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GRADE 4 • MODULE 2

Unit Conversions and Problem Solving with Metric Measurement

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Grade 4 • Module 2
Unit Conversions and Problem Solving with Metric Measurement

OVERVIEW

Students have become accustomed to thinking of 250 as 2 hundreds 5 tens, but the idea of a mixed unit shows up in many varied contexts, such as 2 hr 5 min, $2.50, 2 km 5 m, 2' 5", 2 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:

<table>
<thead>
<tr>
<th>2,437</th>
<th>$\rightarrow$ 2 thousands</th>
<th>437 ones</th>
<th>=</th>
<th>2,437 ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 km 437 m</td>
<td>$\rightarrow$ 2 kilometers</td>
<td>437 meters</td>
<td>=</td>
<td>2,437 meters</td>
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<tr>
<td>2 kg 437 g</td>
<td>$\rightarrow$ 2 kilograms</td>
<td>437 grams</td>
<td>=</td>
<td>2,437 grams</td>
</tr>
<tr>
<td>2 L 437 mL</td>
<td>$\rightarrow$ 2 liters</td>
<td>437 milliliters</td>
<td>=</td>
<td>2,437 milliliters</td>
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In order to explore the process of working with mixed units, Module 2 focuses on length, mass, and capacity in the metric system, 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 to decompose or convert 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). As students progress through the topics, they reason about correct unit sizes and use diagrams such as number lines with measurement scales to represent problems. Conversions between the units are recorded in a two-column table. Addition and subtraction single-step problems of metric units provides an opportunity to practice mental math calculations as well as solve using 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 of 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 will allow for further application and practice throughout subsequent modules, such as when multiplying and dividing metric units.

In Topic B, students again build off of their measurement work from previous grade levels, 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 both of our place value and measurement systems is the efficiency and precision permitted by the use of different size

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1 Pounds, ounces, time, and money will be covered in Module 7.
units to express a given quantity. As students solve word problems by adding and subtracting metric units, their ability to reason in parts and wholes is taken to the next level, which is important preparation for multi-digit operations and for manipulating fractional units in future modules. Tape diagrams and number lines will serve as models throughout to support applying the standard algorithm to word problems.

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

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2 4.MD.3 is addressed in Module 3.
3 Pounds, ounces, and time are addressed in Module 7. This is a non-tested standard, but expressing metric measurements of length, weight, and volume from larger to smaller units strengthens the upcoming modules.
4 Time and money will be addressed in Module 7. This is a non-tested standard, but the context of operating on distance, volume, and mass strengthens the upcoming modules.
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 special cases:

   a. 100 can be thought of as a bundle of ten tens — called a “hundred.”

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.

**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 are able to fluently add and subtract metric units of length, weight, and capacity using the standard algorithm. Tape diagrams and number lines conceptualize a problem before it is solved and are used to find the reasonableness of an answer.

MP.7  **Look for and make use of structure.** Students use place value and mixed units knowledge to find similarities and patterns when converting from a larger unit to a smaller unit. Making use of parts and wholes allows for seamless conversion. They recognize that 1 thousand equals 1,000 ones relates 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 metric unit conversions share a relationship on the place value chart. 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

<table>
<thead>
<tr>
<th>Standards</th>
<th>Topics and Objectives</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.MD.1 4.MD.2</td>
<td><strong>A</strong> Metric Unit Conversions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lesson 1: Express metric length measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric length.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lesson 2: Express metric mass measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric mass.</td>
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<tr>
<td></td>
<td>Lesson 3: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity.</td>
<td></td>
</tr>
<tr>
<td>4.MD.1 4.MD.2</td>
<td><strong>B</strong> Application of Metric Unit Conversions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lesson 4: Know and relate metric units to place value units in order to express measurements in different units.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lesson 5: Use addition and subtraction to solve multi-step word problems involving length, mass, and capacity.</td>
<td></td>
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<tr>
<td></td>
<td>End-of-Module Assessment: Topics A–B (assessment ½ day, return ½ day, remediation or further applications 1 day)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Number of Instructional Days</strong></td>
<td>7</td>
</tr>
</tbody>
</table>

Terminology

New or Recently Introduced Terms

- 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 Symbols

- =, <, > (equal, less than, greater than)

These are terms and symbols students have used or seen previously.
• Capacity (the maximum amount that something can contain)
• Convert (to express a measurement in a different unit)
• Distance (the length of the line segment joining two points)
• Equivalent (equal)
• Estimate (an approximation of the value of a number or quantity)
• 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)
• Table (used to represent data)
• Weight (the measurement of how heavy something is)

Suggested Tools and Representations

• Beakers or liter container
• Number line
• Ruler, meter stick, measuring tape
• Scale, weights (masses)
• Tape diagrams

Scaffolds

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 applicable to more than one population. The charts included in Module 1 provide a general overview of the lesson-aligned scaffolds, organized by Universal Design for Learning (UDL) principles. To read more about the approach to differentiated instruction in A Story of Units, please refer to “How to Implement A Story of Units.”

6 Students 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.
## Assessment Summary

<table>
<thead>
<tr>
<th>Type</th>
<th>Administered</th>
<th>Format</th>
<th>Standards Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-of-Module Assessment Task</td>
<td>After Topic B</td>
<td>Constructed response with rubric</td>
<td>4.MD.1 4.MD.2</td>
</tr>
</tbody>
</table>

Module 2: Unit Conversions and Problem Solving with Metric Measurement

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**Topic A**

**Metric Unit Conversions**

**4.MD.1, 4.MD.2**

| Focus Standard: | 4.MD.1 | Know relative sizes of measurement units within one system of 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), ...** |
| Coherence | 4.MD.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 |

In order to explore the process of working with mixed units, Module 2 focuses on length, mass, and capacity in the metric system, 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 to decompose or convert 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 see the ease of 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). As students progress through the lessons, they reason about correct unit sizes and use diagrams such as number lines with measurement scales to represent problems. Addition and subtraction single-step problems of

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

2 Time 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.

3 Pounds, ounces, time, and money will be covered in Module 7.
metric units provide an opportunity to practice simplifying strategies as well as solve using 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).

Algorithm:

\[
\begin{align*}
2 \text{ km } 608 \text{ m} &+ 3 \text{ km } 412 \text{ m} \\
\hline
5 \text{ km } 1020 \text{ m} \\
1 \text{ km } 20 \text{ m} \\
6 \text{ km } 20 \text{ m} = 6020 \text{ m}
\end{align*}
\]

Simplifying Strategies:

\[
\begin{align*}
2 \text{ km} + 3 \text{ km} &= 5 \text{ km} \\
608 \text{ m} + 412 \text{ m} &= 1020 \text{ m} \\
\hline
5 \text{ km} + 1 \text{ km} 20 \text{ m} &= 6 \text{ km } 20 \text{ m}
\end{align*}
\]

Word problems provide a context in which to apply the conversions, including adding and subtracting mixed units in all lessons. Connecting their familiarity of 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 will allow for further application and practice throughout subsequent modules, such as when multiplying and dividing metric units.

**A Teaching Sequence Towards 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

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: Reviewing these conversions in isolation will help students apply their operations in word problems.

T: (Write 100 cm = ____ m.) 100 centimeters is the same as how many meters?
S: 1 meter.
Repeat process using the following possible sequence: 200 cm, 300 cm, 800 cm, and 500 cm.

T: (Write 1 m = ____ cm.) How many centimeters are in 1 meter?
S: 100 centimeters.
Repeat process using the following possible sequence: 2 m, 3 m, 7 m, 4 m, 9 m.

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.1 and 2.MD.5.

On some occasions, students will work beyond the 4.MD.1 and 4.MD.2 standards by converting from a smaller to a larger unit. This conversion up will be established by creating a connection between units of measures related to place value.

If your students are not ready for the conversions up, you might work in small groups to further develop the number sense necessary for understanding these conversions and always accept answers in the smaller unit.
Meter and Centimeter Number Bonds (8 minutes)

Materials: (S) Personal white boards

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

T: (Project a number bond with 150 centimeters written as the whole and 1 meter as one of the parts.) How many centimeters are in 1 meter?
S: 100 centimeters.
T: (Beneath 1 m, write 100 cm.) On your white boards, write a number bond filling in the missing part.
S: (Write a number bond with a whole of 150 cm and parts 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 missing 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: Write the whole as an addition sentence with mixed units.
S: (Write 1 m + 100 cm = 1 m + 1m = 2 m.)

Repeat the process for 2 m + 100 cm = 3 m and 100 cm + 5 m = 6 m.

Application Problem (8 minutes)

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

Elizabeth sprinted 4,700 meters.
4 km 700 m
Note: This Application Problem builds on G4–M1–Lesson 19. Note that Solution A models the standard algorithm whereas Solution B records a simplifying strategy using number bonds, an application of strategies taught since Grade 1 in which students complete a unit or take from a whole unit. 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) Stapler and staples, ruler, meter stick, teacher-made poster with metric units  (S) Personal white boards

Introduction: Understanding 1 centimeter, 1 meter, and 1 kilometer in terms of concrete objects.

Begin with a brief five-minute discussion of 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 demonstrate the size of a centimeter and meter by indicating the size of the concrete examples that are given.
- 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.

**NOTES ON MULTIPLE MEANS OF REPRESENTATION:**

Students who are English language learners may benefit from further discussion of concrete items that are about the same length as a centimeter, meter, and 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 1

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

Use a two-column table as pictured on 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 m = ____ km on your board. If 1,000 m = 1 km, 2,000 m = how many kilometers? |
| S: | 2 kilometers. |

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

| T: | Compare kilometers and meters. |
| S: | 1 kilometer is 1,000 times as much as 1 meter. ➔ A kilometer is a longer distance because we need 1,000 meters to equal 1 kilometer. |
| T: | (Display 1 km 500 m = ____ m.) Convert 1 km 500 m to meters. 1 kilometer is equal to how many meters? |
| S: | 1,000 meters. |
| T: | (Display 1 km 300 m = ____ 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? |
| 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 2

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

Display horizontally 5 km + 2,500 m.

| T: | Talk for one minute with your partner about how to solve this problem. |
| S: | We have 5 km and 2,500 m. ➔ We can’t add different units together. ➔ We can rename the kilometers to meters before adding. 5 kilometers equals 5,000 meters, so 5,000 m + 2,500 m = 7,500 m. ➔ 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?

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

\[
\begin{align*}
5 \text{ km} & + 2,500 \text{ m} \\
5,000 \text{ m} & + 2,500 \text{ m} \\
7,500 \text{ m} & = 7 \text{ km} 500 \text{ m}
\end{align*}
\]

T: When we added meters, the answer was 7,500 m. When we added mixed units, the answer was 7 km 500 m. Why are they the same amount?

S: It is the same amount because 7 km = 7,000 m and 7,000 m + 500 m = 7,500 m.

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

S: Simplifying strategy, because the 7 hundred and 3 hundred is a kilometer and 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. If you finish before two minutes is 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. Solutions A and B are algorithms. Solutions C and D are simplifying strategies.
Problem 3

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

T: (Display horizontally: 10 km – 3 km 140 m.) 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. If you finish either before two minutes is 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 mental math strategy.

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

T: Look at Solution A. How did they set up for the algorithm?
S: They rewrote everything as meters.
T: What did they do in Solution B?
S: They changed 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 rewriting 1 kilometer as 1,000 meters.
T: Does anyone have a question for the mental math team?
S: How did you know 1 thousand minus 140 was 860?

S: We just subtracted a hundred and then thought of 40 less than 900. We know 6 tens and 4 tens is a 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 it is because they matched kilometers to meters. → You can regroup 6 kilometers as 6,000 meters. → You can regroup 6,000 meters to 6 kilometers. → Both are the same amounts, but represented using different units, either mixed or a single unit.

Problem 4

Solve an application problem using 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?

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 it is because they matched kilometers to meters. → You can regroup 6 kilometers as 6,000 meters. → You can regroup 6,000 meters to 6 kilometers. → Both are the same amounts, but represented using different units, either mixed or a single unit.

Problem 4

Solve an application problem using 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.

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 careful sequencing of the Problem Set guide your selections so that problems continue to be scaffolded. Balance word problems with other problem types to ensure a range of practice. Assign 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. You may choose to use any combination of the questions below 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?

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 in the Problem Set?

Look at Problem 4 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 you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
1. Find the equivalent measures.
   a. \(1 \text{ km} = \underline{\quad} \text{ m}\)
   b. \(4 \text{ km} = \underline{\quad} \text{ m}\)
   c. \(7 \text{ km} = \underline{\quad} \text{ m}\)
   d. \(\underline{\quad} \text{ km} = 18,000 \text{ m}\)
   e. \(1 \text{ m} = \underline{\quad} \text{ cm}\)
   f. \(3 \text{ m} = \underline{\quad} \text{ cm}\)
   g. \(80 \text{ m} = \underline{\quad} \text{ cm}\)
   h. \(\underline{\quad} \text{ m} = 12,000 \text{ cm}\)

2. Find the equivalent measures.
   a. \(3 \text{ km} 312 \text{ m} = \underline{\quad} \text{ m}\)
   b. \(13 \text{ km} 27 \text{ m} = \underline{\quad} \text{ m}\)
   c. \(915 \text{ km} 8 \text{ m} = \underline{\quad} \text{ m}\)
   d. \(3 \text{ m} 56 \text{ cm} = \underline{\quad} \text{ cm}\)
   e. \(14 \text{ m} 8 \text{ cm} = \underline{\quad} \text{ cm}\)
   f. \(120 \text{ m} 46 \text{ cm} = \underline{\quad} \text{ cm}\)

3. Solve.
   a. \(4 \text{ km} - 280 \text{ m} = \underline{\quad}\)
   b. \(1 \text{ m} 15 \text{ cm} - 34 \text{ cm} = \underline{\quad}\)
   c. Express your answer in the smaller of the two units:
      \(1 \text{ km} 431 \text{ m} + 13 \text{ km} 169 \text{ m} = \underline{\quad}\)
   d. Express your answer in the smaller of the two units:
      \(231 \text{ m} 31 \text{ cm} - 14 \text{ m} 48 \text{ cm} = \underline{\quad}\)
   e. \(67 \text{ km} 230 \text{ m} + 11 \text{ km} 879 \text{ m} = \underline{\quad}\)
   f. \(67 \text{ km} 230 \text{ m} - 11 \text{ km} 879 \text{ m} = \underline{\quad}\)
Use a tape diagram to model each problem. Solve using simplifying strategies 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?

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. | Distance |
   | 71 km | _______ m |
   | _____ km | 30,000 m |
   | 81 m | _____ cm |
   | _____ m | 400 cm |

2. 13 km 20 m = _________ m

3. 401 km 101 m – 34 km 153 m = ____________

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 km = __________ m
e. 7 m = __________ cm
   b. 13 km = __________ m
f. 19 m = __________ cm
c. __________ m = 17,000 m
g. __________ m = 2,400 cm
d. 60 km = __________ m
h. 90 m = __________ cm

2. Find the equivalent measures.
   a. 7 km 123 m = __________ m
d. 7 m 45 cm = __________ cm
   b. 22 km 22 m = __________ m
e. 67 m 7 cm = __________ cm
   c. 875 km 4 m = __________ m
f. 204 m 89 cm = __________ cm

3. Solve.
   a. 2 km 303 m – 556 m =
   b. 2 m – 54 cm =
   c. Express your answer in the smaller of the
two units:
      338 km 853 m + 62 km 71 m =
   d. Express your answer in the smaller of the two
      units:
      800 m 35 cm – 154 m 49 cm =
   e. 701 km – 523 km 445 m =
   f. 231 km 811 m + 485 km 829 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 she 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 did 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 boards

Note: Reviewing these conversions in isolation will help students apply their operations in word problems.

T: (Write 1 m = ___ cm.) 1 meter is how many centimeters?
S: 100 centimeters.

Repeat the process and sequence for 2 m, 3 m, 9 m, and 6 m.

T: (Write 1,000 g = ____ kg.) 1,000 grams is the same as how many kilograms?
S: 1 kilogram.

Repeat the process and sequence for 2,000 g, 3,000 g, 7,000 g, and 5,000 g.

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 missing part.

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.1 and 2.MD.5.

Occasionally, students will work beyond the 4.MD.1 and 4.MD.2 standards by converting from a smaller to a larger unit. These advanced conversions will be established by connecting metric units to place value units.

Develop your 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 fluency. 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.
Lesson 2

NYS COMMON CORE MATHEMATICS CURRICULUM

4.2

Lesson 2

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

Date: 7/3/13

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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 compound units.
S: (Write 1 kg + 1,000 g = 1 kg + 1 kg = 2 kg.)

Repeat the process for 2 kg + 1,000 g = 3 kg and 1,000 kg + 4 kg = 5 kg.

Unit Counting (4 minutes)

Note: This fluency will deepen student understanding of the composition and decomposition of unit conversions, laying a foundation for adding and subtracting meters and centimeters.

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 boards

Note: Reviewing this fluency learned in Lesson 1 will help students work towards mastery of adding and subtracting meters and centimeters.

T: (Write 540 cm + 320 cm = ___.) 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 m 40 cm + 3 m 20 cm = ___.) 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 cm + 350 cm = ___.) On your boards, write 420 cm + 350 cm by combining meters and centimeters.
S: (Write 4 m 20 cm + 3 m 50 cm = 7 m 70 cm.)

Repeat the process for possible sequence 650 cm – 140 cm and 780 cm – 210 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. How far is it from Camie’s house to school? Solve using simplifying strategies or an algorithm.

Note: This Application Problem reviews G4–M2–Lesson 1. Students will 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, small paper clips, dollar bill, dictionary, balance scale or weights  (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: This dictionary weighs about 1 kilogram.

T: 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 just as heavy as this dictionary?

S: 1,000.

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.
Lesson 2

NYS COMMON CORE MATHEMATICS CURRICULUM

Lesson 2

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

Date: 7/3/13

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T: (Display a two-column chart and fill in together.) We know that 1 kilogram equals 1,000 grams.
T: How many grams is 2 kilograms? (2,000 g)
T: How many kilograms is 3,000 grams? (3 kg.)

Continue up to 10 kilograms.

T: Compare kilograms and grams.
S: 1 kilogram is 1,000 times as much as 1 gram. → A kilogram is heavier because we need 1,000 grams to equal 1 kilogram.
T: (Display 1 kg 500 g = _____ g.) 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 530g.)
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.

Display horizontally: 8 kg + 8,200 g.

T: Talk for one minute with your partner about how to solve this problem.
S: We can’t add different units together. → We can rename 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?
S: There is no regrouping. → I can add the numbers easily in my head. 8,200 g = 8 kg 200 g. → 8 kg 200 g + 8 kg = 16 kg 200 g.
T: (Display horizontally: 25 kg 537 g + 5 kg 723 g.) A simplifying strategy or the algorithm? Discuss with your partner.
Lesson 2: Express metric mass measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric mass.

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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, you may choose to alter the degree of difficulty of the computations.

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. If you finish either before two minutes is 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.

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

Note: Students have been learning numerous mental math 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 horizontally: 10 kg – 2 kg 250 g.) 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. If you finish either 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.
After two minutes, review the student work on the board, which hopefully includes strategies such as those above. If not, gently supplement. Solutions A and B are algorithms. Solutions C, D, and E are simplifying strategies.

T: Look at the first algorithm used by your peers. How did they prepare the algorithm 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 mental 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. Subtracting 50 from a unit in the hundreds is easy.
T: How did our mental math team solve the problem?
Lesson 2

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

Date: 7/3/13

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 horizontally: 32 kg 205 g – 5 kg 316 g.) 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.

Note: Not all problems present themselves as easily solved using a simplifying strategy. Encourage students to evaluate the problem carefully to decide the most efficient course in solving problems.

Problem 4

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

A suitcase cannot exceed 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.

T: (After one minute.) Tell your partner the known and unknown information.

S: We know how much Robert’s suitcase is allowed to hold and how much it is holding. 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 missing part on your diagram and make a statement of the solution.
Circulate, reviewing the students’ work, which hopefully includes strategies such as those below. If not, gently supplement. Solutions A and B are algorithms. 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 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. You may choose to use any combination of the questions below 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?

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 you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 2 Problem Set

Name ____________________________ Date ________________

1. Complete the table.

<table>
<thead>
<tr>
<th>Mass</th>
<th>kg</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1,000</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>4,000</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>20,000</td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Find the equivalent measures.

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

3. Solve.
   a. 3,715 g – 1,500 g =
   b. 1 kg – 237 g =
   c. Express the answer in the smaller unit:
      25 kg 9 g + 24 kg 991 g =
   d. Express the answer in the smaller unit:
      27 g 650 g – 20 kg 990 g =
   e. Express the answer in mixed units:
      14 kg 505 g – 4,288 g =
   f. Express the answer in mixed units:
      5 kg 658 g + 57,481 g =

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

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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. One package weighs 2 kg 485 g. Another package weighs 5 kg 959 g. What is the total weight of the two packages?

5. Together, a pineapple and a watermelon weigh 6 kg 230 g. If the pineapple weighs 1 kg 255 g, how much does the watermelon weigh?

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

7. The table below shows the weight of three Grade 4 students.

<table>
<thead>
<tr>
<th>Student</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabel</td>
<td>35 kg</td>
</tr>
<tr>
<td>Irene</td>
<td>29 kg 38 g</td>
</tr>
<tr>
<td>Sue</td>
<td>29,238 g</td>
</tr>
</tbody>
</table>

How much heavier is Isabel than the lightest student?
Name ________________________________ Date __________________

1. Find the equivalent measures.
   a. 21 kg 415 g = __________ g
   b. 2 kg 91 g = __________ g
   c. 87 kg 17 g = __________ g
   d. ____ kg _____ g = 96,020 g

Directions: Use a tape diagram to model and solve the problems below.

The table below shows the weight of three dogs.

<table>
<thead>
<tr>
<th>Dog</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Dane</td>
<td>59 kg</td>
</tr>
<tr>
<td>Golden Retriever</td>
<td>32 kg 48 g</td>
</tr>
<tr>
<td>Chihuahua</td>
<td>1,329 g</td>
</tr>
</tbody>
</table>

2. Put the three dogs in order from lightest to heaviest.

3. How much more does the Great Dane weigh than the Chihuahua?
Lesson 2 Homework

Name ________________________________ Date ____________________________

1. Complete the table.

<table>
<thead>
<tr>
<th>Mass</th>
<th>kg</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>8,000</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>24,000</td>
</tr>
<tr>
<td></td>
<td>550</td>
<td></td>
</tr>
</tbody>
</table>

2. Find the equivalent measures.

a. 2 kg 700 g = __________ g
b. 5 kg 945 g = __________ g
c. 29 kg 58 g = __________ g
d. 31 kg 3 g = __________ g
e. 66,597 g = _____ kg _____ g
f. 270 kg 41 g = __________ g

3. Solve.

a. 370 g + 80 g =

b. 5 kg – 730 g =

c. Express the answer in the smaller unit:
   27 kg 547 g + 694 g =

d. Express the answer in the smaller unit:
   16 kg + 2,800 g =

e. Express the answer in mixed units:
   4 kg 229 g – 355 g =

f. Express the answer in mixed units:
   70 kg 101 g – 17 kg 862 g =
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. One suitcase weighs 23 kg 696 g. Another suitcase weighs 25 kg 528 g. What is the total weight of the two suitcases?

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

6. The table below shows the weight of three dogs.

<table>
<thead>
<tr>
<th>Student</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lassie</td>
<td>21 kg 249 g</td>
</tr>
<tr>
<td>Riley</td>
<td>23 kg 128 g</td>
</tr>
<tr>
<td>Fido</td>
<td>21,268 g</td>
</tr>
</tbody>
</table>

What is the weight difference between the heaviest and lightest dog?
Lesson 3

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

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.1 and 2.MD.5. Occasionally, students will work beyond the 4.MD.1 and 4.MD.2 standards by converting from a smaller to a larger unit. These advanced conversions will be established by connecting metric units to place value units. Develop your students’ basic number sense to make these conversions and always accept answers in the smaller unit.

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 (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 boards

Note: Reviewing these conversions in isolation will help students apply their operations in word problems.

T: (Write 1 m = ____ cm.) One meter is how many centimeters?
S: 100 centimeters.
Repeat the process for 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 m = ____ km.) 1,000 meters is the same as how many kilometers?
S: 1 kilometer.
Repeat the process and sequence for 2,000 meters, 3,000 meters, 6,000 meters, and 9,000 meters.

T: (Project a number bond with 2 kilometers written as the whole, 1 kilometer as one of the parts, and ____ m as the other part.) Fill in the missing 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 compound units.
S: (Write 1 km + 1,000 m = 2 km.)

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Repeat the process for 2 km + 1,000 m = 3 km and 1,000 m + 7 km = 8 km.

**Unit Counting (5 minutes)**

**Note:** This fluency will deepen student understanding of the composition and decomposition of units, laying a foundation for adding and subtracting grams and kilograms. Numbers are bolded to show change in direction of counting.

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

- 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 kg 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 boards

**Note:** Reviewing this fluency learned in G4–M2–Lesson 1 will help students work towards mastery of adding and subtracting meters and centimeters.

T: Write 560 cm + 230 cm = ____. Below it, write ____ m ____ cm + ____ m ____ cm = _____ m _____ cm on your white boards, and now complete the two addition sentences.

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

Repeat process for 650 cm – 230 cm and 470 cm + 520 cm.

**Application Problem (8 minutes)**

The Lee family had 3 liters of water. Each liter of water weighs 1 kilogram. At the end of the day they have 290 grams of water left. How much water did they drink? Draw a tape diagram and solve using mental math or an algorithm.

**Note:** This Application Problem reviews G4–M2–Lesson 2’s subject of grams and kilograms, while connecting to this lesson of liters. Students can express kilograms in terms of grams and subtract to solve a measurement word problem involving a tape diagram. Also, students may recall that 1 milliliter of water weighs 1 gram, and use this fact to report their answer in liters and milliliters.
Lesson 3

Concept Development (30 minutes)

Materials: (T) Several 3-liter beakers, water (S) 3-liter beaker with measurements of liters and milliliters, water, personal white boards

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. (Students pour.) 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 L = 1,000 mL on the board.)
T: With your partner, locate 1,500 mL and pour in more water to measure 1,500 mL. (Students pour.) How many liters do you have?
S: Less than 2 but more than 1 liter. → 1 liter 500 milliliters.
T: Yes, just like we named mixed units of kilograms and grams in the last lesson, we can use mixed units of liters and milliliters by using both sides of the scale on the beaker.
T: (Write 1 L 500 ml = 1,500 mL on the board.)
T: Pour water to measure 2 liters. How many milliliters equals 2 liters?
S: 2,000 milliliters.
T: Pour more water to measure 2,200 mL of water. How many liters equals 2,200 mL?
S: 2 L 200 mL.

Activity: Prepare several beakers with different amounts of water, for example, 1 liter, 1,400 milliliters, 1,750 milliliters, 2 liters, 2,300 milliliters. Have students circulate to each beaker, recording the amount of water as mixed units of liters and milliliters and as milliliters. Compare answers as a class and record findings on the board to show equivalency between mixed units of liters and milliliters and milliliters.
Problem 2

Add mixed units of capacity using the algorithm or a simplifying strategy.

T: (Display horizontally: 32 L 420 mL + 13 L 585 mL.) Will you use a simplifying strategy or an algorithm?

S: A simplifying strategy because 420 mL decomposes to 15 mL, 5 mL, and 400 mL. 585 plus 15 make 600 milliliters. 600 and 400 milliliters make 1 liter, with 5 left over. 46 liters 5 milliliters.

T: Choose the way you want to do it. If you finish before two minutes is 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.

After two minutes, review the student work on the board, which hopefully includes strategies such as those below. If not, gently supplement. Solutions A and B are algorithms. Solution C is a simplifying strategy.

\[
\begin{align*}
\text{(A)} & \quad 32 \text{ L} 420 \text{ mL} + 13 \text{ L} 585 \text{ mL} \\
& = 46,005 \text{ mL} \\
& = 46 \text{ L} 5 \text{ mL}
\end{align*}
\]

\[
\begin{align*}
\text{(B)} & \quad 32 \text{ L} 420 \text{ mL} + 13 \text{ L} 585 \text{ mL} \\
& = 45 \text{ L} 1005 \text{ mL} \\
& = 46 \text{ L} 5 \text{ mL}
\end{align*}
\]

\[
\begin{align*}
\text{(C)} & \quad 32 \text{ L} + 13 \text{ L} = 45 \text{ L} \\
& \quad 420 \text{ mL} + 585 \text{ mL} = 1005 \text{ mL} \\
& \quad 46 \text{ L} 5 \text{ mL}
\end{align*}
\]

T: What strategies can we use to solve?

S: We can convert to milliliters before adding. 32 L 420 mL = 32,420 mL. 13 L 585 mL = 13,585 mL. The sum is 46,005 mL.

S: I know that 1,000 mL = 1 L. So 46,005 mL is equivalent to 46 L 5 mL.

S: We can also add the mixed units. 32 L + 13 L = 45 L. 420 mL + 585 mL = 1,005 mL. 1,005 mL is the same as 1 L 5 mL. When I add 45 L and 1 L 5 mL, I get a sum of 46 L 5 mL.

S: We can also count up. 32 L 420 mL + 580 mL = 33 L. 33 L + 13 L = 46 L. 46 L + 5 mL = 46 L 5 mL.

Problem 3

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

T: (Display horizontally: 12 L 215 mL – 8 L 600 mL.) 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. A simplifying strategy. I can count on from 8 liters 600 milliliters. I can do mental math. I’ll show you when we solve.
T: Choose the way you want to do it. If you finish before two minutes is 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.

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

T: Look at the first algorithm. How did they set it up?
S: They regrouped 12 liters 215 milliliters to 11 liters 1,215 milliliters.

T: How is the second algorithm set up?
S: They converted to milliliters before solving and then wrote their answer as a mixed unit.

T: Does anyone have a question on either of the simplifying strategies problems?
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 easily add to regroup to a liter, and then add enough liters and milliliters to reach the total.

T: Compare the counting up strategies, the number line, and the arrow notation and take a moment to review the solution strategies on the board.
Problem 4

Solve a word problem involving mixed units of capacity.

Jennifer was making 2,170 milliliters of her favorite drink that combines iced tea and lemonade. If she put 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.

T: (After two minutes.) Tell your partner the known and unknown information.

S: We know how much iced tea she put in and how much of her favorite drink she is making. We don’t know how much lemonade she needs.

T: Work with your partner to solve for the difference. Will you use a simplifying strategy or an algorithm?

S: A simplifying strategy. I know that 300 + 700 is 1,000. That brings us to 2 liters. Then all I need to do is add 170 milliliters more. 700 + 170 = 870 mL.

T: Label the missing part on your diagram and make a statement of the solution.

S: Jennifer needs 870 milliliters of lemonade.

T: Check your answer by using the subtraction algorithm with your partner.

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.
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. You may choose to use any combination of the questions below 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 distance, 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 weight and length?
Exit Ticket  (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 3: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity.

Date: 8/5/13

Name ____________________________ Date ________________

1. Complete the table.

<table>
<thead>
<tr>
<th>Liquid Capacity</th>
<th></th>
<th>mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>1</td>
<td>1,000</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td></td>
<td>92,000</td>
</tr>
</tbody>
</table>

2. Find the missing numbers.

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

b. $70 \text{ L } 850 \text{ mL} = \underline{_____________}\text{ mL}$

c. $33 \text{ L } 15 \text{ mL} = \underline{_____________}\text{ mL}$

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

e. $3,812 \text{ mL} = \underline{____}\text{ L ______}\text{ mL}$

f. $86,003 \text{ mL} = \underline{____}\text{ L ______}\text{ mL}$

3. Solve.

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

b. $7 \text{ L } 3,400 \text{ mL} = \underline{____}\text{ L ______}\text{ mL}$

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:

$31 \text{ L } 433 \text{ mL} – 12 \text{ L } 876 \text{ mL} =$
Lesson 3: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity.

Date: 8/5/13

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. 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 to make punch.
   a. Order the quantity of each drink from least to greatest.

   b. How much punch did John’s mother make?

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?

6. Petra’s fish tank contains 9 liters 578 milliliters of water. If the tank can hold 12 liters 455 milliliters of water, how many more milliliters of water does she need to fill the tank?
Name ________________________________ Date __________________

1. Find the missing numbers.
   
   a. \(6 \text{ L} 127 \text{ mL} = \ _______ \text{ mL}\)
   
   b. \(706 \text{ L} 220 \text{ mL} = \ _______ \text{ mL}\)
   
   c. \(12 \text{ L} 9 \text{ mL} = \ _______ \text{ mL}\)
   
   d. \(_______ \text{ L} \ _______ \text{ mL} = 906,010 \text{ mL}\)

2. \(81 \text{ L} 603 \text{ mL} - 22 \text{ L} 489 \text{ mL} = \)

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?
Lesson 3 Homework

1. Complete the table.

<table>
<thead>
<tr>
<th>Liquid Capacity</th>
<th>mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>1,000</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>27</td>
<td>39,000</td>
</tr>
<tr>
<td>68</td>
<td>102,000</td>
</tr>
</tbody>
</table>

2. Find the missing numbers.

a. 5 L 850 mL = __________mL
b. 29 L 303 mL = __________mL
c. 37 L 37 mL = __________mL
d. 17 L 2 mL = __________mL
e. 13,674 mL = _____ L _______mL
f. 275,005 mL = _____ L _______mL

3. Solve.

a. 545 mL + 48 mL =

b. 8 L – 5,740 mL =

c. Express the answer in the smaller unit:
27 L 576 mL + 784 mL =

d. Express the answer in the smaller unit:
27 L + 3,100 mL =

e. Express the answer in mixed units:
9 L 213 mL – 638 mL =

f. Express the answer in mixed units:
41 L 724 mL – 28 L 945 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 was filled with 2,530 milliliters of water, Marie’s bucket was filled with 2 liters 30 milliliters of water, and Katie’s bucket was filled with 2 liters 350 milliliters of water. Whose bucket had 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 the car’s gas were used. Then 19 liters 878 milliliters more were used. If the gas tank can hold 56 liters 202 milliliters of gas, how much gas remains?
In Topic B, students again build off of their measurement work from previous grade levels, 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, they discover and explore the relationship between place value and conversions. The beauty of our place value and measurement systems is the efficiency and precision permitted by the use of different size units to express a given quantity.

Lesson 4 will extract the connection of metric measurement conversions to place value by making statements such as, “1 kilometer is 1,000 times as much as 1 meter,” as well as comparing mixed units of measure. As students solve two- and three-step word problems by adding and subtracting metric units, their ability to

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

2 Time 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.
reason in parts and wholes is taken to the next level, which is important preparation for multi-digit operations and for manipulating fractional units in future modules. Tape diagrams and number lines will serve as models throughout to support applying the standard algorithm to word problems. Students solve problems by converting between units and by using simplifying strategies or algorithms (4.MD.1).

### A Teaching Sequence Towards 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 and Subtract 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 drill will prepare students for G4-M3-Lesson 1’s Content 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 lengths?
S: 10 units.
T: What’s the length of the shortest side?
S: 3 units.
Lesson 4

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

Date: 7/3/13

T: (Write 3 units. Point to the missing side.) What’s the length of the missing side?
S: 3 units.

T: (Write 3 units.) What’s the sum of the rectangle’s two shortest lengths?
S: 6 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 process for 4 × 3 and 6 × 4 rectangles.

Add and Subtract Meters and Centimeters (2 minutes)

Materials: (S) Add and Subtract Meters and Centimeters Pattern Sheet

Note: Work with mixed units of meters and centimeters supports students in understanding mixed units of all kinds: liter and milliliters, kilometers and meters, kilograms and grams, whole numbers and fractional units, for example.

T: (Distribute Add and Subtract 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 to whole liters.

Convert Units (2 minutes)

Materials: (S) Personal white boards

Note: Reviewing these conversions in isolation will help students apply their operations in word problems.

T: (Write 1 m 20 cm = ____ cm.) 1 m 20 cm is how many centimeters?
S: 120 centimeters.

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

T: (Write 1,500 g = ___ kg ___ g.) On your boards, fill in the equation.
S: (Write 1,500 g = 1 kg 500 g.)

Repeat the process for 1,300 g, 1,030 g, and 1,005 g.
T:  (Write 1 liter 700 mL = ___ mL.) On your boards, fill in the equation.
S:  (Write 1 liter 700 mL = 1,700 mL)

Repeat the process for 1 liter 70 mL, 1 liter 7 mL, and 1 liter 80 mL.

**Unit Counting (4 minutes)**

Note: This fluency will deepen student understanding of the composition and decomposition of unit conversions, laying a foundation for adding and subtracting liters and milliliters.

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 liter 500 mL, 3 liters, 2 liter 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 day four, 979 milliliters of water remained in the beaker. How much water evaporated?

Note: This Application Problem builds on Lesson 3. Students might express measurements in liters in terms of milliliters and subtract to solve a measurement word problem involving a tape diagram using either the more traditional algorithm or a different strategy based on place value decomposition as pictured above.
Lesson 4

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

Date: 7/3/13

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Concept Development (30 minutes)

Materials: (T) Place value chart (S) Personal white boards

Problem 1

Note patterns of times as much 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, 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 answer as an equation.

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

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.

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

S: Yes. One kilogram is 1,000 times as much as 1 gram like 1 thousand is 1,000 times as much 1 one. \( \rightarrow \) And 1 hundred thousand is 1,000 times as much as 1 hundred. 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: 1 meter = 100 \( \times \) 1 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. And 1 hundred thousand is 100 times as much as 1 thousand. 1 ten thousand is 100 times as much as 1 hundred.
Problem 2

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

T:  (Write 1 m = 100 cm.) One meter is 100 centimeters. What unit is 100 ones?
S: 1 hundred = 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 = 1,000 ones.
T: You renamed 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.

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.
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.

S: 724,706 mL __ 72 L 760 mL

724 L 760 mL

724 > 72
T: Draw a number line from 0 kilometer to 2 kilometers. One 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 easy, 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.

T: (Write 7,256 m, 7 km 246 m, and 725,900 cm.) Work with your partner to place these measures on the number line.

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 = 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 measures have 7 kilometers, I can compare meters. 256 is more than 246. 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 measures from smallest to greatest.
Lesson 4

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

Date: 7/3/13

Problem Set (10 minutes)

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

Student Debrief (10 minutes)

Lesson Objective: 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. You may choose to use any combination of the questions below 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 you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 4: Know and relate metric units to place value units in order to express measurements in different units.

A

<table>
<thead>
<tr>
<th></th>
<th>Write in meters and centimeters.</th>
<th># Correct _____</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 m + 1 m = m cm</td>
<td>23 3 m 10 cm + 1 m 1 cm = m cm</td>
</tr>
<tr>
<td>2</td>
<td>4 m + 2 m = m cm</td>
<td>24 3 m 10 cm + 2 m 2 cm = m cm</td>
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<td>6 m 80 cm + 10 cm = m cm</td>
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<td>22</td>
<td>6 m 90 cm + 60 cm = m cm</td>
<td>44 9 m 74 cm + 8 m 48 cm = m cm</td>
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1. Complete the following table.

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<th>Larger Unit</th>
<th>How Many Times as Large</th>
</tr>
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<td>hundred</td>
<td>100</td>
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<tr>
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<tr>
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<td>thousand</td>
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<td>meter</td>
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</tr>
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<tr>
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<td>kilometer</td>
<td></td>
</tr>
</tbody>
</table>

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 __________ thousands 709 ones.

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

3. Fill in the missing number.

a. __________ is 456 thousands 829 ones.

b. __________ mL is 456 L 829 mL.

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

   2,300 m   2,350 m   2,400 m   2,450 m   2,500 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

   0 kg   4 kg

8. Solve.
   a. 739 m 17 cm + 473 m 83 cm = ______________________ m ≈ ______________________ km

   b. Use the numbers from Problem 8(a) to write a word problem.
Lesson 4 Exit Ticket

1. Fill in the missing 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 〇 2,340 m
   b. 13,798 mL 〇 137 L 980 mL
   c. 5,607 m 〇 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
   30 kg  31 kg  32 kg  33 kg  34 kg
   30,000 g  31,000 g  32,000 g  33,000 g  34,000 g
Lesson 4 Homework

NYS COMMON CORE MATHEMATICS CURRICULUM

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

Name ____________________________ Date ________________

1. Complete the following table.

<table>
<thead>
<tr>
<th>Smaller Unit</th>
<th>Larger Unit</th>
<th>How Many Times as Large</th>
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<td>meter</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>hundred</td>
<td>100</td>
</tr>
<tr>
<td>meter</td>
<td>kilometer</td>
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</tr>
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<td>one</td>
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<tr>
<td>milliliter</td>
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<td>1,000</td>
</tr>
<tr>
<td>one</td>
<td>hundred thousand</td>
<td></td>
</tr>
</tbody>
</table>

2. Fill in the missing 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 _____ thousands 350 ones. 
      f. 12,350 g is 12 kg 350 ____________.

3. Write the missing number.

a. ______________ is 125 thousands 312 ones.

b. ______________ mL is 125 L 312 mL.
4. Fill in each with >, <, or =.
   a. $890,353 \text{ mL } \bigcirc 89 \text{ L } 353 \text{ mL}$
   b. $2 \text{ km } 13 \text{ m } \bigcirc 2,103 \text{ m}$

5. Brandon’s backpack weighs 3,140 grams. Brandon weighs 22 kilograms 610 grams more than his backpack. If Brandon were to stand on a scale wearing his backpack, what would the weight read?

6. Place the following measurements on the number line:
   - $3 \text{ km } 275 \text{ m}$
   - $3,500 \text{ m}$
   - $3 \text{ km } 5 \text{ m}$
   - $394,000 \text{ cm}$

   3,000 m 3,250 m 3,500 m 3,750 m 4,000 m

7. Place the following measurements on the number line:
   - $1 \text{ kg } 379 \text{ g}$
   - $3,079 \text{ g}$
   - $2 \text{ kg } 79 \text{ g}$
   - $3,579 \text{ g}$
   - $579 \text{ g}$

   0 g 3,000 g 4,000 g

8. Solve.
   a. $356 \text{ m } 14 \text{ cm } – 179 \text{ m } 26 \text{ cm} = \underline{\text{_____________}}$

   b. Use the numbers from Problem 8(a) to write a word problem.
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)

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 will help students automatize their gram and kilogram conversions and apply them in word problems.

Convert Units (2 minutes)

Note: Reviewing these conversions in isolation will help students apply their operations in word problems.

T: (Write 1 L 400 mL = ___ mL.) Fill in the equation.
S: (Write 1 L 400 mL = 1,400 mL.)

Repeat the process for 1 L 40 mL, 1 L 4 mL, and 1 L 90 mL.

Unit Counting (2 minutes)

Note: This fluency will deepen student understanding of the composition and decomposition of unit conversions, and work towards their mastery of adding and subtracting meters and centimeters.

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.1 and 2.MD.5.

Occasionally, students will work beyond the 4.MD.1 and 4.MD.2 standards by converting from a smaller to a larger unit. These advanced conversions will be established by connecting metric units to place value units.

Develop your 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 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.

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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 Lesson 5, the Problem Set will be comprised of the word problems from the lesson and is, therefore, to be used during the lesson itself for Problems 1–4. Problems 5 and 6 will be completed independently at the conclusion of the Concept Development and the lesson will conclude with the Debrief.

1. **Model the problem.**

   Have two pairs of students who you think can be successful with modeling 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 that question, sharing their work and thinking with a peer. All should then write their equations and statements of the answer.

3. **Assess the solution for reasonableness.**

   Give students one to two minutes to assess and explain the reasonableness of their solution.
Lesson 5

NYS COMMON CORE MATHEMATICS CURRICULUM

Lesson 5

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

\[
\begin{align*}
\text{Potatoes} & \quad 3 \text{ kg} \ 420 \text{ g} \\
\text{Onions} & \quad 1,050 \text{ g} \\
\hline
\text{Total} & \quad \frac{2}{3} \text{ kg} \ 1,050 \text{ g} + \frac{2}{3} \text{ kg} \ 370 \text{ g} = 5 \text{ kg} \ 790 \text{ g}
\end{align*}
\]

The potatoes and onions weigh 5 kg 790 g.

Solution 2

\[
\begin{align*}
\frac{3}{4} \text{ kg} \ 420 \text{ g} & \quad ? \\
\frac{2320}{1050} \text{ kg} & = 2.3 \text{ kg} \ 1050 \text{ g} \\
\frac{2370}{370} \text{ g} & = \frac{2000}{370} \text{ g} + \frac{420}{420} \text{ g} = 5 \text{ kg} \ 790 \text{ g}
\end{align*}
\]

The potatoes and onions weighed 5 kg 790 g.

The structure of this problem and what it demands of the students is similar to that found within Module 1. Students will be familiar, therefore, with the process of a two-step problem. The main difference within this problem is that the focus is on mass and that 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 m 46 cm of string to fly her kite. She then let out 13 m 78 cm more before reeling back in 590 cm. How long was her string after reeling it in?

Solution 1

Let out $18\,\text{m}\,46\,\text{cm} + 13\,\text{m}\,78\,\text{cm}$

reel in $590\,\text{cm}$

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

Solution 2

\[
18\,\text{m}\,46\,\text{cm} + 13\,\text{m}\,78\,\text{cm} = 31\,\text{m}\,4\,\text{cm} + 78\,\text{cm}
\]

\[
= 31\,\text{m}\,\text{4}\,\text{cm} + 78\,\text{cm}
\]

\[
\quad = 31\,\text{m}\,12\,\text{cm}
\]

\[
\quad = 32\,\text{m}\,2\,\text{cm}
\]

\[
\text{The string was 26 m 34 cm.}
\]

This two-step problem requires regrouping from meters to centimeters. As in the previous problem, students will use what they learned from Module 1 and Module 2 to help solve this problem. Students might regroup across mixed units or change to similar units in order to solve this problem. In the second solution, the student adds the meters first, then the centimeters, and finally subtracts the 590 cm 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

\[
\begin{align*}
\text{Barrel:} & \quad 6 \text{ L } 775 \text{ mL} \\
\text{Day 1:} & \quad - 2 \text{ L } 125 \text{ mL} \\
& \quad 4 \text{ L } 650 \text{ mL} \\
\text{Day 2:} & \quad + 1 \text{ L } 118 \text{ mL} \\
& \quad 5 \text{ L } 768 \text{ mL} \\
\end{align*}
\]

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

Solution 2

\[
\begin{align*}
6,775 & - 2,125 = 4,650 \\
4,650 & + 1,118 = 5,768 \\
5,768 & - 1,769 = 3,999 \\
\end{align*}
\]

Shyan used 3,999 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 by converting to milliliters prior to solving. In the second solution, the student sees that it’s easy to subtract 2,125 from 6,775 so does that first, then adds the amount Adele poured in, and then 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

\[ \text{Thurs.} \quad 12 \text{ kg 240 g} \]
\[ \text{Fri.} \quad 12 \text{ kg 240 g} \]
\[ \text{Sat.} \quad 12 \text{ kg 240 g} + 1,888 \text{ g} \]

\[ 12,240 \text{ g} + 1,888 \text{ g} = 14,128 \text{ g} \]

\[ \text{The total amount of flour was 36 kg 428 g.} \]

Solution 2

\[ 3 \text{ units of 12 kg 240 g} = 36 \text{ kg 720 g} \]
\[ 2 \text{ kg 180 g} - 1 \text{ kg 888} = 292 \text{ g} \]
\[ 1 \text{ kg 1000 g} \]
\[ 36 \text{ kg 720 g} - 292 \text{ g} = 36 \text{ kg 428 g} \]

\[ \text{The bakery used 36 kg 428 g.} \]

This three-step problem increases the complexity in that students might calculate as in the first solution for the three addends 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 Friday’s worth of flour.
Problem Set (10 minutes)

Please note that the Problem Set in Topic B is comprised of the lesson’s problems as stated at the introduction 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 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. You may choose to use any combination of the questions below to lead the discussion.

- How was the work completed to solve Problem 5 in the Problem Set different than the other problems?
- Did you find yourself using similar strategies to add and to subtract the mixed unit problems?
- 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?
- How is regrouping a mixed unit of measurement similar to regrouping a whole number when adding or subtracting?
- In what ways 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 you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
### A

Write in kilograms and grams.

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<td>g</td>
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Lesson 5: Use addition and subtraction to solve multi-step word problems involving length, mass, and capacity.

**Date:** 7/3/13

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<td>3</td>
<td>3,000 g = kg</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>8,000 g = kg</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>6,000 g = kg</td>
<td>27</td>
</tr>
<tr>
<td>6</td>
<td>9,000 g = kg</td>
<td>28</td>
</tr>
<tr>
<td>7</td>
<td>4,000 g = kg</td>
<td>29</td>
</tr>
<tr>
<td>8</td>
<td>7,000 g = kg</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>5,000 g = kg</td>
<td>31</td>
</tr>
<tr>
<td>10</td>
<td>5,100 g = kg</td>
<td>32</td>
</tr>
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<td>11</td>
<td>5,110 g = kg</td>
<td>33</td>
</tr>
<tr>
<td>12</td>
<td>5,101 g = kg</td>
<td>34</td>
</tr>
<tr>
<td>13</td>
<td>5,010 g = kg</td>
<td>35</td>
</tr>
<tr>
<td>14</td>
<td>5,011 g = kg</td>
<td>36</td>
</tr>
<tr>
<td>15</td>
<td>5,001 g = kg</td>
<td>37</td>
</tr>
<tr>
<td>16</td>
<td>7,002 g = kg</td>
<td>38</td>
</tr>
<tr>
<td>17</td>
<td>7,020 g = kg</td>
<td>39</td>
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<tr>
<td>18</td>
<td>7,200 g = kg</td>
<td>40</td>
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<tr>
<td>19</td>
<td>7,022 g = kg</td>
<td>41</td>
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<tr>
<td>20</td>
<td>7,220 g = kg</td>
<td>42</td>
</tr>
<tr>
<td>21</td>
<td>7,222 g = kg</td>
<td>43</td>
</tr>
<tr>
<td>22</td>
<td>4,378 g = kg</td>
<td>44</td>
</tr>
</tbody>
</table>
Name ____________________________ Date __________________

Directions: Solve. Model the problems using a tape diagram. 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 altogether?

2. Adele let out 18 m 46 cm of string to fly her kite. She then let out 13 m 78 cm more before reeling back in 5 m 90 cm. How long was her string after reeling it in?

3. Shyan’s barrel contained 6 liters 775 milliliters of paint. She poured in 1 liters 118 milliliters more. The first day Shyan used 2 liters 125 milliliters of the paint. At the end of the second day, there was 1 liters 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 kilogram 888 grams more than on Friday. What was the total amount of flour used over the three days?

5. Zachary’s car holds 60 liters of gas. When he had 2,050 milliliters of gas left, he added 23 liters 825 milliliters gas. How much more gas can Zachary add to his car?

6. A giraffe was 5 m 20 cm tall. An elephant was 1 m 77 cm shorter than the giraffe. A rhinoceros was 1 m 58 cm shorter than the elephant. How tall was the rhinoceros?
Lesson 5 Exit Ticket

Name ___________________________ Date ______________

Use a tape diagram to model and solve the problems below.

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 m 87 cm tall. Bonnie is 58 cm shorter than Brian. Betina is 26 cm taller than Bonnie. How tall is Betina?
Name _______________________________ Date ________________

Directions: Solve. Model the problems using a tape diagram. Answer with a statement.

1. Jose’s vase can hold up to 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?

2. Eric biked 1 km 125 m on Monday. On Tuesday, he biked 375 m less than on Monday. How far did he bike both days?

3. 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 weight difference, in grams, between the Newfoundland and the Springer Spaniel?

5. Marsha has three rugs. The first rug is 2 m 87 cm long. The second rug has a length 98 cm less than the first. The third rug is 111 cm longer than the second rug. What is the difference in centimeters between the length of the first rug and 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 was there in all?
1. Complete the following conversion charts:

<table>
<thead>
<tr>
<th>Length</th>
<th>Mass</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 km</td>
<td>___ kg 3,000 g</td>
<td>___ L 4,000 mL</td>
</tr>
<tr>
<td>___ km 9,000 m</td>
<td>20 kg 300 g  ___ g</td>
<td>48 L 808 mL  ___ mL</td>
</tr>
<tr>
<td>6 km 435 m</td>
<td>1 kg 74 g  ___ g</td>
<td>2 L 20 mL   ___ mL</td>
</tr>
<tr>
<td>12 km 12 m</td>
<td>403 kg 4 g  ___ g</td>
<td>639 L 6 mL  ___ mL</td>
</tr>
</tbody>
</table>

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 = 38,000 g

3. Find the sum or difference. Use the boxes to show your work.

| a. 493 km 543 m + 17 km 57 m | b. 25 kg 32 g − 23 kg 83 g | c. 100 L 99 mL + 2,999 mL |

| d. Write a word problem for which (a), (b), or (c) would be the solution equation. |
4. Billy has been training for a half-marathon. He has a strict gym routine that he follows six times a week. 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 kilometers does Billy run each day?

b. Since Billy has started training, he has also been drinking more water. On Saturday, he drank 2 L 755 mL of water. On Sunday, he drank some more. If Billy drank a total of 4 L 255 mL of water on Saturday and Sunday, how many milliliters of water did Billy drink 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 kg 530 g of weight. In the following two weeks of training, he lost 1 kg 855 g per week. Billy now weighs 61 kg 760 g. What was Billy’s weight, in grams, before he started training? Explain your thinking.
End-of-Module Assessment Task Standards Addressed

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

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

4.MD.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.

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 each student is to achieve Step 4 mastery. These steps are meant to help teachers and students identify and celebrate what the student CAN do now, and what they need to work on next.

---

1 Pounds, ounces, and time will be assessed in Module 7.
2 Time, money, and numbers as fractions or decimals will be assessed in Module 7.
## A Progression Toward Mastery

<table>
<thead>
<tr>
<th>Assessment Task Item</th>
<th>STEP 1</th>
<th>STEP 2</th>
<th>STEP 3</th>
<th>STEP 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.MD.1</strong></td>
<td>Little evidence of reasoning without a correct answer. (1 Point)</td>
<td>Evidence of some reasoning without a correct answer. (2 Points)</td>
<td>Evidence of some reasoning with a correct answer or evidence of solid reasoning with an incorrect answer. (3 Points)</td>
<td>Evidence of solid reasoning with a correct answer. (4 Points)</td>
</tr>
</tbody>
</table>
| 1                    | The student is unable to complete a majority of the conversions. | The student correctly identifies six to nine of the twelve conversions. | The student correctly identifies ten of the twelve conversions. | The student correctly completes the conversion chart:  
- 3,000 m, 9 km,  
- 6,435 m, 12,012 m  
- 3 kg, 20,300 g, 1,074 g, 403,004 g  
- 4 L, 48,808 mL, 2,020 mL, 639,006 mL |
| 2                    | The student identifies fewer than two conversions with no reasoning. | The student correctly identifies two of the conversions with little evidence of reasoning. | The student correctly identifies that Parts (a) and (b) are correct and Part (c) is incorrect, but does not provide clear reasoning. | The 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                    | The student incorrectly answers all parts. | The student correctly answers one of the three parts and attempts to write a reasonable word problem. | The student correctly answers two of the three parts and writes a reasonable word problem. | The student correctly answers all three parts using conversions:  
- 510 km 600m  
- 1 kg 949 g  
- 103 L 98 mL  
Writes a reasonable word problem for Part (a), (b), or (c). |
<table>
<thead>
<tr>
<th></th>
<th>4.MD.1</th>
<th>4.MD.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>The student incorrectly answers two or all of the three parts.</td>
<td>The student correctly answers two of the three parts, but shows little reasoning in Part (c).</td>
</tr>
</tbody>
</table>
1. Complete the following conversion charts:

<table>
<thead>
<tr>
<th>Length</th>
<th>Mass</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 km</td>
<td>3,000 m</td>
<td>4 L</td>
</tr>
<tr>
<td>9 km</td>
<td>9,000 m</td>
<td>48,808 mL</td>
</tr>
<tr>
<td>6 km 435 m</td>
<td>6,435 m</td>
<td>2 L 20 mL</td>
</tr>
<tr>
<td>12 km 12 m</td>
<td>12,012 m</td>
<td>639 L 6 mL</td>
</tr>
<tr>
<td></td>
<td>3 kg 3,000 g</td>
<td>4,000 mL</td>
</tr>
<tr>
<td></td>
<td>20 kg 300 g</td>
<td>48,808 mL</td>
</tr>
<tr>
<td></td>
<td>1 kg 74 g</td>
<td>2,020 mL</td>
</tr>
<tr>
<td></td>
<td>403 kg 4 g</td>
<td>639,004 mL</td>
</tr>
</tbody>
</table>

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 = 38,000 g

   Letters a and b are correct. I used the tables below to show the conversion.

   Letter c is incorrect because 1 kg = 1000 g, so 38 kg = 38,000 g, not 38,000 g.

3. Find the sum or difference. Use the boxes to show your work.

   a. 493 km 543 m + 17 km 57 m = 510 km 600 m
   b. 25 kg 32 g - 23 kg 83 g = 1 kg 49 g
   c. 100 L 99 mL + 2,999 mL = 103 L 98 mL

   d. Write a word problem for which a, b, or c would be the solution equation.

   B. Olivia weighs 25 kg 32 g. Isa weighs 23 kg 83 g. How much more does Olivia weigh than Isa?
4. Billy has been training for a half-marathon. He has a strict gym routine that he follows six times a week. 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 kilometers does Billy run each day?

\[
\begin{array}{c}
1 \text{ km} = 1,000 \text{ m} \\
5 \text{ km} = 5,000 \text{ m} \\
6,000 \text{ m} = 6 \text{ km} \\
5 \text{ km} \\
+ 6 \text{ km} \\
11 \text{ km}
\end{array}
\]

Billy runs 11 km each day.

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

\[
\begin{array}{c}
4 \text{ L} = 4,000 \text{ mL} \\
2 \text{ L} = 2,000 \text{ mL} \\
2,755 \text{ mL} \\
3,125 \text{ mL} \\
755 \text{ mL}
\end{array}
\]

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 kg 530 g of weight. In the following two weeks of training he lost 1 kg 855 g per week. Billy now weighs 61 kg 760 g. What was Billy’s weight, in grams, before he started training? Explain your thinking.

\[
\begin{array}{c}
2,530 \text{ g} \\
1,855 \text{ g} \\
61,760 \text{ g} \\
+ 61,240 \text{ g} \\
68,000 \text{ g}
\end{array}
\]

Billy’s weight was 68,000 grams before he started training. I converted all weight to grams. I added up how much he lost in 3 weeks. Then I added his lost weight to what he weighs now.