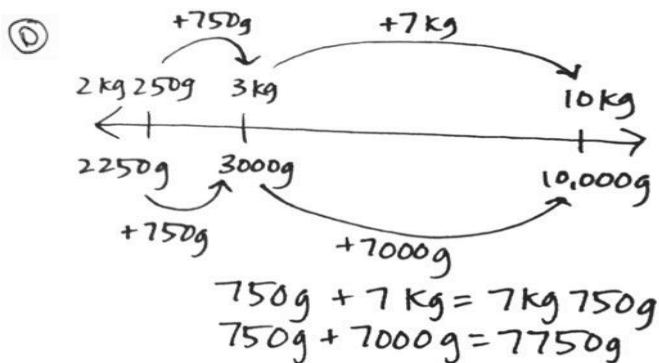
- T: (Display $10 \text{ kg} - 2 \text{ kg } 250 \text{ g}$ horizontally.) A simplifying strategy or the algorithm? Discuss with a partner.
- S: There are no grams in the number I'm subtracting from, so I'm going to use the algorithm. → This is like 10 thousand minus 2 thousand 250. I'm going to use the algorithm, because there is a lot of regrouping. → I think I can do this with a simplifying strategy, because we are subtracting from 10 kg.

T: Choose the way you want to do it. You will have two minutes. If you finish before two minutes is up, try solving the other way. Let's have two pairs of students work at the board, one pair using the algorithm, one pair recording a simplifying strategy.

$$\begin{array}{r} \textcircled{A} \\ 9 \text{ kg} \\ 10 \text{ kg} \\ - 2 \text{ kg} \\ \hline 7 \text{ kg} \end{array} \quad \begin{array}{r} 1,000 \text{ g} \\ 250 \text{ g} \\ \hline 750 \text{ g} \end{array}$$

$$\begin{array}{r} \textcircled{B} \\ 9 \text{ kg} \\ 10 \text{ kg} \\ - 2,250 \text{ g} \\ \hline 7,750 \text{ g} \end{array}$$

$$\begin{array}{r} \textcircled{C} \\ 10 \text{ kg} - 2 \text{ kg} = 8 \text{ kg} \\ 8 \text{ kg} - 250 \text{ g} = 7 \text{ kg } 750 \text{ g} \end{array}$$



\textcircled{E}

$$2 \text{ kg } 250 \text{ g} \xrightarrow{+750 \text{ g}} 3 \text{ kg} \xrightarrow{+7 \text{ kg}} 10 \text{ kg}$$

$$750 \text{ g} + 7 \text{ kg} = 7 \text{ kg } 750 \text{ g}$$

After two minutes, review the student work on the board, which hopefully includes strategies such as those above. If not, gently supplement or provide alternative solutions such as the ones shown above. Solutions A and B use an algorithm. Solutions C, D, and E are simplifying strategies.

- T: Look at the first algorithm used by your peers. How did they prepare the problem for subtraction?
 S: They renamed 10 kilograms as 9 kilograms and 1,000 grams first.
 T: What did they do in their second solution?
 S: Converted kilograms to grams.
 T: How did our first simplifying strategy pair solve the problem?
 S: They subtracted the 2 kilograms first.
 T: And then?
 S: Subtracted the 250 grams from 1 kilogram.
 T: Does anyone have a question for the simplifying strategy math team?
 S: How did you know 1 thousand minus 250 was 750?
 S: We just subtracted 2 hundred from 1 thousand and then thought of 50 less than 800.
 T: How did the next simplifying strategies team solve the problem?
 S: They added up from 2 kilograms 250 grams to 3 kilograms first, and then added 7 more kilograms to get to 10 kilograms.

- T: What does the number line show?
- S: It shows how we can count up from 2 kilograms 250 grams to 10 kilograms to find our answer. It also shows that 7 kilograms 750 grams is equivalent to 7,750 grams.
- T: With your partner, take a moment to review the solution strategies on the board.
- T: (Display $32 \text{ kg } 205 \text{ g} - 5 \text{ kg } 316 \text{ g}$ horizontally.) A simplifying strategy or the algorithm? Discuss with a partner.
- S: Those numbers are not easy to subtract. I'm going to use the algorithm. → Definitely the algorithm. There are not enough grams in the first number, so I know we will have to regroup.
- T: Choose the way you want to do it and solve.

$$32 \text{ kg } 205 \text{ g} - 5 \text{ kg } 316 \text{ g}$$

$\begin{array}{r} \text{ kg } \text{ g} \\ 2 \text{ kg } \text{ g} \\ \underline{32 \text{ kg } 205 \text{ g}} \\ - 5 \text{ kg } 316 \text{ g} \\ \hline 26 \text{ kg } 889 \text{ g} \end{array}$	$\begin{array}{r} \text{ kg } \text{ g} \\ 32 \text{ kg } \text{ g} \\ \underline{32 \text{ kg } 205 \text{ g}} \\ - 5 \text{ kg } 316 \text{ g} \\ \hline 26 \text{ kg } 889 \text{ g} \end{array}$
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Note: Not all problems are easily solved using a simplifying strategy. Encourage students to evaluate the problem carefully to determine the most efficient course for solving problems.

Problem 4: Solve a word problem involving mixed units of mass, modeled with a tape diagram.

A suitcase cannot weigh more than 23 kilograms for a flight. Robert packed his suitcase for his flight, and it weighs 18 kilograms 705 grams. How many more grams can he add to his suitcase without going over the weight limit?

- T: Read with me. Take one minute to draw and label a tape diagram. (Allow students time to work.)
- T: Tell your partner the known and unknown information.
- S: We know how much Robert's suitcase is allowed to weigh and how much it already weighs. We don't know how many more grams it can hold to reach the maximum allowed weight of 23 kilograms.
- T: Will you use the algorithm or a simplifying strategy? Label the unknown part on your diagram and make a statement of the solution.

(A)

(B)

$$\begin{array}{r} \text{ kg } \text{ g} \\ 23 \text{ kg } \text{ g} \\ \underline{18 \text{ kg } 705 \text{ g}} \\ 4 \text{ kg } 295 \text{ g} \end{array}$$

4,295g

(C)

$$18 \text{ kg } 705 \text{ g} \xrightarrow{+295 \text{ g}} 19 \text{ kg} \xrightarrow{+4 \text{ kg}} 23 \text{ kg}$$

$295 \text{ g} + 4 \text{ kg} = 4 \text{ kg } 295 \text{ g}$
4,295g

Robert can add 4,295 more grams to his suitcase.

Circulate, reviewing the students' work, which hopefully includes strategies such as those above. If not, gently supplement. Solutions A and B use the algorithm. Solution C is a simplifying strategy.

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 should solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Express metric mass measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric mass.

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.

Any combination of the questions below may be used to lead the discussion.

- In our lesson, we solved addition and subtraction problems two different ways but got equivalent answers. Is one answer better than the other? Why or why not?
- What did you do differently in Problem 3 when it asked you to express the answer in the smaller unit versus in mixed units?
- In Problem 6, did it make sense to answer in the smallest unit or mixed units? Why? When might it be better to answer in the smallest unit?
- Explain to your partner how you solved Problem 7. Was there more than one way to solve it?
- How did the Application Problem connect to today's lesson?
- How did today's lesson of weight conversions build on yesterday's lesson of length conversions?

Name Jack Date _____

1. Complete the conversion table.

Mass	
kg	g
1	1,000
3	3,000
4	4,000
17	17,000
20	20,000
300	300,000

2. Convert the measurements.

a. 1 kg 500 g = 1,500 g
b. 3 kg 715 g = 3,715 g
c. 17 kg 84 g = 17,084 g
d. 25 kg 9 g = 25,009 g
e. 7 kg 481 g = 7,481 g
f. 210 kg 90 g = 210,090 g

3. Solve.

a. $3,715 \text{ g} - 1,500 \text{ g} = 2,215 \text{ g}$

$$\begin{array}{r} 3,715 \\ -1,500 \\ \hline 2,215 \end{array}$$

b. $1 \text{ kg} - 237 \text{ g} = 763 \text{ g}$

$$\begin{array}{r} 1,000 \\ -237 \\ \hline 763 \end{array}$$

c. Express the answer in the smaller unit:
 $25 \text{ kg } 9 \text{ g} + 24 \text{ kg } 991 \text{ g} = 50,000 \text{ g}$

$$\begin{array}{r} 25,009 \text{ g} \\ + 24,991 \text{ g} \\ \hline 50,000 \text{ g} \end{array}$$

d. Express the answer in the smaller unit:
 $27 \text{ kg } 650 \text{ g} - 20 \text{ kg } 990 \text{ g} = 6,660 \text{ g}$

$$\begin{array}{r} 27,650 \text{ g} \\ - 20,990 \text{ g} \\ \hline 6,660 \text{ g} \end{array}$$

e. Express the answer in mixed units:
 $14 \text{ kg } 505 \text{ g} - 4,288 \text{ g} = 10 \text{ kg } 217 \text{ g}$

$$\begin{array}{r} 14 \text{ kg } 505 \text{ g} \\ - 4 \text{ kg } 288 \text{ g} \\ \hline 10 \text{ kg } 217 \text{ g} \end{array}$$

f. Express the answer in mixed units:
 $5 \text{ kg } 658 \text{ g} + 57,481 \text{ g} = 63 \text{ kg } 139 \text{ g}$

$$\begin{array}{r} 5 \text{ kg } 658 \text{ g} \\ + 57 \text{ kg } 481 \text{ g} \\ \hline 62 \text{ kg } 1139 \text{ g} \\ \hline 63 \text{ kg } 139 \text{ g} \end{array}$$

Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

4. One package weighs 2 kilograms 485 grams. Another package weighs 5 kilograms 959 grams. What is the total weight of the two packages?

$$\begin{array}{r} 2 \text{ kg } 485 \text{ g} \\ + 5 \text{ kg } 959 \text{ g} \\ \hline 7 \text{ kg } 1444 \text{ g} \\ \hline 1,000 \text{ g} = 1 \text{ kg} \\ \hline 7 \text{ kg } 444 \text{ g} \\ \hline 8 \text{ kg } 444 \text{ g} \end{array}$$

The total weight of the two packages is 8 kg 444 g.

5. Together, a pineapple and a watermelon weigh 6 kilograms 250 grams. If the pineapple weighs 1 kilogram 255 grams, how much does the watermelon weigh?

$$\begin{array}{r} 6 \text{ kg } 250 \text{ g} \\ - 1 \text{ kg } 255 \text{ g} \\ \hline 4 \text{ kg } 975 \text{ g} \end{array}$$

The watermelon weighs 4 kg 975 g.

6. Javier's dog weighs 3,902 grams more than Bradley's dog. Bradley's dog weighs 24 kilograms 175 grams. How much does Javier's dog weigh?

$$\begin{array}{r} 24 \text{ kg } 175 \text{ g} \\ + 3 \text{ kg } 902 \text{ g} \\ \hline 27 \text{ kg } 1077 \text{ g} \\ \hline 1,000 \text{ g} = 1 \text{ kg} \\ \hline 28 \text{ kg } 77 \text{ g} \end{array}$$

Javier's dog weighs 28 kg 77 g.

7. The table to the right shows the weight of three Grade 4 students. How much heavier is Isabel than the lightest student?

Student	Weight
Isabel	35 kg
Irene	29 kg 38 g = 29,038 g
Sue	29,238 g

Isabel is 5 kg 962 g heavier than Irene, the lightest student.

$$\begin{array}{r} 35 \text{ kg} \\ - 29 \text{ kg } 38 \text{ g} \\ \hline 29 \text{ kg } 38 \text{ g} \\ + 29 \text{ kg } 100 \text{ g} \\ \hline 29 \text{ kg } 100 \text{ g} \\ + 20 \text{ kg} \\ \hline 5 \text{ kg } 962 \text{ g} \end{array}$$

- What is **mass**?
- When might we use grams rather than kilograms?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

Name _____

Date _____

1. Complete the conversion table.

Mass	
kg	g
1	1,000
3	
	4,000
17	
	20,000
300	

2. Convert the measurements.

a. $1 \text{ kg } 500 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

b. $3 \text{ kg } 715 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

c. $17 \text{ kg } 84 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

d. $25 \text{ kg } 9 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

e. $\underline{\hspace{1cm}} \text{ kg } \underline{\hspace{1cm}} \text{ g} = 7,481 \text{ g}$

f. $210 \text{ kg } 90 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

3. Solve.

a. $3,715 \text{ g} - 1,500 \text{ g}$

b. $1 \text{ kg} - 237 \text{ g}$

c. Express the answer in the smaller unit:
 $25 \text{ kg } 9 \text{ g} + 24 \text{ kg } 991 \text{ g}$

d. Express the answer in the smaller unit:
 $27 \text{ kg } 650 \text{ g} - 20 \text{ kg } 990 \text{ g}$

e. Express the answer in mixed units:
 $14 \text{ kg } 505 \text{ g} - 4,288 \text{ g}$

f. Express the answer in mixed units:
 $5 \text{ kg } 658 \text{ g} + 57,481 \text{ g}$

Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

4. One package weighs 2 kilograms 485 grams. Another package weighs 5 kilograms 959 grams. What is the total weight of the two packages?



5. Together, a pineapple and a watermelon weigh 6 kilograms 230 grams. If the pineapple weighs 1 kilogram 255 grams, how much does the watermelon weigh?
6. Javier's dog weighs 3,902 grams more than Bradley's dog. Bradley's dog weighs 24 kilograms 175 grams. How much does Javier's dog weigh?

7. The table to the right shows the weight of three Grade 4 students. How much heavier is Isabel than the lightest student?

Student	Weight
Isabel	35 kg
Irene	29 kg 38 g
Sue	29,238 g

Name _____

Date _____

1. Convert the measurements.

a. 21 kg 415 g = _____ g

b. 2 kg 91 g = _____ g

c. 87 kg 17 g = _____ g

d. ____ kg ____ g = 96,020 g

Use a tape diagram to model the following problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

2. The table to the right shows the weight of three dogs. How much more does the Great Dane weigh than the Chihuahua?

Dog	Weight
Great Dane	59 kg
Golden Retriever	32 kg 48 g
Chihuahua	1,329 g

Name _____

Date _____

1. Complete the conversion table.

Mass	
kg	g
1	1,000
6	
	8,000
15	
	24,000
550	

2. Convert the measurements.

a. $2 \text{ kg } 700 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

b. $5 \text{ kg } 945 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

c. $29 \text{ kg } 58 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

d. $31 \text{ kg } 3 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

e. $66,597 \text{ g} = \underline{\hspace{1cm}} \text{ kg } \underline{\hspace{1cm}} \text{ g}$

f. $270 \text{ kg } 41 \text{ g} = \underline{\hspace{2cm}} \text{ g}$

3. Solve.

a. $370 \text{ g} + 80 \text{ g}$

b. $5 \text{ kg} - 730 \text{ g}$

c. Express the answer in the smaller unit:
 $27 \text{ kg } 547 \text{ g} + 694 \text{ g}$

d. Express the answer in the smaller unit:
 $16 \text{ kg} + 2,800 \text{ g}$

e. Express the answer in mixed units:
 $4 \text{ kg } 229 \text{ g} - 355 \text{ g}$

f. Express the answer in mixed units:
 $70 \text{ kg } 101 \text{ g} - 17 \text{ kg } 862 \text{ g}$

Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

4. One suitcase weighs 23 kilograms 696 grams. Another suitcase weighs 25 kilograms 528 grams. What is the total weight of the two suitcases?

5. A bag of potatoes and a bag of onions combined weigh 11 kilograms 15 grams. If the bag of potatoes weighs 7 kilograms 300 grams, how much does the bag of onions weigh?

6. The table to the right shows the weight of three dogs. What is the difference in weight between the heaviest and lightest dog?

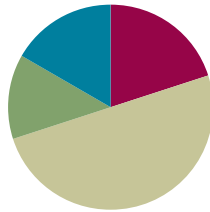
Dog	Weight
Lassie	21 kg 249 g
Riley	23 kg 128 g
Fido	21,268 g

Lesson 3

Objective: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity.

Suggested Lesson Structure

■ Fluency Practice	(12 minutes)
■ Application Problem	(8 minutes)
■ Concept Development	(30 minutes)
■ Student Debrief	(10 minutes)
Total Time	(60 minutes)



NOTES ON STANDARDS ALIGNMENT:

In Module 2, students convert metric capacity units to add and subtract mixed units. This lesson builds on the content of **2.MD.5** and **3.MD.2**.

Occasionally, students work beyond the **4.MD.1** and **4.MD.2** standards by converting from a smaller unit to a larger unit. They do this by connecting metric units to place value units.

Develop students' basic number sense to make these conversions, and always accept answers in the smaller unit.

Fluency Practice (12 minutes)

- Convert Units **4.MD.1** (3 minutes)
- Unit Counting **4.MD.1** (5 minutes)
- Add and Subtract Meters and Centimeters **4.MD.2** (4 minutes)

Convert Units (3 minutes)

Materials: (S) Personal white board

Note: Isolated review builds fluency with conversion so that students can use this skill as a tool for solving word problems.

T: (Write $1\text{ m} = \underline{\hspace{1cm}}\text{ cm}$.) 1 meter is how many centimeters?

S: 100 centimeters.

Repeat the process with the following possible sequence: 2 m, 4 m, 4 m 50 cm, 8 m 50 cm, 8 m 5 cm, and 6 m 35 cm.

T: (Write $1,000\text{ m} = \underline{\hspace{1cm}}\text{ km}$.) 1,000 meters is the same as how many kilometers?

S: 1 kilometer.

Repeat the process with the following possible sequence: 2,000 m, 3,000 m, 6,000 m, and 9,000 m.

T: (Project a number bond with 2 kilometers written as the whole, 1 kilometer as one of the parts, and $\underline{\hspace{1cm}}$ m as the other part.) Fill in the unknown part.

S: (Write a number bond with 2 kilometers as the whole, 1 kilometer as one of the parts, and 1,000 m as the other part.)

T: Write the whole as an addition sentence with mixed units.

S: (Write $1 \text{ km} + 1,000 \text{ m} = 2 \text{ km}$.)

Repeat the process with the following possible sequence: $2 \text{ km} + 1,000 \text{ m} = 3 \text{ km}$ and $1,000 \text{ m} + 7 \text{ km} = 8 \text{ km}$.

Unit Counting (5 minutes)

Note: This fluency activity deepens student understanding of the composition and decomposition of units, laying a foundation for adding and subtracting grams and kilograms. The numbers in bold type indicate the point at which the direction of the counting changes.

Direct students to count by grams in the following sequence, letting them know with gestures when to change direction in counting:

- 500 g, 1,000 g, 1,500 g, 2,000 g, 2,500 g, **3,000 g**, 2,500 g, 2,000 g, 1,500 g, 1,000 g, 500 g
- 500 g, 1 kg, 1,500 g, 2 kg, 2,500 g, **3 kg**, 2,500 g, 2 kg, 1,500 g, 1 kg, 500 g
- 500 g, 1 kg, 1 kg 500 g, 2 kg, 2 kg 500 g, **3 kg**, 2 kg 500 g, 2 kg, 1 kg 500 g, 1 kg, 500 g
- 200 g, 400 g, 600 g, 800 g, 1 kg, 1 kg 200 g, 1 kg 400 g, 1 kg 600 g, 1 kg 800 g, 2 kg
- 600 g, 1,200 g, 1,800 g, 2,400 g, **3 kg**, 2,400 g, 1,800 g, 1,200 g, 600 g
- 600 g, 1 kg 200 g, 1 kg 800 g, 2 kg 400 g, **3 kg**, 2 kg 400 g, 1 kg 800 g, 1 kg 200 g, 600 g

Add and Subtract Meters and Centimeters (4 minutes)

Materials: (S) Personal white board

Note: Reviewing this concept from Lesson 1 helps students work towards mastery of adding and subtracting meters and centimeters.

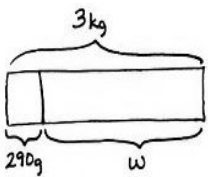
T: Write $560 \text{ cm} + 230 \text{ cm} = \underline{\quad}$. Below it, write $\underline{\quad} \text{ m } \underline{\quad} \text{ cm} + \underline{\quad} \text{ m } \underline{\quad} \text{ cm} = \underline{\quad} \text{ m } \underline{\quad} \text{ cm}$ on your personal white boards. Now, complete the two addition sentences.

S: (Write $560 \text{ cm} + 230 \text{ cm} = 790 \text{ cm}$. Below it, write $5 \text{ m } 60 \text{ cm} + 2 \text{ m } 30 \text{ cm} = 7 \text{ m } 90 \text{ cm}$.)

Repeat the process with the following possible sequence: $650 \text{ cm} - 230 \text{ cm}$ and $470 \text{ cm} + 520 \text{ cm}$.

Application Problem (8 minutes)

A liter of water weighs 1 kilogram. The Lee family took 3 liters of water with them on a hike. At the end of the hike, they had 290 grams of water left. How much water did they drink? Draw a tape diagram, and solve using an algorithm or a simplifying strategy.



The Lee family drank
2 kg 710 g of water.

Algorithm:

$$\begin{array}{r} 2 \text{ kg } 0 \text{ g } 1000 \text{ g} \\ - 290 \text{ g} \\ \hline 2 \text{ kg } 710 \text{ g} \end{array} \qquad \begin{array}{r} 2 \text{ kg } 0 \text{ g } 000 \text{ g} \\ - 290 \text{ g} \\ \hline 2 \text{ kg } 710 \text{ g} \end{array}$$

Simplifying strategy

$$290 \text{ g} \xrightarrow{+10 \text{ g}} 300 \text{ g} \xrightarrow{+700 \text{ g}} 1 \text{ kg} \xrightarrow{2 \text{ kg}} 3 \text{ kg}$$

$$10 \text{ g} + 700 \text{ g} + 2 \text{ kg} = 2 \text{ kg } 710 \text{ g}$$

$$3 \text{ kg} - 290 \text{ g} = 2 \text{ kg } 710 \text{ g}$$

$$\begin{array}{r} 3 \text{ kg} \\ - 290 \text{ g} \\ \hline 2 \text{ kg } 710 \text{ g} \end{array}$$



NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Scaffold constructed responses with sentence frames, such as, “The Lee family drank ____ of water.” Or, have students dictate their responses to a partner. Provide sheets with pre-formatted tape diagrams that can be slipped inside personal white boards, or use virtual manipulatives as an alternative.

Note: This Application Problem reviews working with grams and kilograms from Lesson 2 while connecting to today’s work with liters. Students can express kilograms in terms of grams and subtract to solve a measurement word problem involving a tape diagram. Students may also recall that 1 milliliter of water weighs 1 gram and use this fact to report their answer in liters and milliliters.

Concept Development (30 minutes)

Materials: (T) 3-liter beaker, bucket of water (S) 3-liter graduated beaker (marked with liters and milliliters), bucket of water, personal white board

Note: For Problem 1, students should work in groups of three students each.

Problem 1: Compare the sizes and note the relationship between 1 liter and 1 milliliter.

- T: Point to the mark on your beaker that says 1 liter.
- T: Pour water into your beaker until you reach that amount. Now, how many **milliliters** are in your beaker?
- S: 1,000 mL.
- T: How do you know?
- S: 1 liter is the same as 1,000 milliliters. The beaker shows both measurements on the scale.
- T: (Write $1 \text{ L} = 1,000 \text{ mL}$ on the board.)

- T: What strategies can we use to solve?
- S: We can convert to milliliters before adding. $32 \text{ L } 420 \text{ mL} = 32,420 \text{ mL}$. $13 \text{ L } 585 \text{ mL} = 13,585 \text{ mL}$. The sum is $46,005 \text{ mL}$.
- S: I know that $1,000 \text{ mL} = 1 \text{ L}$, so $46,005 \text{ mL}$ is equivalent to $46 \text{ L } 5 \text{ mL}$.
- S: We can also add the mixed units. $32 \text{ L} + 13 \text{ L} = 45 \text{ L}$. $420 \text{ mL} + 585 \text{ mL} = 1,005 \text{ mL}$. $1,005 \text{ mL}$ is the same as $1 \text{ L } 5 \text{ mL}$. When I add 45 L and $1 \text{ L } 5 \text{ mL}$, I get a sum of $46 \text{ L } 5 \text{ mL}$.
- S: We can also count up. $32 \text{ L } 420 \text{ mL} + 580 \text{ mL} = 33 \text{ L}$. $\rightarrow 33 \text{ L} + 13 \text{ L} = 46 \text{ L}$. $\rightarrow 46 \text{ L} + 5 \text{ mL} = 46 \text{ L } 5 \text{ mL}$.

Problem 3: Subtract mixed units of capacity using the algorithm or a simplifying strategy.

- T: (Display $12 \text{ L } 215 \text{ mL} - 8 \text{ L } 600 \text{ mL}$ horizontally.) A simplifying strategy or the algorithm? Discuss with a partner.
- S: Oh, for sure, I'm using the algorithm. We have to rename a liter. \rightarrow A simplifying strategy. I can count on from 8 liters 600 milliliters. \rightarrow I can do mental math. I'll show you when we solve.
- T: Choose the way you want to do it. I will give you two minutes. If you finish before the two minutes are up, try solving a different way. Let's have two pairs of students work at the board, one pair using the algorithm, one pair recording a simplifying strategy.

(A)

$$\begin{array}{r} 11 \quad 012 \\ 12 \text{ L } 215 \text{ mL} \\ - 8 \text{ L } 600 \text{ mL} \\ \hline 3 \text{ L } 615 \text{ mL} \end{array}$$

(B)

$$\begin{array}{r} 11 \\ 12 \text{ L } 215 \text{ mL} \\ - 8 \text{ L } 600 \text{ mL} \\ \hline 3 \text{ L } 615 \text{ mL} \end{array}$$

(C)

$$\begin{array}{l} 12 \text{ L} - 8 \text{ L} = 4 \text{ L} \\ 4 \text{ L } 215 \text{ mL} - 600 \text{ mL} = 3 \text{ L } 615 \text{ mL} \\ \begin{array}{l} \swarrow \quad \searrow \\ 3000 \text{ mL} \quad 1215 \text{ mL} \\ \quad \quad \quad 615 \text{ mL} \end{array} \end{array}$$

(D)

$$8 \text{ L } 600 \text{ mL} \xrightarrow{+400 \text{ mL}} 9 \text{ L} \xrightarrow{+215 \text{ mL}} 9 \text{ L } 215 \text{ mL} \xrightarrow{+3 \text{ L}} 12 \text{ L } 215 \text{ mL}$$

$$400 \text{ mL} + 215 \text{ mL} + 3 \text{ L} = 3 \text{ L } 615 \text{ mL}$$

(E)

$$\begin{array}{ccc} 8 \text{ L } 600 \text{ mL} & \xrightarrow{+400 \text{ mL}} & 9 \text{ L} \\ & \xrightarrow{+3 \text{ L}} & 12 \text{ L } 215 \text{ mL} \\ & \xrightarrow{+215 \text{ mL}} & 12 \text{ L } 215 \text{ mL} \end{array}$$

$$\begin{array}{ccc} 8600 \text{ mL} & \xrightarrow{+400 \text{ mL}} & 9000 \text{ mL} \\ & \xrightarrow{+3000 \text{ mL}} & 12,000 \text{ mL} \\ & \xrightarrow{+215 \text{ mL}} & 12,215 \text{ mL} \end{array}$$

$$400 \text{ mL} + 3 \text{ L} + 215 \text{ mL} = 3 \text{ L } 615 \text{ mL}$$

$$400 \text{ mL} + 3000 \text{ mL} + 215 \text{ mL} = 3,615 \text{ mL}$$

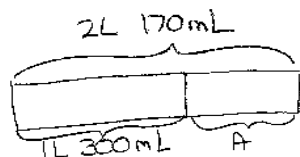
After two minutes, review the student work on the board, which hopefully includes strategies such as those above. If not, gently supplement or provide alternative solutions such as the ones shown above. Solutions A and B use the algorithms. Solutions C, D, and E are simplifying strategies.

- T: Look at the first problem. How did they set it up?
- S: They regrouped 12 liters 215 milliliters as 11 liters 1,215 milliliters.
- T: How is the second problem set up?
- S: They converted to milliliters before solving, and then wrote their answer as a mixed unit.
- T: Does anyone have a question about any of the simplifying strategies?
- S: Why did you convert 4 liters to 4,000 milliliters and combine that with 215 milliliters?
- S: I couldn't subtract 600 from 215, so I converted to milliliters to regroup.
- T: How did counting on work?
- S: You could add to regroup and make a liter and then add enough liters and milliliters to reach the total.
- T: Take a moment to review the solution strategies on the board. Compare the counting up strategies, the number line, and the arrow way.

Problem 4: Solve a word problem involving mixed units of capacity.

Jennifer is making 2,170 milliliters of her favorite drink that combines iced tea and lemonade. If she puts in 1 liter 300 milliliters of iced tea, how much lemonade does she need?

- T: Read with me. Take two minutes to draw and label a tape diagram. (Allow time for students to work.)
- T: Tell your partner the known and unknown information.
- S: We know how much iced tea she puts in and how much of her favorite drink she is making. We don't know how much lemonade she needs.
- MP.1** T: Work with your partner to solve. Will you use a simplifying strategy or an algorithm?
- S: A simplifying strategy. I know that 300 milliliters + 700 milliliters is 1,000 milliliters. That brings us to 2 liters. Then, all I need to do is add 170 milliliters more. $700 \text{ mL} + 170 \text{ mL} = 870 \text{ mL}$.
- T: Label the unknown part on your tape diagram, and make a statement of the solution.
- S: Jennifer needs 870 milliliters of lemonade.



$1\text{L } 300\text{mL} \xrightarrow{+700\text{mL}} 2\text{L} \xrightarrow{+170\text{mL}} 2\text{L } 170\text{mL}$
Jennifer needs 870mL of lemonade.



**NOTES ON
MULTIPLE MEANS
OF ACTION AND
EXPRESSION:**

Help learners develop plans and strategies to solve word problems. Provide a problem-solving checklist that students can use to monitor their steps as they solve.

- T: With your partner, check your answer by using the subtraction algorithm.

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 should solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity.

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. Any combination of the questions below may be used to lead the discussion.

- In Problem 4(a), what was your strategy for ordering the drinks?
- Discuss why you chose to solve Problem 5 using mixed units or converting all units to milliliters.
- Which strategy do you prefer for adding and subtracting mixed units? Why is one way preferable to the other for you?
- What new terms to describe capacity did you learn today?
- What patterns have you noticed about the vocabulary used to measure length, mass, and capacity?
- How did the Application Problem connect to today's lesson?
- Describe the relationship between liters and milliliters.
- How did today's lesson relate to the lessons on mass and length?

Name Jack Date _____

1. Complete the conversion table.

Liquid Capacity	
L	ml
1	1,000
5	5,000
38	38,000
49	49,000
54	54,000
92	92,000

2. Convert the measurements.

- 2 L 500 mL = 2,500 mL
- 70 L 850 mL = 70,850 mL
- 33 L 15 mL = 33,015 mL
- 2 L 8 mL = 2,008 mL
- 3 L 812 mL = 3,812 mL
- 86,003 mL = 86 L 3 mL

3. Solve.

- 1,760 mL + 40 L = 41 L 760 mL

$$\begin{array}{r} 1\text{ L } 760\text{ mL} \\ + 40\text{ L} \\ \hline 41\text{ L } 760\text{ mL} \end{array}$$
- 7 L - 3,400 mL = 3 L 600 mL

$$\begin{array}{r} 7\text{ L} \\ - 3,400\text{ mL} \\ \hline 3\text{ L } 600\text{ mL} \end{array}$$
- Express the answer in the smaller unit:

$$\begin{array}{r} 25\text{ L } 478\text{ mL} \\ + 3\text{ L } 812\text{ mL} \\ \hline 28\text{ L } 1290\text{ mL} \end{array}$$
- Express the answer in mixed units:

$$\begin{array}{r} 7\text{ L } 425\text{ mL} \\ - 547\text{ mL} \\ \hline 6\text{ L } 878\text{ mL} \end{array}$$
- Express the answer in the smaller unit:

$$\begin{array}{r} 21\text{ L } 218\text{ mL} \\ - 2,008\text{ mL} \\ \hline 18,992\text{ mL} \end{array}$$
- Express the answer in mixed units:

$$\begin{array}{r} 31\text{ L } 433\text{ mL} \\ - 12\text{ L } 876\text{ mL} \\ \hline 18\text{ L } 557\text{ mL} \end{array}$$

Directions: Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm and write your answer as a statement.

4. To make fruit punch, John's mother combined 3,500 milliliters of tropical drink, 3 liters 95 milliliters of ginger ale, and 1 liter 600 milliliters of pineapple juice.

- Order the quantity of each drink from least to greatest.

$$\begin{array}{l} 3,500\text{ mL} = 3\text{ L } 500\text{ mL} \text{ (greatest)} \\ 3\text{ L } 95\text{ mL} \text{ (ginger ale)} \\ 1\text{ L } 600\text{ mL} \text{ (pineapple)} \end{array}$$

least
- How much punch did John's mother make?

$$\begin{array}{r} 3\text{ L } 500\text{ mL} \\ 3\text{ L } 95\text{ mL} \\ + 1\text{ L } 600\text{ mL} \\ \hline 7\text{ L } 1195\text{ mL} \\ \hline 7\text{ L } 1195\text{ mL} \end{array}$$

John's mother made 7 L 1195 mL of punch.

5. A family drank 1 liter 210 milliliters of milk at breakfast. If there were 3 liters of milk before breakfast, how much milk is left?


$$\begin{array}{r} 3\text{ L} \\ - 1\text{ L } 210\text{ mL} \\ \hline 1\text{ L } 790\text{ mL} \end{array}$$

There is 1 L 790 mL milk left.

6. Petra's fish tank contains 9 liters 578 milliliters of water. If the capacity of the tank is 12 liters 455 milliliters of water, how many more milliliters of water does she need to fill the tank?

$$\begin{array}{r} 12\text{ L } 455\text{ mL} \\ - 9\text{ L } 578\text{ mL} \\ \hline 2\text{ L } 877\text{ mL} \end{array}$$

She needs 2,877 more milliliters of water.



Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

Name _____

Date _____

1. Complete the conversion table.

Liquid Capacity	
L	mL
1	1,000
5	
38	
	49,000
54	
	92,000

2. Convert the measurements.

a. $2 \text{ L } 500 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

b. $70 \text{ L } 850 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

c. $33 \text{ L } 15 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

d. $2 \text{ L } 8 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

e. $3,812 \text{ mL} = \underline{\hspace{1cm}} \text{ L } \underline{\hspace{1cm}} \text{ mL}$

f. $86,003 \text{ mL} = \underline{\hspace{1cm}} \text{ L } \underline{\hspace{1cm}} \text{ mL}$

3. Solve.

a. $1,760 \text{ mL} + 40 \text{ L}$

b. $7 \text{ L} - 3,400 \text{ mL}$

c. Express the answer in the smaller unit:
 $25 \text{ L } 478 \text{ mL} + 3 \text{ L } 812 \text{ mL}$

d. Express the answer in the smaller unit:
 $21 \text{ L} - 2 \text{ L } 8 \text{ mL}$

e. Express the answer in mixed units:
 $7 \text{ L } 425 \text{ mL} - 547 \text{ mL}$

f. Express the answer in mixed units:
 $31 \text{ L } 433 \text{ mL} - 12 \text{ L } 876 \text{ mL}$

Name _____

Date _____

1. Convert the measurements.

a. $6 \text{ L } 127 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

b. $706 \text{ L } 220 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

c. $12 \text{ L } 9 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

d. $\underline{\hspace{1cm}} \text{ L } \underline{\hspace{1cm}} \text{ mL} = 906,010 \text{ mL}$

2. Solve.

$81 \text{ L } 603 \text{ mL} - 22 \text{ L } 489 \text{ mL}$

Use a tape diagram to model the following problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

3. The Smith's hot tub has a capacity of 1,458 liters. Mrs. Smith put 487 liters 750 milliliters of water in the tub. How much water needs to be added to fill the hot tub completely?

Name _____

Date _____

1. Complete the conversion table.

Liquid Capacity	
L	mL
1	1,000
8	
27	
	39,000
68	
	102,000

2. Convert the measurements.

a. $5 \text{ L } 850 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

b. $29 \text{ L } 303 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

c. $37 \text{ L } 37 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

d. $17 \text{ L } 2 \text{ mL} = \underline{\hspace{2cm}} \text{ mL}$

e. $13,674 \text{ mL} = \underline{\hspace{1cm}} \text{ L } \underline{\hspace{1cm}} \text{ mL}$

f. $275,005 \text{ mL} = \underline{\hspace{1cm}} \text{ L } \underline{\hspace{1cm}} \text{ mL}$

3. Solve.

a. $545 \text{ mL} + 48 \text{ mL}$

b. $8 \text{ L} - 5,740 \text{ mL}$

c. Express the answer in the smaller unit:
 $27 \text{ L } 576 \text{ mL} + 784 \text{ mL}$

d. Express the answer in the smaller unit:
 $27 \text{ L} + 3,100 \text{ mL}$

e. Express the answer in mixed units:
 $9 \text{ L } 213 \text{ mL} - 638 \text{ mL}$

f. Express the answer in mixed units:
 $41 \text{ L } 724 \text{ mL} - 28 \text{ L } 945 \text{ mL}$

Use a tape diagram to model each problem. Solve using a simplifying strategy or an algorithm, and write your answer as a statement.

4. Sammy's bucket holds 2,530 milliliters of water. Marie's bucket holds 2 liters 30 milliliters of water. Katie's bucket holds 2 liters 350 milliliters of water. Whose bucket holds the least amount of water?

5. At football practice, the water jug was filled with 18 liters 530 milliliters of water. At the end of practice, there were 795 milliliters left. How much water did the team drink?

6. 27,545 milliliters of gas were added to a car's empty gas tank. If the gas tank's capacity is 56 liters 202 milliliters, how much gas is needed to fill the tank?



Topic B

Application of Metric Unit Conversions

4.MD.1, 4.MD.2

Focus 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. <i>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), ...</i>
	4.MD.2 ²	Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
Instructional Days:	2	
Coherence -Links from:	G2–M2	Addition and Subtraction of Length Units
	G3–M2	Place Value and Problem Solving with Units of Measure
-Links to:	G5–M1	Place Value and Decimal Fractions
	G5–M2	Multi-Digit Whole Number and Decimal Fraction Operations

In Topic B, students continue to build off their measurement work from previous grade levels. They solidify their understanding of the relationship between metric units and the place value chart and apply unit conversions to solve and reason about multi-step word problems (4.MD.2). Applying the skills learned in Module 1, students discover and explore the relationship between place value and conversions. The beauty of both the place value and measurement systems is the efficiency and precision permitted by the use of different size units to express a given quantity.

¹Pounds, ounces, and time are addressed in Module 7. This is a non-tested standard, but expressing metric measurements of length, mass, and capacity from larger to smaller units strengthens the upcoming modules.

²Time and money are addressed in Module 7. This is a non-tested standard, but the context of operating on distance, volume, and mass strengthens the upcoming modules.

Lesson 4 connects metric measurement conversions and place value by comparing mixed units of measure and verifying statements such as *1 kilometer is 1,000 times as much as 1 meter*. In Lesson 5, as students solve two- and three-step word problems by adding and subtracting metric units, their ability to reason in parts and wholes is taken to the next level. This is important preparation for multi-digit operations and manipulating fractional units in future modules.

Throughout Topic B, tape diagrams and number lines serve as models to support application of the standard algorithm to word problems. Students solve problems by converting between units and using simplifying strategies or algorithms (**4.MD.1**).

A Teaching Sequence Toward Mastery of Application of Metric Unit Conversions

Objective 1: Know and relate metric units to place value units in order to express measurements in different units.
(Lesson 4)

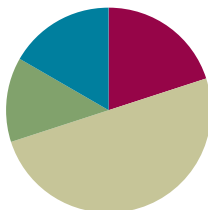
Objective 2: Use addition and subtraction to solve multi-step word problems involving length, mass, and capacity.
(Lesson 5)

Lesson 4

Objective: Know and relate metric units to place value units in order to express measurements in different units.

Suggested Lesson Structure

■ Fluency Practice	(12 minutes)
■ Application Problem	(8 minutes)
■ Concept Development	(30 minutes)
■ Student Debrief	(10 minutes)
Total Time	(60 minutes)



Fluency Practice (12 minutes)

- Perimeter and Area **4.MD.3** (4 minutes)
- Add Meters and Centimeters **4.MD.2** (2 minutes)
- Convert Units **4.MD.1** (2 minutes)
- Unit Counting **4.MD.1** (4 minutes)

Perimeter and Area (4 minutes)

Note: This fluency activity prepares students for G4–M3–Lesson 1’s Concept Development.

- T: (Project grid paper with a rectangle of 5 units by 3 units shaded.) What’s the length of the longest side?
 S: 5 units.
- T: (Write *5 units*. Point to the opposite side.) What’s the length of the opposite side?
 S: 5 units.
- T: (Write *5 units*.) What’s the sum of the rectangle’s two longest sides?
 S: 10 units.
- T: What’s the length of the shortest side?
 S: 3 units.
- T: (Write *3 units*. Point to the unknown side.) What’s the length of the unknown side?
 S: 3 units.
- T: (Write *3 units*.) What’s the sum of the rectangle’s two shortest sides?



NOTES ON STANDARDS ALIGNMENT:

In Module 2, students convert metric length, mass, and capacity units to add and subtract mixed units. This lesson builds on the content of **2.MD.5** and **3.MD.2**.

Occasionally, students work beyond the **4.MD.1** and **4.MD.2** standards by converting from a smaller unit to a larger unit. They do this by connecting metric units to place value units.

Develop students’ basic number sense to make these conversions, and always accept answers in the smaller unit.

S: 6 units.

T: What is the sum of the four sides of the rectangle?

S: 16 units.

T: How many square units are in one row?

S: 5 square units.

T: How many rows of 5 square units are there?

S: 3 rows.

T: Let's find how many square units there are in the rectangle, counting by fives.

S: 5, 10, 15.

T: How many square units in all?

S: 15 square units.

Repeat the process for 4×3 and 6×4 rectangles.

Add Meters and Centimeters (2 minutes)

Materials: (S) Add Meters and Centimeters Pattern Sheet

Note: This work with mixed units of meters and centimeters supports students in understanding mixed units of all kinds: liters and milliliters, kilometers and meters, kilograms and grams, and whole numbers and fractional units.

T: (Distribute Add Meters and Centimeters Pattern Sheet.) Do as many problems as you can in two minutes. If you finish early, skip-count by 400 milliliters on the back. Stop when you get to 4,000 milliliters. Then, go back through each multiple, and convert multiples of 1,000 milliliters to whole liters.

Convert Units (2 minutes)

Materials: (S) Personal white board

Note: Isolated review builds fluency with conversion so that students can use this skill as a tool for solving word problems.

T: (Write $1 \text{ m } 20 \text{ cm} = \underline{\hspace{1cm}} \text{ cm}$.) 1 m 20 cm is how many centimeters?

S: 120 centimeters.

Repeat the process for the following possible sequence: 1 m 80 cm, 1 m 8 cm, and 2m 4 cm.

T: (Write $1,500 \text{ g} = \underline{\hspace{1cm}} \text{ kg } \underline{\hspace{1cm}} \text{ g}$.) On your personal white boards, fill in the equation.

S: (Write $1,500 \text{ g} = 1 \text{ kg } 500 \text{ g}$.)

Repeat the process for the following possible sequence: 1,300 g, 1,030 g, and 1,005 g.

T: (Write $1 \text{ liter } 700 \text{ mL} = \underline{\hspace{1cm}} \text{ mL}$.) On your boards, fill in the equation.

S: (Write $1 \text{ liter } 700 \text{ mL} = 1,700 \text{ mL}$.)

Repeat the process for the following possible sequence: 1 liter 70 mL, 1 liter 7 mL, and 1 liter 80 mL.

Unit Counting (4 minutes)

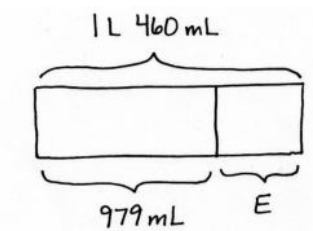
Note: This fluency activity deepens student understanding of the composition and decomposition of unit conversions, laying a foundation for adding and subtracting liters and milliliters. The numbers in bold type indicate the point at which the direction of the counting changes.

Direct students to count by liters in the following sequence:

- 500 mL, 1,000 mL, 1,500 mL, 2,000 mL, 2,500 mL, **3,000 mL**, 2,500 mL, 2,000 mL, 1,500 mL, 1,000 mL, 500 mL
- 500 mL, 1 liter, 1,500 mL, 2 liters, 2,500 mL, **3 liters**, 2,500 mL, 2 liters, 1,500 mL, 1 liter, 500 mL
- 500 mL, 1 liter, 1 liter 500 mL, 2 liters, 2 liters 500 mL, **3 liters**, 2 liters 500 mL, 2 liters, 1 liter 500 mL, 1 liter, 500 mL
- 200 mL, 400 mL, 600 mL, 800 mL, 1 liter, 1 liter 200 mL, 1 liter 400 mL, 1 liter 600 mL, 1 liter 800 mL, 2 liters
- 400 mL, 800 mL, 1,200 mL, 1,600 mL, **2,000 mL**, 1,600 mL, 1,200 mL, 800 mL, 400 mL
- 400 mL, 800 mL, 1 liter 200 mL, 1 liter 600 mL, **2 liters**, 1 liter 600 mL, 1 liter 200 mL, 800 mL, 400 mL

Application Problem (8 minutes)

Adam poured 1 liter 460 milliliters of water into a beaker. Over three days, some of the water evaporated. On the fourth day, 979 milliliters of water remained in the beaker. How much water evaporated?



$$1 \text{ L } 460 \text{ mL} = 1,460 \text{ mL}$$

481 mL evaporated.

Solution A

$$\begin{array}{r} 0 \text{ } 13 \text{ } 15 \\ 8 \text{ } 8 \text{ } 10 \\ 1,460 \text{ mL} \\ - 979 \text{ mL} \\ \hline 481 \text{ mL} \end{array}$$

$$E = 481 \text{ mL}$$

Solution B

$$1460 \text{ mL} - 979 \text{ mL} = 481 \text{ mL}$$

\swarrow
~~1000 mL~~ 460 mL
 21 mL

Solution C

$$979 \text{ mL} \xrightarrow{+21 \text{ mL}} 1,000 \text{ mL} \xrightarrow{+460 \text{ mL}} 1,460 \text{ mL}$$

$$21 \text{ mL} + 460 \text{ mL} = 481 \text{ mL}$$

Note: This application problem builds on Lesson 3. Students might express measurements of liters in terms of milliliters and then subtract to solve the measurement word problem using either the more traditional algorithm (Solution A) or a simplifying strategy (Solutions B and C) based on place value decomposition, as pictured above.

Concept Development (30 minutes)

Materials: (T) Unlabeled hundred thousands place value chart (Template) (S) Unlabeled hundred thousands place value chart (Template), personal white board

Problem 1: Note patterns of *times as much as* among units of length, mass, capacity, and place value.

T: Turn and tell your neighbor the units for mass, length, and capacity that we have learned so far.

S: Gram, kilogram, centimeter, meter, kilometer, milliliter, and liter.

T: What relationship have you discovered between milliliters and liters?

S: 1 liter is 1,000 milliliters. \rightarrow 1 liter is 1,000 times as much as 1 milliliter.

T: (Write $1\text{ L} = 1,000 \times 1\text{ mL}$.) What do you notice about the relationship between grams and kilograms? Meters and kilometers? Write your answers as equations.

S: 1 kilogram is 1,000 times as much as 1 gram.
(Write $1\text{ kg} = 1,000 \times 1\text{ g}$.) 1 kilometer is 1,000 times as much as 1 meter. (Write $1\text{ km} = 1,000 \times 1\text{ m}$.)

T: I wonder if other units have similar relationships. What other units have we discussed in fourth grade so far?

S: Ones, tens, hundreds, thousands, ten thousands, hundred thousands, and millions.

T: What do you notice about the units of place value? Are the relationships similar to those of metric units?

S: Yes. 1 kilogram is 1,000 times as much as 1 gram, like 1 thousand is 1,000 times as much as 1 one. \rightarrow And 1 hundred thousand is 1,000 times as much as 1 hundred. \rightarrow That's true, and 1 ten thousand is 1,000 times as much as 1 ten.

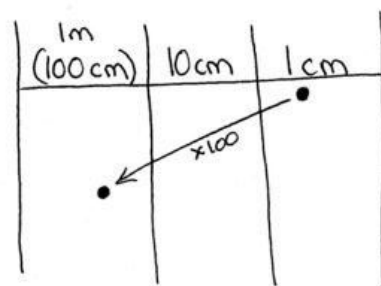
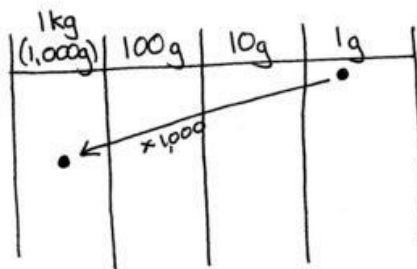
T: What unit is 100 times as much as 1 centimeter? Write your answer as an equation.

S: (Write $1\text{ meter} = 100 \times 1\text{ centimeter}$.)

T: Can you think of a place value unit relationship that is similar?

S: 1 hundred is 100 times as much as 1 one. 1 hundred thousand is 100 times as much as 1 thousand. 1 ten thousand is 100 times as much as 1 hundred.

$$\begin{aligned} 1\text{ L} &= 1,000 \times 1\text{ mL} \\ 1\text{ kg} &= 1,000 \times 1\text{ g} \\ 1\text{ km} &= 1,000 \times 1\text{ m} \\ 1\text{ thousand} &= 1,000 \times 1\text{ one} \end{aligned}$$



Problem 2: Relate units of length, mass, and capacity to units of place value.

T: (Write $1\text{ m} = 100\text{ cm}$.) 1 meter is equal to 100 centimeters. What unit is 100 ones?

S: 1 hundred equals 100 ones.

T: I notice 1 kilogram is 1,000 grams and 1 liter is 1,000 milliliters. Did you discover two place value units with a similar relationship?

- S: 1 thousand equals 1,000 ones.
 T: You can rename 1,200 milliliters as 1 liter 200 milliliters. How could you break 1,200 into place value units?
 S: 1,200 is 1 thousand 200 ones.

1L (1,000mL)	100mL	10mL	1mL
•	••		
1	, 2	0	0

Repeat renaming for 15,450 milliliters, 15,450 kilograms, and 15,450 ones, as well as 895 cm and 895 ones.

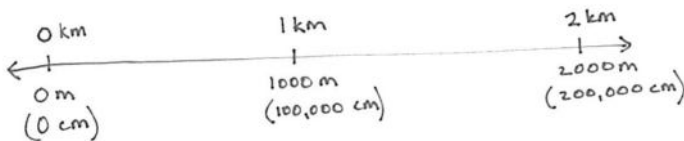
Problem 3: Compare metric units using place value knowledge and a number line.

- T: (Write 724,706 mL 72 L 760 mL.) Which is more? Tell your partner how you can use place value knowledge to compare.

100L (100,000 mL)	10L (10,000 mL)	1L (1,000 mL)	100mL	10mL	1mL
	7	2,	7	6	0
7	2	4,	7	0	6

724,706 mL 72 L 760 mL
 ↓
 724 L 706 mL
 724 > 72

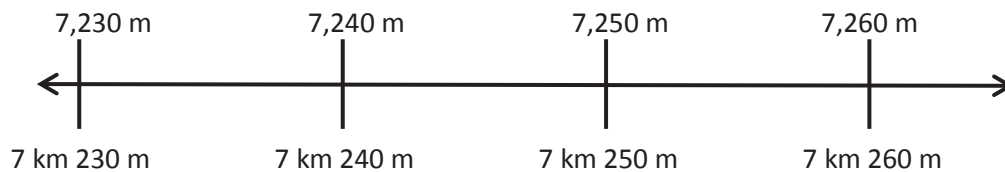
- S: I saw that 724,706 milliliters is 724 liters, and 724 is greater than 72. → I saw that 72 liters is 72,000 milliliters, and 724 thousand is greater than 72 thousand.
 T: Draw a number line from 0 kilometers to 2 kilometers. 1 kilometer is how many meters?



- S: 1,000 meters.
 T: 2 kilometers is equal to how many meters?
 S: 2,000 meters.
 T: Discuss with your partner how many centimeters are equal to 1 kilometer.
 S: 1 meter is 100 centimeters. 1 kilometer is 1 thousand meters. → So, 1 thousand times 1 hundred is 100 thousand. → 2 meters is 200 centimeters, so 10 meters is 1,000 centimeters. 100 meters is ten of those, 10,000 centimeters. Ten of those is 100,000 centimeters.

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Reduce the small motor demands of plotting points on a number line by enlarging the number line and offering alternatives to marking with a pencil, such as placing stickers or blocks.



Display a number line as pictured above.

- T: (Write 7,256 m, 7 km 246 m, and 725,900 cm.) Work with your partner to place these measurements on a number line. Explain how you know where they are to be placed.
- S: I know that 100 centimeters equals 1 meter. In the number 725,900, there are 7,259 hundreds. That means that 725,900 cm equals 7,259 m. Now, I am able to place 725,900 cm on the number line.
- S: 7,256 m is between 7,250 m and 7,260 m. It is less than 7,259 m. 7 km 246 m is between 7 km 240 m (7,240 m) and 7 km 250 m (7,250 m).
- S: Since all the measurements have 7 kilometers, I can compare meters. 256 is more than 246, and 259 is more than 256.
- S: 7 km 246 m is less than 7,256 m, which is less than 725,900 cm.
- T: Order the measurements from least to greatest.

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 should solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Know and relate metric units to place value units in order to express measurements in different units.

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.



NOTES ON MULTIPLE MEANS OF REPRESENTATION:

Clarify math vocabulary during the Debrief using pictures, gestures, and students' first languages. Give students multiple opportunities to articulate their math thinking. Offer English language learners the option of expressing themselves in the language most comfortable to them. Some students may feel more confident responding in writing. Turn-and-talk may also be an effective alternative.

Any combination of the questions below may be used to lead the discussion.

- What patterns did you notice as you solved Problem 2?
- Explain to your partner how to find the number of centimeters in 1 kilometer. Did you relate each unit to meters? Place value?
- Do you find the number line helpful when comparing measures? Why or why not?
- How are metric units and place value units similar? Different? Do money units relate to place value units similarly? Time units?
- How did finding the amount of water that evaporated from Adam’s beaker (in the Application Problem) connect to place value?
- How did the previous lessons on conversions prepare you for today’s lesson?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students’ understanding of the concepts that were presented in today’s lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

Name Jack Date _____

1. Complete the table.

Smaller Unit	Larger Unit	How Many Times as Large as?
one	hundred	100
centimeter	meter	100
one	thousand	1,000
gram	Kilogram	1,000
meter	kilometer	1,000
milliliter	liter	1,000
centimeter	kilometer	100,000

2. Fill in the units in word form.

a. 429 is 4 hundreds 29 ONES b. 429 cm is 4 meters 29 cm.

c. 2,456 is 2 thousands 456 ones. d. 2,456 m is 2 kilometers 456 m.

e. 13,709 is 13 thousands 709 ones. f. 13,709 g is 13 kg 709 grams.

3. Fill in the unknown number.

a. 456,829 is 456 thousands 829 ones. b. 456,829 mL is 456 L 829 mL.

4. Use words, equations, or pictures to show and explain how metric units are like and not like place value units.

They are alike because I can rename them. 1,200 ones = 1 thousand 200 ones.
 Or 1,200 mL = 1 L 200 mL. They are not alike because I don't know how to rename any measurements as equal to tens.

5. Compare using >, <, or =.

a. 891,503 mL > 89 L 353 mL
 891,503 mL

b. 410 km 3 m < 4,103 m
 4 km 103 m

c. 5,339 m < 533,900 cm
 533,900 cm

6. Place the following measurements on the number line:

2 km 415 m 2,379 m 2 km 305 m 245,500 cm

2,415 m 2,379 m 2,305 m 2,455 m

7. Place the following measurements on the number line:

2 kg 900 g 3,500 g 1 kg 500 g 2,900 g 750 g

3 kg 900 g 2 kg 900 g 750 g 1 kg 500 g 2 kg 900 g 3 kg 900 g 750 g

Correct _____

Write in meters and centimeters.

1	$3\text{ m} + 1\text{ m} =$	m	cm	23	$3\text{ m } 10\text{ cm} + 1\text{ m } 1\text{ cm} =$	m	cm
2	$4\text{ m} + 2\text{ m} =$	m	cm	24	$3\text{ m } 10\text{ cm} + 2\text{ m } 2\text{ cm} =$	m	cm
3	$2\text{ m} + 3\text{ m} =$	m	cm	25	$3\text{ m } 10\text{ cm} + 3\text{ m } 3\text{ cm} =$	m	cm
4	$5\text{ m} + 4\text{ m} =$	m	cm	26	$3\text{ m } 20\text{ cm} + 3\text{ m } 3\text{ cm} =$	m	cm
5	$2\text{ m} + 2\text{ m} =$	m	cm	27	$6\text{ m } 30\text{ cm} + 2\text{ m } 20\text{ cm} =$	m	cm
6	$3\text{ m} + 3\text{ m} =$	m	cm	28	$8\text{ m } 30\text{ cm} + 2\text{ m } 20\text{ cm} =$	m	cm
7	$4\text{ m} + 4\text{ m} =$	m	cm	29	$6\text{ m } 50\text{ cm} + 2\text{ m } 25\text{ cm} =$	m	cm
8	$5\text{ m} + 5\text{ m} =$	m	cm	30	$6\text{ m } 25\text{ cm} + 2\text{ m } 25\text{ cm} =$	m	cm
9	$5\text{ m } 7\text{ cm} + 1\text{ m} =$	m	cm	31	$4\text{ m } 70\text{ cm} + 1\text{ m } 10\text{ cm} =$	m	cm
10	$6\text{ m } 7\text{ cm} + 1\text{ m} =$	m	cm	32	$4\text{ m } 80\text{ cm} + 1\text{ m } 10\text{ cm} =$	m	cm
11	$7\text{ m } 7\text{ cm} + 1\text{ m} =$	m	cm	33	$4\text{ m } 90\text{ cm} + 1\text{ m } 10\text{ cm} =$	m	cm
12	$9\text{ m } 7\text{ cm} + 1\text{ m} =$	m	cm	34	$4\text{ m } 90\text{ cm} + 1\text{ m } 20\text{ cm} =$	m	cm
13	$9\text{ m } 7\text{ cm} + 1\text{ cm} =$	m	cm	35	$4\text{ m } 90\text{ cm} + 1\text{ m } 60\text{ cm} =$	m	cm
14	$5\text{ m } 7\text{ cm} + 1\text{ cm} =$	m	cm	36	$5\text{ m } 75\text{ cm} + 2\text{ m } 25\text{ cm} =$	m	cm
15	$3\text{ m } 7\text{ cm} + 1\text{ cm} =$	m	cm	37	$5\text{ m } 75\text{ cm} + 2\text{ m } 50\text{ cm} =$	m	cm
16	$3\text{ m } 7\text{ cm} + 3\text{ cm} =$	m	cm	38	$4\text{ m } 90\text{ cm} + 3\text{ m } 50\text{ cm} =$	m	cm
17	$6\text{ m } 70\text{ cm} + 10\text{ cm} =$	m	cm	39	$5\text{ m } 95\text{ cm} + 3\text{ m } 25\text{ cm} =$	m	cm
18	$6\text{ m } 80\text{ cm} + 10\text{ cm} =$	m	cm	40	$4\text{ m } 85\text{ cm} + 3\text{ m } 25\text{ cm} =$	m	cm
19	$6\text{ m } 90\text{ cm} + 10\text{ cm} =$	m	cm	41	$5\text{ m } 85\text{ cm} + 3\text{ m } 45\text{ cm} =$	m	cm
20	$6\text{ m } 90\text{ cm} + 20\text{ cm} =$	m	cm	42	$4\text{ m } 87\text{ cm} + 3\text{ m } 76\text{ cm} =$	m	cm
21	$6\text{ m } 90\text{ cm} + 30\text{ cm} =$	m	cm	43	$6\text{ m } 36\text{ cm} + 4\text{ m } 67\text{ cm} =$	m	cm
22	$6\text{ m } 90\text{ cm} + 60\text{ cm} =$	m	cm	44	$9\text{ m } 74\text{ cm} + 8\text{ m } 48\text{ cm} =$	m	cm

Name _____

Date _____

1. Complete the table.

Smaller Unit	Larger Unit	How Many Times as Large as?
one	hundred	100
centimeter		100
one	thousand	1,000
gram		1,000
meter	kilometer	
milliliter		1,000
centimeter	kilometer	

2. Fill in the units in word form.

a. 429 is 4 hundreds 29 _____.

b. 429 cm is 4 _____ 29 cm.

c. 2,456 is 2 _____ 456 ones.

d. 2,456 m is 2 _____ 456 m.

e. 13,709 is 13 _____ 709 ones.

f. 13,709 g is 13 kg 709 _____.

3. Fill in the unknown number.

a. _____ is 456 thousands 829 ones.

b. _____ mL is 456 L 829 mL.

4. Use words, equations, or pictures to show and explain how metric units are like and unlike place value units.

5. Compare using $>$, $<$, or $=$.

a. 893,503 mL 89 L 353 mL

b. 410 km 3 m 4,103 m

c. 5,339 m 533,900 cm

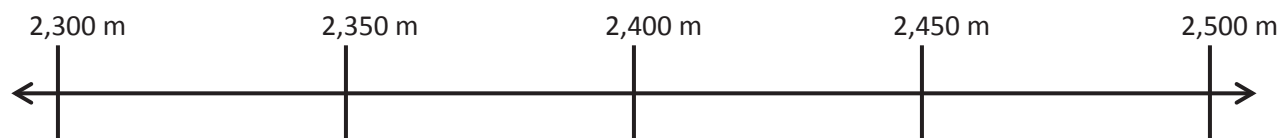
6. Place the following measurements on the number line:

2 km 415 m

2,379 m

2 km 305 m

245,500 cm



7. Place the following measurements on the number line:

2 kg 900 g

3,500 g

1 kg 500 g

2,900 g

750 g



Name _____

Date _____

1. Fill in the unknown unit in word form.

a. 8,135 is 8 _____ 135 ones.

b. 8,135 kg is 8 _____ 135 g.

2. _____ mL is equal to 342 L 645 mL.

3. Compare using $>$, $<$, or $=$.a. 23 km 40 m 2,340 mb. 13,798 mL 137 L 980 mLc. 5,607 m 560,701 cm

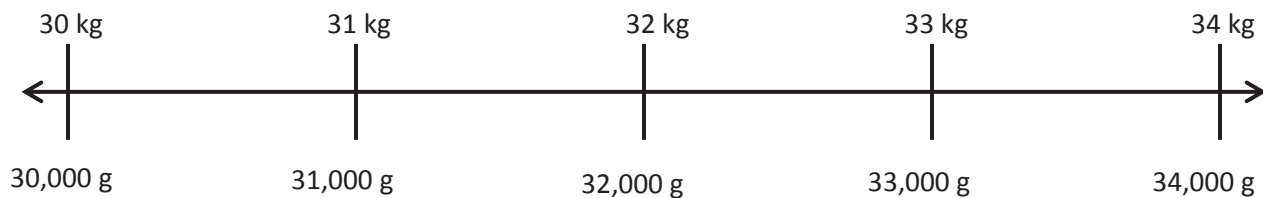
4. Place the following measurements on the number line:

33 kg 100 g

31,900 g

32,350 g

30 kg 500 g



Name _____

Date _____

1. Complete the table.

Smaller Unit	Larger Unit	How Many Times as Large as?
centimeter	meter	100
	hundred	100
meter	kilometer	
gram		1,000
one		1,000
milliliter		1,000
one	hundred thousand	

2. Fill in the unknown unit in word form.

a. 135 is 1 _____ 35 ones.

b. 135 cm is 1 _____ 35 cm.

c. 1,215 is 1 _____ 215 ones.

d. 1,215 m is 1 _____ 215 m.

e. 12,350 is 12 _____ 350 ones.

f. 12,350 g is 12 kg 350 _____.

3. Write the unknown number.

a. _____ is 125 thousands 312 ones.

b. _____ mL is 125 L 312 mL.

4. Fill in each with $>$, $<$, or $=$.

a. 890,353 mL 89 L 353 mL

b. 2 km 13 m 2,103 m

5. Brandon's backpack weighs 3,140 grams. Brandon weighs 22 kilograms 610 grams more than his backpack. If Brandon stands on a scale wearing his backpack, what will the weight read?

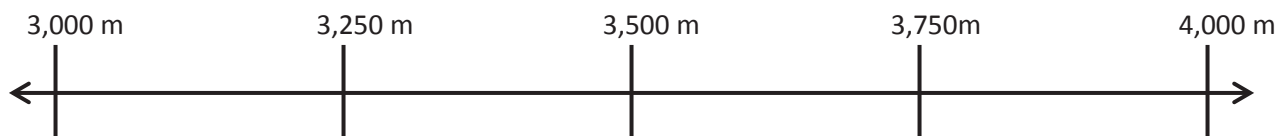
6. Place the following measurements on the number line:

3 km 275 m

3,500 m

3 km 5 m

394,000 cm



7. Place the following measurements on the number line:

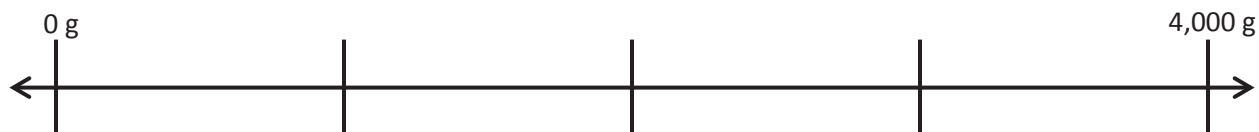
1 kg 379 g

3,079 g

2 kg 79 g

3,579 g

579 g



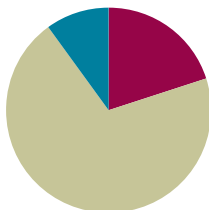
unlabeled hundred thousands place value chart

Lesson 5

Objective: Use addition and subtraction to solve multi-step word problems involving length, mass, and capacity.

Suggested Lesson Structure

■ Fluency Practice	(12 minutes)
■ Concept Development	(42 minutes)
■ Student Debrief	(6 minutes)
Total Time	(60 minutes)



NOTES ON STANDARDS ALIGNMENT:

In Module 2, students convert metric length, mass, and capacity units to add and subtract mixed units. This lesson builds on the content of **2.MD.5** and **3.MD.2**.

Occasionally, students work beyond the **4.MD.1** and **4.MD.2** standards by converting from a smaller unit to a larger unit. They do this by connecting metric units to place value units.

Develop students' basic number sense to make these conversions, and always accept answers in the smaller unit.



NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Some of the objectives of the Sprint are to generate excitement about math, to cultivate self-determination and perseverance, and to offer joyful experiences of success in math. The first weeks of school are an appropriate time to involve students in the design of their Sprint experience. Guide students through a discussion to make optimal decisions about tools and supports that can be used, the sequence or timing for completion, and the type of reward and recognition for success and improvement.

Fluency Practice (12 minutes)

- Sprint: Convert to Kilograms and Grams **4.MD.1** (8 minutes)
- Convert Units **4.MD.1** (2 minutes)
- Unit Counting **4.MD.1** (2 minutes)

Sprint: Convert to Kilograms and Grams (8 minutes)

Materials: (S) Convert to Kilograms and Grams Sprint

Note: This Sprint helps students automatize their gram and kilogram conversions when applying them in word problems.

Convert Units (2 minutes)

Materials: (S) Personal white board

Note: Isolated review builds fluency with conversion so that students can use this skill as a tool for solving word problems.

T: (Write $1 \text{ L } 400 \text{ mL} = \underline{\quad} \text{ mL}$.) Fill in the equation.

S: (Write $1 \text{ L } 400 \text{ mL} = 1,400 \text{ mL}$.)

Repeat the process for $1 \text{ L } 40 \text{ mL}$, $1 \text{ L } 4 \text{ mL}$, and $1 \text{ L } 90 \text{ mL}$.

Unit Counting (2 minutes)

Note: This fluency activity deepens student understanding of the composition and decomposition of unit conversions and works toward their mastery of adding and subtracting meters and centimeters. The numbers in bold type indicate the point at which the direction of the counting changes.

Direct students to count by centimeters using the following sequence:

- 800 cm, 1,600 cm, 2,400 cm, 3,200 cm, **4,000 cm**, 3,200 cm, 2,400 cm, 1,600 cm, 800 cm
- 800 cm, 1,600 cm, 2,400 cm, 3,200 cm, **4 m**, 3,200 cm, 2,400 cm, 1,600 cm, 800 cm
- 800 cm, 1 m 600 cm, 2 m 400 cm, 3 m 200 cm, **4 m**, 3 m 200 cm, 2 m 400 cm, 1 m 600 cm, 800 cm

Concept Development (42 minutes)

Materials: (S) Problem Set

Note: In this lesson, the Problem Set is comprised of the word problems from the lesson and used during the lesson itself for Problems 1–4. Problems 5 and 6 should be completed independently at the conclusion of the Concept Development. The lesson concludes with the Debrief.

1. Model the problem.

Have two pairs of students (choose as models those students who are likely to successfully solve the problem) work at the board while the others work independently or in pairs at their seats. Review the following questions before beginning the first problem.

- Can you draw something?
- What can you draw?
- What conclusions can you make from your drawing?

As students work, circulate. Reiterate the questions above.

After two minutes, have the two pairs of students share *only* their labeled diagrams.

For about one minute, have the demonstrating students receive and respond to feedback and questions from their peers.

2. Calculate to solve and write a statement.

Give everyone two minutes to finish work on the problem, sharing their work and thinking with a peer. All should then write their equations and statements for the answer.

3. Assess the solution for reasonableness.

Give students one to two minutes to assess and explain the reasonableness of their solutions.

Problem 1: Solve a two-step problem involving grams.

The potatoes Beth bought weighed 3 kilograms 420 grams. Her onions weighed 1,050 grams less than the potatoes. How much did the potatoes and onions weigh together?

Solution 1

Potatoes $3\text{ kg } 420\text{ g}$
 Onions $1,050\text{ g}$

$$\begin{array}{r} 3\text{ kg } 420\text{ g} \\ - 1,050\text{ g} \\ \hline 2\text{ kg } 370\text{ g} \end{array}$$

$$\begin{array}{r} 3\text{ kg } 420\text{ g} \\ + 2\text{ kg } 370\text{ g} \\ \hline 5\text{ kg } 790\text{ g} \end{array}$$

The potatoes and onions weigh $5\text{ kg } 790\text{ g}$.

Solution 2

P $3\text{ kg } 420\text{ g}$
 O $1,050\text{ g}$

$$3420 - 1050 = 2370$$

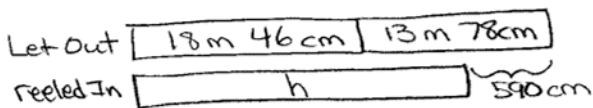
$$2370 + 3420 = 5790$$

The potatoes and onions weighed $5\text{ kg } 790\text{ g}$.

The structure of this problem and what it demands of the students is similar to that found within Module 1. Therefore, students are familiar with the process of a two-step problem. The main differences within this problem are that the focus is on mass and students are computing with mixed units. Lessons 1–4 have prepared the students for mixed unit calculations and conversions. Answering in mixed units or as a single unit of grams should be accepted. Watch for students using alternate strategies as well.

Problem 2: Solve a two-step problem involving meters.

Adele let out 18 meters 46 centimeters of string to fly her kite. She then let out 13 meters 78 centimeters more before reeling back in 590 centimeters. How long was her string after reeling it in?

Solution 1

$$\begin{array}{r} 18 \text{ m } 46 \text{ cm} \\ + 13 \text{ m } 78 \text{ cm} \\ \hline 31 \text{ m } 124 \text{ cm} \end{array}$$

1 m 24 cm = 32 m 24 cm

$$32 \text{ m } 24 \text{ cm} = 3,224 \text{ cm}$$

$$\begin{array}{r} 3,224 \text{ cm} \\ - 590 \text{ cm} \\ \hline 2,634 \text{ cm} \end{array}$$

$$\begin{array}{r} 2,634 \text{ cm} \\ \hline 26 \text{ m } 34 \text{ cm} \end{array}$$

The string was 26 m 34 cm after reeling it in.

Solution 2

$$\begin{aligned} & 18 \text{ m } 46 \text{ cm} + 13 \text{ m } 78 \text{ cm} \\ &= 31 \text{ m } 46 \text{ cm} + 78 \text{ cm} \\ &\quad \begin{array}{r} \diagdown \quad \diagup \\ 30 \text{ 16} \quad 70 \quad 8 \end{array} \\ &= 31 \text{ m } 124 \text{ cm} \\ &= 32 \text{ m } 24 \text{ cm} \end{aligned}$$

$$\begin{aligned} & 32 \text{ m } 24 \text{ cm} - 590 \text{ cm} \\ & 3224 \text{ cm} - 590 \text{ cm} \\ &\quad \begin{array}{r} \diagdown \quad \diagup \\ 2224 \quad +000 \\ \quad \quad 410 \end{array} \\ & 2224 + 410 = 2634 \end{aligned}$$

The string was 26 m 34 cm.

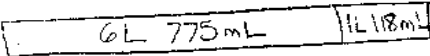
This two-step problem requires regrouping from meters to centimeters. As in the previous problem, students use what they have learned so far in Grade 4 to help solve this problem. Students might regroup across mixed units or change to similar units. In the second solution, the student adds the meters first, then the centimeters, and finally subtracts 590 centimeters from the total.

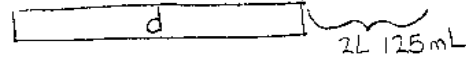
Problem 3


Solve a three-step problem involving liters.

Shyan's barrel contained 6 liters 775 milliliters of paint. She poured in 1 liter 118 milliliters more. The first day, Shyan used 2 liters 125 milliliters of the paint. After the second day, there were 1,769 milliliters of paint remaining in the barrel. How much paint did Shyan use on the second day?

Solution 1

Barrel 

Day 1 

Day 2 

$$\begin{array}{r} 6\text{ L } 775\text{ mL} \\ + 1\text{ L } 118\text{ mL} \\ \hline 7\text{ L } 893\text{ mL} \end{array}$$

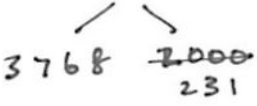
$$\begin{array}{r} 7\text{ L } 893\text{ mL} \\ - 2\text{ L } 125\text{ mL} \\ \hline 5\text{ L } 768\text{ mL} = 5,768\text{ mL} \end{array}$$

$$\begin{array}{r} 5,768\text{ mL} \\ - 1,769\text{ mL} \\ \hline 3,999\text{ mL} \end{array}$$

Shyan used 3,999 mL of paint on the second day.

Solution 2

$$\begin{aligned} 6775 - 2125 &= 4650 \\ 4650 + 1118 &= 5768 \\ 5768 - 1769 &= 3999 \end{aligned}$$



Shyan used 3 L 999 mL on the second day.

This is a three-step problem involving regrouping across units. Students are familiar with multi-step problems from Module 1 and extend their practice with them by solving with mixed units or converting to milliliters prior to solving. In the second solution, the student sees that it is easy to subtract 2,125 from 6,775 first, then adds the amount Adele poured in, and finally finishes the problem in the same way as shown in Solution 1, by subtracting the part left in the barrel.

Problem 4: Solve a three-step problem involving grams.

On Thursday, the pizzeria used 2 kilograms 180 grams less flour than they used on Friday. On Friday, they used 12 kilograms 240 grams. On Saturday, they used 1,888 grams more than on Friday. What was the total amount of flour used over the three days?

Solution 1

Thurs. \boxed{W} $\left. \begin{array}{l} \\ \\ \end{array} \right\}$ $\begin{array}{r} 12 \text{ kg } 240 \text{ g} \\ - 2 \text{ kg } 180 \text{ g} \\ \hline \text{Thurs. } 10 \text{ kg } 60 \text{ g} \end{array}$

Fri. $\boxed{12 \text{ kg } 240 \text{ g}}$

Sat. $\boxed{12 \text{ kg } 240 \text{ g } + 1,888 \text{ g}}$

$12 \text{ kg } 240 \text{ g} = 12,240 \text{ g}$

$\begin{array}{r} 12,240 \text{ g} \\ + 1,888 \text{ g} \\ \hline \text{Sat. } 14,128 \text{ g} \end{array}$

$\begin{array}{r} 10,060 \text{ g} \\ 12,240 \text{ g} \\ \hline 22,300 \text{ g} \\ + 14,128 \text{ g} \\ \hline 36,428 \text{ g} \end{array}$

The total amount of flour was 36 kg 428g.

Solution 2

3 units of 12 kg 240g = 36 kg 720g

2 kg 180g - 1 kg 888g = 292g

$\begin{array}{r} 1 \text{ kg } 1000 \text{ g} \\ - 1 \text{ kg } 888 \text{ g} \\ \hline 112 \text{ g} \end{array}$

$36 \text{ kg } 720 \text{ g} - 292 \text{ g} = 36 \text{ kg } 428 \text{ g}$

$\begin{array}{r} 36 \text{ kg } 720 \text{ g} \\ - 292 \text{ g} \\ \hline 35 \text{ kg } 428 \text{ g} \end{array}$

The bakery used 36 kg 428g.

MP.7

This three-step problem increases the complexity in that students might calculate, as in the first solution, for the three adds to complete the third step for determining how much flour was used over the three days. In the second solution strategy, the student, because of the tape diagram, notices 3 units of Friday minus the difference between the two small chunks. The answer will be a little less than three Fridays' worth of flour.

Problem Set (10 minutes)

Please note that Problems 1 through 4 of the Problem Set for this lesson are comprised of the lesson's problems as stated at the introduction of the lesson. Problems 5 and 6 may be completed individually during this part of the lesson.

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 should solve these problems using the RDW approach used for Application Problems.

Student Debrief (6 minutes)

Lesson Objective: Use addition and subtraction to solve multi-step word problems involving length, mass, and capacity.

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.

Any combination of the questions below may be used to lead the discussion.

- How was the work completed to solve Problem 5 in the Problem Set different than that of the other problems?
- Did you find yourself using similar strategies to add and to subtract the mixed unit problems? Explain.
- How can drawing different models to represent a problem lead you to a correct answer?
- How was drawing a model helpful in organizing your thoughts to solve Problem 6?
- Describe a mixed unit. What other mixed units can you name?
- How can converting to a smaller unit be useful when solving problems? When is it not useful?



NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Sustain engagement during this challenging lesson by guiding and rewarding responsible collaboration among students. Teach students to independently ask themselves, “Can I draw something? What can I draw? What conclusions can I make from my drawing?” Empower students to self-monitor their math work with a rubric for problem solving. Students working below or above grade level may want to omit drawing. Emphasize the value of modeling. Ask, “How did the picture help you solve? What happened when you did not draw the picture? Why?”

Name _____ Date _____

Model each problem with a tape diagram. Solve and answer with a statement.

1. The potatoes Beth bought weighed 3 kilograms 420 grams. Her onions weighed 1,050 grams less than the potatoes. How much did the potatoes and onions weigh together?

potatoes $3\text{ kg } 420\text{ g}$ } $3\text{ kg } 420\text{ g}$
 onions \checkmark } $1,050\text{ g}$
 $2\text{ kg } 370\text{ g (potatoes)} + 2\text{ kg } 370\text{ g}$
 $5\text{ kg } 740\text{ g}$
 The potatoes and onions together weigh 5 kg 740g.

2. Adele let out 18 meters 46 centimeters of string to fly her kite. She then let out 13 meters 78 centimeters more before reeling back in 590 centimeters. How long was her string after reeling it in?

Let-out $18\text{ m } 46\text{ cm}$ } $18\text{ m } 46\text{ cm}$
 after reeling in h } $13\text{ m } 78\text{ cm}$
 The string was $26\text{ m } 24\text{ cm}$ after reeling it in.
 $32\text{ m } 24\text{ cm} = 3,224\text{ cm}$
 $3,224\text{ cm} - 590\text{ cm} = 2,634\text{ cm}$
 $2,634\text{ cm} = 26\text{ m } 24\text{ cm}$

3. Shyan's barrel contained 6 liters 775 milliliters of paint. She poured in 1 liter 118 milliliters more. The first day, Shyan used 2 liters 125 milliliters of the paint. At the end of the second day, there were 1,769 milliliters of paint remaining in the barrel. How much paint did Shyan use on the second day?

Barrel $6\text{ L } 775\text{ mL}$ } $6\text{ L } 775\text{ mL}$
 after day 1 d } $+ 1\text{ L } 118\text{ mL}$
 after day 2 f } $7\text{ L } 893\text{ mL}$
 $7\text{ L } 893\text{ mL} - 2\text{ L } 125\text{ mL} = 5,768\text{ mL}$
 $5,768\text{ mL} - 1,769\text{ mL} = 3,999\text{ mL}$
 Shyan used 3,999 mL of paint on the second day.

- How is regrouping a mixed unit of measurement similar to regrouping a whole number when adding or subtracting?
- How is converting mixed units of measurement useful in everyday situations?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help with assessing students' understanding of the concepts that were presented in today's lesson and planning more effectively for future lessons. The questions may be read aloud to the students.

4. On Thursday, the pizzeria used 2 kilograms 180 grams less flour than they used on Friday. On Friday, they used 12 kilograms 240 grams. On Saturday, they used 1,888 grams more than on Friday. What was the total amount of flour used over the three days?

Friday $12\text{ kg } 240\text{ g}$
 Thursday $2\text{ kg } 180\text{ g}$
 Saturday $12\text{ kg } 240\text{ g} + 1,888\text{ g}$

$12\text{ kg } 240\text{ g} - 2\text{ kg } 180\text{ g} = 10\text{ kg } 60\text{ g}$ (Thursday)

$12\text{ kg } 240\text{ g} + 1,888\text{ g} = 14\text{ kg } 128\text{ g}$ (Saturday)

The total amount of flour used over the three days was $36\text{ kg } 428\text{ g}$.

5. The gas tank in Zachary's car has a capacity of 60 liters. He adds 23 liters 825 milliliters of gas to the tank, which already has 2,000 milliliters of gas. How much more gas can Zachary add to the gas tank?

$23\text{ L } 825\text{ mL} = 23,825\text{ mL}$

$23,825\text{ mL} + 2,000\text{ mL} = 25,825\text{ mL}$

$60\text{ L} = 60,000\text{ mL}$

$60,000\text{ mL} - 25,825\text{ mL} = 34,175\text{ mL}$

Zachary can add $34,175\text{ mL}$ more gas to his car.

6. A giraffe is 5 meters 20 centimeters tall. An elephant is 1 meter 77 centimeters shorter than the giraffe. A rhinoceros is 1 meter 85 centimeters shorter than the elephant. How tall is the rhinoceros?

giraffe $5\text{ m } 20\text{ cm}$
 elephant $1\text{ m } 77\text{ cm}$
 rhinoceros $1\text{ m } 85\text{ cm}$

$5\text{ m } 20\text{ cm} - 1\text{ m } 77\text{ cm} = 3\text{ m } 43\text{ cm}$

$3\text{ m } 43\text{ cm} - 1\text{ m } 85\text{ cm} = 1\text{ m } 58\text{ cm}$

The rhinoceros was $1\text{ meter } 85\text{ centimeters tall}$.

A

Number Correct: _____

Convert to Kilograms and Grams

1.	2,000 g =	kg	g
2.	3,000 g =	kg	g
3.	4,000 g =	kg	g
4.	9,000 g =	kg	g
5.	6,000 g =	kg	g
6.	1,000 g =	kg	g
7.	8,000 g =	kg	g
8.	5,000 g =	kg	g
9.	7,000 g =	kg	g
10.	6,100 g =	kg	g
11.	6,110 g =	kg	g
12.	6,101 g =	kg	g
13.	6,010 g =	kg	g
14.	6,011 g =	kg	g
15.	6,001 g =	kg	g
16.	8,002 g =	kg	g
17.	8,020 g =	kg	g
18.	8,200 g =	kg	g
19.	8,022 g =	kg	g
20.	8,220 g =	kg	g
21.	8,222 g =	kg	g
22.	7,256 g =	kg	g

23.	3,800 g =	kg	g
24.	4,770 g =	kg	g
25.	4,807 g =	kg	g
26.	5,065 g =	kg	g
27.	5,040 g =	kg	g
28.	6,007 g =	kg	g
29.	2,003 g =	kg	g
30.	1,090 g =	kg	g
31.	1,055 g =	kg	g
32.	9,404 g =	kg	g
33.	9,330 g =	kg	g
34.	3,400 g =	kg	g
35.	4,000 g + 2,000 g =	kg	g
36.	5,000 g + 3,000 g =	kg	g
37.	4,000 g + 4,000 g =	kg	g
38.	8 × 7,000 g =	kg	g
39.	49,000 g ÷ 7 =	kg	g
40.	16,000 g × 5 =	kg	g
41.	63,000 g ÷ 7 =	kg	g
42.	17 × 4,000 g =	kg	g
43.	13,000 g × 5 =	kg	g
44.	84,000 g ÷ 7 =	kg	g

B

Number Correct: _____

Improvement: _____

Convert to Kilograms and Grams

1.	1,000 g =	kg	g
2.	2,000 g =	kg	g
3.	3,000 g =	kg	g
4.	8,000 g =	kg	g
5.	6,000 g =	kg	g
6.	9,000 g =	kg	g
7.	4,000 g =	kg	g
8.	7,000 g =	kg	g
9.	5,000 g =	kg	g
10.	5,100 g =	kg	g
11.	5,110 g =	kg	g
12.	5,101 g =	kg	g
13.	5,010 g =	kg	g
14.	5,011 g =	kg	g
15.	5,001 g =	kg	g
16.	7,002 g =	kg	g
17.	7,020 g =	kg	g
18.	7,200 g =	kg	g
19.	7,022 g =	kg	g
20.	7,220 g =	kg	g
21.	7,222 g =	kg	g
22.	4,378 g =	kg	g

23.	2,700 g =	kg	g
24.	3,660 g =	kg	g
25.	3,706 g =	kg	g
26.	4,095 g =	kg	g
27.	4,030 g =	kg	g
28.	5,006 g =	kg	g
29.	3,004 g =	kg	g
30.	2,010 g =	kg	g
31.	2,075 g =	kg	g
32.	1,504 g =	kg	g
33.	1,440 g =	kg	g
34.	4,500 g =	kg	g
35.	$3,000\text{ g} + 2,000\text{ g} =$	kg	g
36.	$4,000\text{ g} + 3,000\text{ g} =$	kg	g
37.	$5,000\text{ g} + 4,000\text{ g} =$	kg	g
38.	$9 \times 8,000\text{ g} =$	kg	g
39.	$64,000\text{ g} \div 8 =$	kg	g
40.	$17,000\text{ g} \times 5 =$	kg	g
41.	$54,000\text{ g} \div 6 =$	kg	g
42.	$18,000\text{ g} \times 4 =$	kg	g
43.	$14 \times 5,000\text{ g} =$	kg	g
44.	$96,000\text{ g} \div 8 =$	kg	g

Name _____

Date _____

Model each problem with a tape diagram. Solve and answer with a statement.

1. The potatoes Beth bought weighed 3 kilograms 420 grams. Her onions weighed 1,050 grams less than the potatoes. How much did the potatoes and onions weigh together?



2. Adele let out 18 meters 46 centimeters of string to fly her kite. She then let out 13 meters 78 centimeters more before reeling back in 590 centimeters. How long was her string after reeling it in?



3. Shyan's barrel contained 6 liters 775 milliliters of paint. She poured in 1 liter 118 milliliters more. The first day, Shyan used 2 liters 125 milliliters of the paint. At the end of the second day, there were 1,769 milliliters of paint remaining in the barrel. How much paint did Shyan use on the second day?

4. On Thursday, the pizzeria used 2 kilograms 180 grams less flour than they used on Friday. On Friday, they used 12 kilograms 240 grams. On Saturday, they used 1,888 grams more than on Friday. What was the total amount of flour used over the three days?



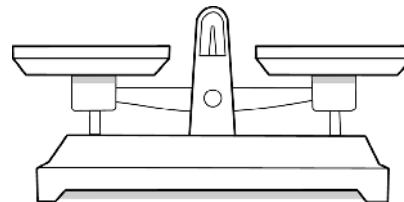
5. The gas tank in Zachary's car has a capacity of 60 liters. He adds 23 liters 825 milliliters of gas to the tank, which already has 2,050 milliliters of gas. How much more gas can Zachary add to the gas tank?
6. A giraffe is 5 meters 20 centimeters tall. An elephant is 1 meter 77 centimeters shorter than the giraffe. A rhinoceros is 1 meter 58 centimeters shorter than the elephant. How tall is the rhinoceros?

Name _____

Date _____

Model each problem with a tape diagram. Solve and answer with a statement.

1. Jeff places a pineapple with a mass of 890 grams on a balance scale. He balances the scale by placing two oranges, an apple, and a lemon on the other side. Each orange weighs 280 grams. The lemon weighs 195 grams less than each orange. What is the mass of the apple?



2. Brian is 1 meter 87 centimeters tall. Bonnie is 58 centimeters shorter than Brian. Betina is 26 centimeters taller than Bonnie. How tall is Betina?

Name _____

Date _____

Model each problem with a tape diagram. Solve and answer with a statement.

- The capacity of Jose's vase is 2,419 milliliters of water. He poured 1 liter 299 milliliters of water into the empty vase. Then, he added 398 milliliters. How much more water will the vase hold?
- Eric biked 1 kilometer 125 meters on Monday. On Tuesday, he biked 375 meters less than on Monday. How far did he bike both days?
- Zachary weighs 37 kilograms 95 grams. Gabe weighs 4,650 grams less than Zachary. Harry weighs 2,905 grams less than Gabe. How much does Harry weigh?

4. A Springer Spaniel weighs 20 kilograms 490 grams. A Cocker Spaniel weighs 7,590 grams less than a Springer Spaniel. A Newfoundland weighs 52 kilograms 656 grams more than a Cocker Spaniel. What is the difference, in grams, between the weights of the Newfoundland and the Springer Spaniel?
5. Marsha has three rugs. The first rug is 2 meters 87 centimeters long. The second rug has a length 98 centimeters less than the first. The third rug is 111 centimeters longer than the second rug. What is the difference in centimeters between the length of the first rug and the third rug?
6. One barrel held 60 liters 868 milliliters of sap. A second barrel held 20,089 milliliters more sap than the first. A third barrel held 40 liters 82 milliliters less sap than the second. If the sap from the three barrels was poured into a larger container, how much sap would there be in all?

Name _____

Date _____

1. Complete the conversion charts.

Length	
3 km	_____ m
9 km	_____ m
6 km 435 m	_____ m
12 km 12 m	_____ m

Mass	
3 kg	_____ g
20 kg 300 g	_____ g
1 kg 74 g	_____ g
403 kg 4 g	_____ g

Capacity	
4 L	_____ mL
48 L 808 mL	_____ mL
2 L 20 mL	_____ mL
639 L 6 mL	_____ mL

2. A student completed the problem below. Check his work. Explain how you know if each solution is correct or incorrect.

<p>Convert the following measurements:</p> <p>a. 24 km = <u>24,000</u> m</p> <p>b. 16 L = <u>16,000</u> mL</p> <p>c. 38 kg = <u>3,800</u> g</p>
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3. Find the sum or difference.

a. $493 \text{ km } 43 \text{ m} + 17 \text{ km } 57 \text{ m}$

b. $25 \text{ kg } 32 \text{ g} - 23 \text{ kg } 83 \text{ g}$

c. $100 \text{ L } 99 \text{ mL} + 2,999 \text{ mL}$

4. Billy is training for a half marathon. For the problems below, use tape diagrams, numbers, and words to explain each answer.
- a. Each day, Billy runs on the treadmill for 5 kilometers and runs on the outdoor track for 6,000 meters. In all, how many meters does Billy run each day?
- b. Since Billy has started training, he has also been drinking more water. On Saturday, he drank 2 liters 755 milliliters of water. On Sunday, he drank some more. If Billy drank a total of 4 liters 255 milliliters of water on Saturday and Sunday, how many milliliters of water did Billy drink on Sunday?
- c. Since he began exercising so much for his half marathon, Billy has been losing weight. In his first week of training, he lost 2 kilograms 530 grams. In the following two weeks of training, he lost 1 kilogram 855 grams each week. Billy now weighs 61 kilograms 760 grams. What was Billy's weight, in grams, before he started training? Explain your thinking.

**End-of-Module Assessment Task
Standards Addressed**

Topics A–B

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

- 4.MD.1¹** 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), ...*
- 4.MD.2²** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

Evaluating Student Learning Outcomes

A Progression Toward Mastery is provided to describe steps that illuminate the gradually increasing understandings that students develop *on their way to proficiency*. In this chart, this progress is presented from left (Step 1) to right (Step 4). The learning goal for students is to achieve Step 4 mastery. These steps are meant to help teachers and students identify and celebrate what the students CAN do now and what they need to work on next.

¹Pounds, ounces, and time are assessed in Module 7.

²Time, money, and numbers as fractions or decimals are assessed in Module 7.

A Progression Toward Mastery

Assessment Task Item	STEP 1 Little evidence of reasoning without a correct answer. (1 Point)	STEP 2 Evidence of some reasoning without a correct answer. (2 Points)	STEP 3 Evidence of some reasoning with a correct answer or evidence of solid reasoning with an incorrect answer. (3 Points)	STEP 4 Evidence of solid reasoning with a correct answer. (4 Points)
1 4.MD.1	Student correctly completes fewer than six of the twelve conversions.	Student correctly identifies six to nine of the twelve conversions.	Student correctly identifies ten or eleven of the twelve conversions.	Student correctly completes the conversion chart: <ul style="list-style-type: none"> ▪ 3,000, 9,000, 6,435, 12,012 ▪ 3,000, 20,300, 1,074, 403,004 ▪ 4,000, 48,808, 2,020, 639,006
2 4.MD.1	Student correctly identifies fewer than two conversions with no evidence of reasoning.	Student correctly identifies two of the conversions with little evidence of reasoning.	Student correctly identifies that Parts (a) and (b) are correct and Part (c) is incorrect but does not provide clear reasoning.	Student correctly reasons that Parts (a) and (b) are correct because 1,000 m equals 1 km and 1,000 mL equals 1 L, and Part (c) is incorrect because 1,000 g equals 1 kg, so 38 kg should equal 38,000 g.
3 4.MD.1 4.MD.2	Student correctly answers fewer than two parts, with multiple computation or conversion errors.	Student correctly answers one of the three parts and makes fewer than two computational or conversion errors on the other parts.	Student correctly answers two of the three parts.	Student correctly answers: <ol style="list-style-type: none"> a. 510 km 100 m or 510,100 m b. 1 kg 949 g or 1,949 g c. 103 L 98 mL or 103,098 mL



A Progression Toward Mastery

<p>4</p> <p>4.MD.1</p> <p>4.MD.2</p>	<p>Student correctly answers fewer than two of the three parts.</p>	<p>Student correctly answers two of the three parts but shows little evidence of reasoning in Part (c).</p>	<p>Student answers three parts correctly but does not show solid reasoning of understanding metric conversions in Part (c).</p>	<p>Student correctly answers all three parts:</p> <ul style="list-style-type: none">a. 11,000 metersb. 1,500 millilitersc. 68,000 grams; <p>Explains or shows computation of all measurements and the conversion to grams.</p>
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Name Jack

Date _____

1. Complete the following conversion charts:

Length	
3 km	<u>3,000</u> m
9 km	<u>9,000</u> m
6 km 435 m	<u>6,435</u> m
12 km 12 m	<u>12,012</u> m

Mass	
3 kg	<u>3,000</u> g
20 kg 300 g	<u>20,300</u> g
1 kg 74 g	<u>1,074</u> g
403 kg 4 g	<u>403,004</u> g

Capacity	
4 L	<u>4,000</u> mL
48 L 808 mL	<u>48,808</u> mL
2 L 20 mL	<u>2,020</u> mL
639 L 6 mL	<u>639,006</u> mL

2. A student completed the problem below. Check his work. Explain how you know if each solution is correct or incorrect.

Convert the following measurements:

~~a.~~ 24 km = 24,000 m

~~b.~~ 16 L = 16,000 mL

c. 38 kg = 3,800 g

$$1 \text{ km} = 1,000 \text{ m}$$

$$24 \text{ km} = 24,000 \text{ m}$$

$$1 \text{ L} = 1,000 \text{ mL}$$

$$16 \text{ L} = 16,000 \text{ mL}$$

$$1 \text{ kg} = 1,000 \text{ g}$$

$$38 \text{ kg} = 38,000 \text{ g}$$

Problems a and b are correct because there are 1,000 meters, mL, or grams in 1 km, L, or kg.

Problem c is wrong. 38 kg is really 38,000 g.

3. Find the sum or difference.

a. $493 \text{ km } 43 \text{ m} + 17 \text{ km } 57 \text{ m}$

$$\begin{array}{r} 493 \text{ km } 43 \text{ m} \\ + 17 \text{ km } 57 \text{ m} \\ \hline 510 \text{ km } 100 \text{ m} \end{array}$$

b. $25 \text{ kg } 32 \text{ g} - 23 \text{ kg } 83 \text{ g}$

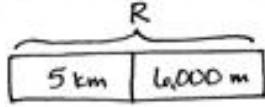
$$\begin{array}{r} 4 2 2 \\ 25,032 \text{ g} \\ - 23,083 \text{ g} \\ \hline 1,949 \text{ g} \end{array}$$

c. $100 \text{ L } 99 \text{ mL} + 2,999 \text{ mL}$

$$\begin{array}{r} 100,099 \text{ mL} \\ + 2,999 \text{ mL} \\ \hline 103,098 \text{ mL} \end{array}$$

4. Billy is training for a half-marathon. For the problems below, use tape diagrams, numbers, and words to explain each answer.

- a. Each day Billy runs on the treadmill for 5 kilometers and runs on the outdoor track for 6,000 meters. In all, how many meters does Billy run each day?



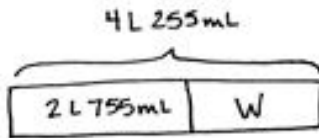
$$5 \text{ km} = 5,000 \text{ m}$$

$$5,000 \text{ m} + 6,000 \text{ m} = 11,000 \text{ m}$$

$$R = 11,000 \text{ m}$$

Billy runs 11,000 meters each day.

- b. Since Billy has started training, he has also been drinking more water. On Saturday, he drank 2 liters 755 milliliters of water. On Sunday, he drank some more. If Billy drank a total of 4 liters 255 milliliters of water on Saturday and Sunday, how many milliliters of water did Billy drink on Sunday?



$$4 \text{ L } 255 \text{ mL} = 4,255 \text{ mL}$$

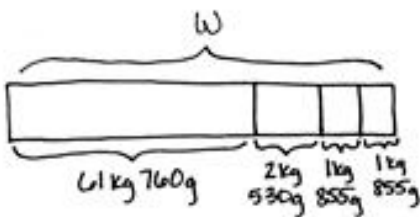
$$2 \text{ L } 755 \text{ mL} = 2,755 \text{ mL}$$

$$\begin{array}{r} 3 \text{ 12} \\ 4,255 \\ - 2,755 \\ \hline 1,500 \end{array}$$

$$W = 1,500 \text{ mL}$$

Billy drank 1,500 mL of water on Sunday.

- c. Since exercising so much for his half-marathon, Billy has been losing weight. In his first week of training, he lost 2 kilograms 530 grams. In the following two weeks of training, he lost 1 kilogram 855 grams each week. Billy now weighs 61 kilograms 760 grams. What was Billy's weight, in grams, before he started training? Explain your thinking.



$$\begin{array}{r} 2,530 \text{ g} \\ 1,855 \text{ g} \\ + 1,855 \text{ g} \\ \hline 6,240 \text{ g} \end{array} \quad \begin{array}{r} 61,760 \text{ g} \\ + 6,240 \text{ g} \\ \hline 68,000 \text{ g} \end{array}$$

$$W = 68,000 \text{ g}$$

Billy's weight before training was 68,000 grams.

If he lost his weight, he had to weigh more before, so I added all the weight he lost to how much he weighs now for my answer.



Answer Key

GRADE 4 • MODULE 2

Unit Conversions and Problem Solving With Metric Measurement

Lesson 1

Problem Set

- 1,000
 - 4,000
 - 7,000
 - 18
 - 100
 - 300
 - 8,000
 - 120
- 3,312
 - 13,027
 - 915,008
 - 356
 - 1,408
 - 12,046
- 3,720 m or 3 km 720 m
 - 81 cm
 - 14,600 m
 - 21,683 cm
 - 79,109 m or 79 km 109 m
 - 55,351 m or 55 km 351 m
- 1,737 cm or 17 m 37 cm
- 2,691 m or 2 km 691 m
- 283 cm or 2 m 83 cm
- 2,379 m or 2 km 379 m

Exit Ticket

- 71,000; 30; 8,100; 4
- 13,020
- 366,948 m or 366 km 948 m
- 260 cm or 2 m 60 cm

Homework

1.
 - a. 5,000
 - b. 13,000
 - c. 17
 - d. 60,000
 - e. 700
 - f. 1,900
 - g. 24
 - h. 9,000
2.
 - a. 7,123
 - b. 22,022
 - c. 875,004
 - d. 745
 - e. 6,707
 - f. 20,489
3.
 - a. 1,747 m or 1 km 747 m
 - b. 146 cm or 1 m 46 cm
 - c. 400,924 m
 - d. 64,586 cm
 - e. 177,555 m or 177 km 555 m
 - f. 717,640 m or 717 km 640 m
4. 1,822 cm or 18 m 22 cm
5. 6,710 m or 6 km 710 m
6. 647 m
7. 172 cm

Lesson 2

Problem Set

- 3,000; 4; 17,000; 20; 300,000
- 1,500
 - 3,715
 - 17,084
 - 25,009
 - 7; 481
 - 210,090
- 2,215 g or 2 kg 215 g
 - 763 g
 - 50,000 g
 - 6,660 g
 - 10 kg 217 g
 - 63 kg 139 g
- 8,444 g or 8 kg 444 g
- 4,975 g or 4 kg 975 g
- 28,077 g or 28 kg 77 g
- 5,962 g or 5 kg 962 g

Exit Ticket

- 21,415
 - 2,091
 - 87,017
 - 96; 20
- 57 kg 671 g or 57,671 g

Homework

1. 6,000; 8; 15,000; 24; 550,000
2.
 - a. 2,700
 - b. 5,945
 - c. 29,058
 - d. 31,003
 - e. 66; 597
 - f. 270,041
3.
 - a. 450 g
 - b. 4,270 g or 4 kg 270 g
 - c. 28,241 g
 - d. 18,800 g
 - e. 3 kg 874 g
 - f. 52 kg 239 g
4. 49,224 g or 49 kg 224 g
5. 3,715 g or 3 kg 715 g
6. 1,879 g or 1 kg 879 g

Lesson 3

Problem Set

- 5,000; 38,000; 49; 54,000; 92
- 2,500
 - 70,850
 - 33,015
 - 2,008
 - 3; 812
 - 86; 3
- 41,760 L or 41 L 760 mL
 - 3,600 mL or 3 L 600 mL
 - 29,290 mL
 - 18,992 mL
 - 6 L 878 mL
 - 18 L 557 mL
- Pineapple, ginger ale, tropical
 - 8,195 mL or 8 L 195 mL
- 1,790 mL or 1 L 790 mL
- 2,877 mL

Exit Ticket

- 6,127
 - 706,220
 - 12,009
 - 906; 10
- 59,114 mL or 59 L 114 mL
- 970,250 mL or 970 L 250 mL

Homework

1. 8,000; 27,000; 39; 68,000; 102
2.
 - a. 5,850
 - b. 29,303
 - c. 37,037
 - d. 17,002
 - e. 13; 674
 - f. 275; 5
3.
 - a. 593 mL
 - b. 2,260 mL or 2 L 260 mL
 - c. 28,360 mL
 - d. 30,100 mL
 - e. 8 L 575 mL
 - f. 12 L 779 mL
4. Marie's bucket
5. 17,735 mL or 17 L 735 mL
6. 28,657 mL or 28 L 657 mL

Lesson 4

Pattern Sheet

- | | | | |
|----------|-----------|------------|------------|
| 1. 4, 0 | 12. 10, 7 | 23. 4, 11 | 34. 6, 10 |
| 2. 6, 0 | 13. 9, 8 | 24. 5, 12 | 35. 6, 50 |
| 3. 5, 0 | 14. 5, 8 | 25. 6, 13 | 36. 8, 0 |
| 4. 9, 0 | 15. 3, 8 | 26. 6, 23 | 37. 8, 25 |
| 5. 4, 0 | 16. 3, 10 | 27. 8, 50 | 38. 8, 40 |
| 6. 6, 0 | 17. 6, 80 | 28. 10, 50 | 39. 9, 20 |
| 7. 8, 0 | 18. 6, 90 | 29. 8, 75 | 40. 8, 10 |
| 8. 10, 0 | 19. 7, 0 | 30. 8, 50 | 41. 9, 30 |
| 9. 6, 7 | 20. 7, 10 | 31. 5, 80 | 42. 8, 63 |
| 10. 7, 7 | 21. 7, 20 | 32. 5, 90 | 43. 11, 3 |
| 11. 8, 7 | 22. 7, 50 | 33. 6, 0 | 44. 18, 22 |

Problem Set

- Meter; kilogram; 1,000; liter; 100,000
- Ones
 - Meters
 - Thousands
 - Kilometers
 - Thousands
 - Grams
- 456,829
 - 456,829
- Explanations will vary.
- >
 - >
 - =
- Measurements plotted accurately on the number line
- Measurements plotted accurately on the number line

Exit Ticket

- Thousands
 - Kilograms
- 342,645
- >
 - <
 - <
- Measurements plotted accurately on the number line

Homework

- One; 1,000; kilogram; thousand; liter; 100,000
- Hundred
 - Meter
 - Thousand
 - Kilometer
 - Thousands
 - Grams
- 125,312
 - 125,312
- >
 - <
- 28,890 g or 28 kg 890 g
- Measurements plotted accurately on the number line
- Measurements plotted accurately on the number line

Lesson 5

Sprint

Side A

- | | | | |
|------------|------------|------------|------------|
| 1. 2, 0 | 12. 6, 101 | 23. 3, 800 | 34. 3, 400 |
| 2. 3, 0 | 13. 6, 10 | 24. 4, 770 | 35. 6, 0 |
| 3. 4, 0 | 14. 6, 11 | 25. 4, 807 | 36. 8, 0 |
| 4. 9, 0 | 15. 6, 1 | 26. 5, 65 | 37. 8, 0 |
| 5. 6, 0 | 16. 8, 2 | 27. 5, 40 | 38. 56, 0 |
| 6. 1, 0 | 17. 8, 20 | 28. 6, 7 | 39. 7, 0 |
| 7. 8, 0 | 18. 8, 200 | 29. 2, 3 | 40. 80, 0 |
| 8. 5, 0 | 19. 8, 22 | 30. 1, 90 | 41. 9, 0 |
| 9. 7, 0 | 20. 8, 220 | 31. 1, 55 | 42. 68, 0 |
| 10. 6, 100 | 21. 8, 222 | 32. 9, 404 | 43. 65, 0 |
| 11. 6, 110 | 22. 7, 256 | 33. 9, 330 | 44. 12, 0 |

Side B

- | | | | |
|------------|------------|------------|------------|
| 1. 1, 0 | 12. 5, 101 | 23. 2, 700 | 34. 4, 500 |
| 2. 2, 0 | 13. 5, 10 | 24. 3, 660 | 35. 5, 0 |
| 3. 3, 0 | 14. 5, 11 | 25. 3, 706 | 36. 7, 0 |
| 4. 8, 0 | 15. 5, 1 | 26. 4, 95 | 37. 9, 0 |
| 5. 6, 0 | 16. 7, 2 | 27. 4, 30 | 38. 72, 0 |
| 6. 9, 0 | 17. 7, 20 | 28. 5, 6 | 39. 8, 0 |
| 7. 4, 0 | 18. 7, 200 | 29. 3, 4 | 40. 85, 0 |
| 8. 7, 0 | 19. 7, 22 | 30. 2, 10 | 41. 9, 0 |
| 9. 5, 0 | 20. 7, 220 | 31. 2, 75 | 42. 72, 0 |
| 10. 5, 100 | 21. 7, 222 | 32. 1, 504 | 43. 70, 0 |
| 11. 5, 110 | 22. 4, 378 | 33. 1, 440 | 44. 12, 0 |

Problem Set

1. 5,790 g or 5 kg 790 g
2. 2,634 cm or 26 m 34 cm
3. 3,999 mL or 3 L 999 mL
4. 36,428 g or 36 kg 428 g
5. 34,125 mL or 34 L 125 mL
6. 185 cm or 1 m 85 cm

Exit Ticket

1. 245 g
2. 155 cm or 1 m 55 cm

Homework

1. 722 mL
2. 1,875 m or 1 km 875 m
3. 29,540 g or 29 kg 540 g
4. 45,066 g
5. 13 cm
6. 182,700 mL or 182 L 700 mL