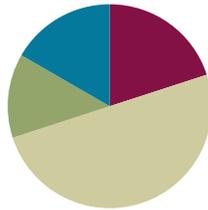


## Lesson 3

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

### Suggested Lesson Structure

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



### NOTES ON STANDARDS ALIGNMENT:

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

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

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

### Fluency Practice (12 minutes)

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

### Convert Units (3 minutes)

Materials: (S) Personal white board

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

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

S: 100 centimeters.

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

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

S: 1 kilometer.

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

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

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

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

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

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

### Unit Counting (5 minutes)

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

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

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

### Add and Subtract Meters and Centimeters (4 minutes)

Materials: (S) Personal white board

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

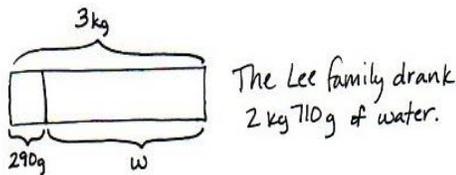
T: Write  $560 \text{ cm} + 230 \text{ cm} = \underline{\quad}$ . Below it, write  $\underline{\quad} \text{ m } \underline{\quad} \text{ cm} + \underline{\quad} \text{ m } \underline{\quad} \text{ cm} = \underline{\quad} \text{ m } \underline{\quad} \text{ cm}$  on your personal white boards. Now, complete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

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

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

**Application Problem (8 minutes)**

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



Algorithm:

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

$$\begin{array}{r} 2,000 \text{ g} \\ - 290 \text{ g} \\ \hline 1,710 \text{ g} \end{array}$$

Simplifying Strategy

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

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

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



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

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

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

**Concept Development (30 minutes)**

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

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

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

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



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

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

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

(A)

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

(B)

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

(C)

$$12\text{ L} - 8\text{ L} = 4\text{ L}$$

$$4\text{ L } 215\text{ mL} - 600\text{ mL} = 3\text{ L } 615\text{ mL}$$

(D)

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

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

(E)

Number line showing subtraction from  $8\text{ L } 600\text{ mL}$  to  $12\text{ L } 215\text{ mL}$  in three steps:  $+400\text{ mL}$  to  $9\text{ L}$ ,  $+3\text{ L}$  to  $12\text{ L}$ , and  $+215\text{ mL}$  to  $12\text{ L } 215\text{ mL}$ . Total added:  $400\text{ mL} + 3\text{ L} + 215\text{ mL} = 3\text{ L } 615\text{ mL}$ .

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

- T: Look at the first problem. How did they set it up?

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

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

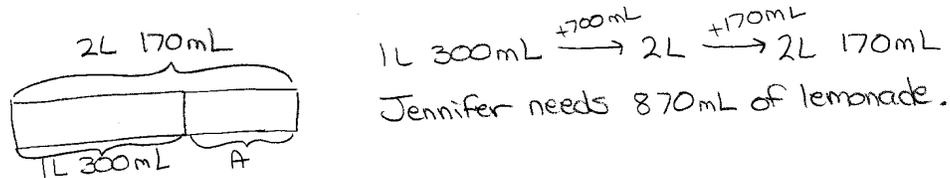
Jennifer is making 2,170 milliliters of her favorite drink that combines iced tea and lemonade. If she puts in 1 liter 300 milliliters of iced tea, how much lemonade does she need?

MP.1

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

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

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



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

### Problem Set (10 minutes)

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

### Student Debrief (10 minutes)

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

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

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

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 length, mass, and capacity?
- How did the Application Problem connect to today's lesson?
- Describe the relationship between liters and milliliters.

NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 3 Problem Set 4•2

Name Jack Date \_\_\_\_\_

1. Complete the conversion table.

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

2. Convert the measurements.

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

3. Solve.

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

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

$$\begin{array}{r} 7\text{ L } 3,400\text{ mL} \\ - 4\text{ L } 000\text{ mL} \\ \hline 3\text{ L } 600\text{ mL} \end{array}$$
- Express the answer in the smaller unit:  

$$\begin{array}{r} 25\text{ L } 478\text{ mL} + 3\text{ L } 812\text{ mL} = 29\text{ L } 290\text{ mL} \\ 25\text{ L } 478\text{ mL} \\ + 3\text{ L } 812\text{ mL} \\ \hline 28\text{ L } 1290\text{ mL} \end{array}$$
- Express the answer in mixed units:  

$$\begin{array}{r} 7\text{ L } 425\text{ mL} - 547\text{ mL} = 6\text{ L } 878\text{ mL} \\ 7\text{ L } 425\text{ mL} \\ - 547\text{ mL} \\ \hline 6\text{ L } 878\text{ mL} \end{array}$$

4. Express the answer in the smaller unit:  

$$\begin{array}{r} 21\text{ L} - 2\text{ L } 8\text{ mL} = 18\text{ L } 992\text{ mL} \\ 21\text{ L} \\ - 2\text{ L } 8\text{ mL} \\ \hline 18\text{ L } 992\text{ mL} \end{array}$$

5. Express the answer in mixed units:  

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

COMMON CORE Lesson 3: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity. 6/24/13 engage<sup>ny</sup> 2.A.39

NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 3 Problem Set 4•2

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

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

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

$$3,500\text{ mL} = 3\text{ L } 500\text{ mL}$$

greatest ↑ 3 L 500 mL tropical  
 3 L 95 mL ginger ale  
 1 L 600 mL pineapple  
 ↓ least
- How much punch did John's mother make?  

$$\begin{array}{r} 3\text{ L } 500\text{ mL} \\ 3\text{ L } 95\text{ mL} \\ + 1\text{ L } 600\text{ mL} \\ \hline 7\text{ L } 1195\text{ mL} \\ 7\text{ L } 1195\text{ mL} \\ \hline 14\text{ L } 195\text{ mL} \end{array}$$

John's mother made 14 L 195 mL of punch.

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

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

There is 1 L 790 mL milk left.

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

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

She needs 2,877 more milliliters of water.

COMMON CORE Lesson 3: Express metric capacity measurements in terms of a smaller unit; model and solve addition and subtraction word problems involving metric capacity. 6/24/13 engage<sup>ny</sup> 2.A.40

- How did today's lesson relate to the lessons on mass 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.

Name \_\_\_\_\_

Date \_\_\_\_\_

1. Complete the conversion table.

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

2. Convert the measurements.

a. 2 L 500 mL = \_\_\_\_\_ mL

b. 70 L 850 mL = \_\_\_\_\_ mL

c. 33 L 15 mL = \_\_\_\_\_ mL

d. 2 L 8 mL = \_\_\_\_\_ mL

e. 3,812 mL = \_\_\_\_\_ L \_\_\_\_\_ mL

f. 86,003 mL = \_\_\_\_\_ L \_\_\_\_\_ mL

3. Solve.

a. 1,760 mL + 40 L

b. 7 L – 3,400 mL

c. Express the answer in the smaller unit:  
25 L 478 mL + 3 L 812 mL

d. Express the answer in the smaller unit:  
21 L – 2 L 8 mL

e. Express the answer in mixed units:  
7 L 425 mL – 547 mL

f. Express the answer in mixed units:  
31 L 433 mL – 12 L 876 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. To make fruit punch, John's mother combined 3,500 milliliters of tropical drink, 3 liters 95 milliliters of ginger ale, and 1 liter 600 milliliters of pineapple juice.
- Order the quantity of each drink from least to greatest.

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 capacity of tank is 12 liters 455 milliliters of water, how many more milliliters of water does she need to fill the tank?



Name \_\_\_\_\_

Date \_\_\_\_\_

1. Convert the measurements.

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

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

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

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

2.  $81 \text{ L } 603 \text{ mL} - 22 \text{ L } 489 \text{ mL}$ 

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

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

Name \_\_\_\_\_

Date \_\_\_\_\_

1. Complete the conversion table.

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

2. Convert the measurements.

a. 5 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.

- Sammy's bucket holds 2,530 milliliters of water. Marie's bucket holds 2 liters 30 milliliters of water. Katie's bucket holds 2 liters 350 milliliters of water. Whose bucket holds the least amount of water?
- 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?
- 27, 545 milliliters of gas were added to a car's empty gas tank. If the gas tank's capacity is 56 liters 202 milliliters, how much gas is needed to fill the tank?