Lesson 5

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

Suggested Lesson Structure

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency Practice</td>
<td>12 minutes</td>
</tr>
<tr>
<td>Concept Development</td>
<td>42 minutes</td>
</tr>
<tr>
<td>Student Debrief</td>
<td>6 minutes</td>
</tr>
<tr>
<td><strong>Total Time</strong></td>
<td>60 minutes</td>
</tr>
</tbody>
</table>

**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.
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.
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

\[
\begin{align*}
\text{Potatoes} & : 3\,\text{kg} \, 420\,\text{g} \\
\text{Onions} & : 1,050\,\text{g} \\
\end{align*}
\]

\[
\begin{align*}
\text{Total weight of potatoes and onions} &= 3\,\text{kg} \, 420\,\text{g} - 1,050\,\text{g} + 2\,\text{kg} \, 370\,\text{g} \\
&= 5\,\text{kg} \, 790\,\text{g} \\
\end{align*}
\]

The potatoes and onions weigh 5 kg 790 g.

Solution 2

\[
\begin{align*}
\text{Potatoes} & : 3\,\text{kg} \, 420\,\text{g} \\
\text{Onions} & : 1,050\,\text{g} \\
\end{align*}
\]

\[
\begin{align*}
3\,\text{kg} \, 420\,\text{g} - 1,050\,\text{g} & = 2\,\text{kg} \, 370\,\text{g} \\
2\,\text{kg} \, 370\,\text{g} + 3\,\text{kg} \, 420\,\text{g} & = 5\,\text{kg} \, 790\,\text{g} \\
\end{align*}
\]

The potatoes and onions weigh 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

\[
\begin{align*}
\text{Let Out} & \quad 18 \text{ m} 46 \text{ cm} \\
\text{Add} & \quad 13 \text{ m} 78 \text{ cm} \\
\text{Reel In} & \quad -590 \text{ cm} \\
\hline
\text{Total} & \quad 26 \text{ m} 34 \text{ cm}
\end{align*}
\]

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

Solution 2

\[
\begin{align*}
18 \text{ m} 46 \text{ cm} + 13 \text{ m} 78 \text{ cm} &= 31 \text{ m} 124 \text{ cm} \\
32 \text{ m} 124 \text{ cm} - 590 \text{ cm} &= 26 \text{ m} 34 \text{ cm}
\end{align*}
\]

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

\[
\begin{align*}
\text{Barrel} & : 6 \text{ L} 775 \text{ mL} + 1 \text{ L} 118 \text{ mL} = 7 \text{ L} 893 \text{ mL} \\
\text{Day 1} & : 7 \text{ L} 893 \text{ mL} - 2 \text{ L} 125 \text{ mL} = 5 \text{ L} 768 \text{ mL} \\
\text{Day 2} & : 5 \text{ L} 768 \text{ mL} - 1,769 \text{ mL} = 3,999 \text{ mL}
\end{align*}
\]

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

\[
\begin{align*}
\text{Thurs.} & \quad 2\text{ kg 180 g} \\
\text{Fri.} & \quad 12\text{ kg } 240\text{ g} \\
\text{Sat.} & \quad 12\text{ kg } 240\text{ g } 1,888\text{ g}
\end{align*}
\]

\[
\begin{align*}
12\text{ kg } 240\text{ g} - 2\text{ kg } 180\text{ g} &= F - \text{Thurs. } 10\text{ kg } 60\text{ g} \\
12\text{ kg } 240\text{ g} &= 12,240\text{ g} \\
1,888\text{ g} &= 1,888\text{ g}
\end{align*}
\]

\[
\begin{align*}
12,240\text{ g} + 1,888\text{ g} &= \text{Sat. } 14,128\text{ g}
\end{align*}
\]

The total amount of flour was 36 kg 428 g.

Solution 2

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

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

Date: 3/26/14

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?
Lesson 5:

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

Date: 3/26/14

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

### Date: 3/26/14

#### A

<table>
<thead>
<tr>
<th></th>
<th>Write in kilograms and grams.</th>
<th># Correct _____</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>2</td>
<td>3,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>3</td>
<td>4,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>4</td>
<td>9,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>5</td>
<td>6,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>6</td>
<td>1,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>7</td>
<td>8,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>8</td>
<td>5,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>9</td>
<td>7,000 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>10</td>
<td>6,100 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>11</td>
<td>6,110 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>12</td>
<td>6,101 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>13</td>
<td>6,010 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>14</td>
<td>6,011 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>15</td>
<td>6,001 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>16</td>
<td>8,002 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>17</td>
<td>8,020 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>18</td>
<td>8,200 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>19</td>
<td>8,022 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>20</td>
<td>8,220 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>21</td>
<td>8,222 g = kg</td>
<td>g</td>
</tr>
<tr>
<td>22</td>
<td>7,256 g = kg</td>
<td>g</td>
</tr>
</tbody>
</table>

© Bill Davidson
### Lesson 5: Use addition and subtraction to solve multi-step word problems involving length, mass, and capacity.

**Date:** 3/26/14

© 2013 Common Core, Inc. Some rights reserved. Commoncore.org

This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.

#### B

Write in kilograms and grams.

<table>
<thead>
<tr>
<th></th>
<th>Improvement</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,000 g =</td>
<td>23 kg g</td>
</tr>
<tr>
<td>2</td>
<td>2,000 g =</td>
<td>24 kg g</td>
</tr>
<tr>
<td>3</td>
<td>3,000 g =</td>
<td>25 kg g</td>
</tr>
<tr>
<td>4</td>
<td>8,000 g =</td>
<td>26 kg g</td>
</tr>
<tr>
<td>5</td>
<td>6,000 g =</td>
<td>27 kg g</td>
</tr>
<tr>
<td>6</td>
<td>9,000 g =</td>
<td>28 kg g</td>
</tr>
<tr>
<td>7</td>
<td>4,000 g =</td>
<td>29 kg g</td>
</tr>
<tr>
<td>8</td>
<td>7,000 g =</td>
<td>30 kg g</td>
</tr>
<tr>
<td>9</td>
<td>5,000 g =</td>
<td>31 kg g</td>
</tr>
<tr>
<td>10</td>
<td>5,100 g =</td>
<td>32 kg g</td>
</tr>
<tr>
<td>11</td>
<td>5,110 g =</td>
<td>33 kg g</td>
</tr>
<tr>
<td>12</td>
<td>5,101 g =</td>
<td>34 kg g</td>
</tr>
<tr>
<td>13</td>
<td>5,010 g =</td>
<td>35 kg g</td>
</tr>
<tr>
<td>14</td>
<td>5,011 g =</td>
<td>36 kg g</td>
</tr>
<tr>
<td>15</td>
<td>5,001 g =</td>
<td>37 kg g</td>
</tr>
<tr>
<td>16</td>
<td>7,002 g =</td>
<td>38 kg g</td>
</tr>
<tr>
<td>17</td>
<td>7,020 g =</td>
<td>39 kg g</td>
</tr>
<tr>
<td>18</td>
<td>7,200 g =</td>
<td>40 kg g</td>
</tr>
<tr>
<td>19</td>
<td>7,022 g =</td>
<td>41 kg g</td>
</tr>
<tr>
<td>20</td>
<td>7,220 g =</td>
<td>42 kg g</td>
</tr>
<tr>
<td>21</td>
<td>7,222 g =</td>
<td>43 kg g</td>
</tr>
<tr>
<td>22</td>
<td>4,378 g =</td>
<td>44 kg g</td>
</tr>
</tbody>
</table>

© Bill Davidson
Lesson 5 Problem Set

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

Date: 3/26/14

2.B.30

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?