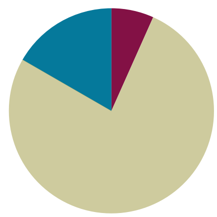
Lesson 9

Objective: Decompose a liter to reason about the size of 1 liter, 100 milliliters, 10 milliliters, and 1 milliliter.

Suggested Lesson Structure

Fluency Practice	(4 minutes)
Concept Development	(46 minutes)
Student Debrief	(10 minutes)
Total Time	**(60 minutes)**



Fluency Practice (4 minutes)

- Decompose 1 Kilogram **3.MD.2** (4 minutes)

Decompose 1 Kilogram (4 minutes)

Materials: (S) Personal white boards

Note: Decomposing 1 kilogram using a number bond helps students relate part–whole thinking to measurement concepts.

T: (Project a number bond with 1 kg written as the whole.) There are 1,000 grams in 1 kilogram.

T: (Write 900 g as one of the parts.) On your boards, write a number bond filling in the missing part.

S: (Students draw number bond with 100 g completing the missing part.)

Continue with the following possible sequence: 500 g, 700 g, 400 g, 600 g, 300 g, 750 g, 650 g, 350 g, 250 g, 850 g, and 150 g.

A NOTE ON STANDARDS ALIGNMENT:

In this lesson, students decompose 1 liter into milliliters following the same procedure used to decompose 1 kilogram into grams used in Lesson 6.

They make connections between metric units as well as with the base ten place value system. The opportunity to make these connections comes from introducing milliliters, which the standards do not include until Grade 4 (**4.MD.1**). Although milliliters are used in Module 2, they are not assessed.

Concept Development (46 minutes)

Materials: (T) Beaker, 2-liter bottle (empty, top cut off, without label), ten-frame, 12 clear plastic cups (labeled A–L), dropper, one each of the following sizes of containers: cup, pint, quart, gallon (labeled 1, 2, 3, and 4, respectively)

Part 1: Compare the capacities of containers with different shapes and sizes.

T: (Measure 1 liter of water using a beaker. Pour it into the 2-liter bottle. Use a marker to draw a line at the water level in the bottle and label it *1L.* Have containers 1–4 ready.)

T: Which holds more water, a swimming pool or a glass?

S: A swimming pool!

T: Which holds more water, a swimming pool or a bathtub?

S: A swimming pool!

T: Which holds the least amount of water, a swimming pool, a bathtub, or a glass?

S: A glass holds the least amount of water.

T: The amount of liquid a container holds is called its **capacity**. The glass has the smallest capacity because it holds the least amount of water. (Show bottle.) Is this container filled to capacity?

S: No!

T: The amount of water inside measures 1 **liter**. A liter is a unit we use to measure amounts of liquid. To abbreviate the word *liter* use a capital *L*. (Show the side of the bottle.) Use your finger to write the abbreviation in the air.

T: Let's compare the capacities of different containers by pouring 1 liter into them to see how it fits. (Show Container 1 and the bottle side by side.) Talk to your partner. Predict whether Container 1 holds more, less, or about the same as 1 liter. Circle your prediction on Part 1, Problem A of your Problem Set.

S: (Discuss and circle predictions.)

T: I'll pour water from the bottle into Container A to confirm our predictions. (Pour.) Is the capacity of Container 1 more or less than 1 liter?

S: Less!

T: Does that match your prediction? What surprised you? Why?

S: (Discuss.)

T: Next to the word *actual* on Problem A write *less*.

NOTES ON MATERIALS:

Maximize Part 1 by choosing odd-shaped containers, or ones that appear to hold less for the quart and gallon comparisons. This will challenge students' sense of conservation; they will likely predict that the shorter, wider container holds less than the bottle. Take the opportunity for discussion. How might a shampoo bottle fool you into thinking you are getting more for your money?

Repeat the process with Containers 2–4. Container 2 holds less than 1 liter, Container 3 holds about the same as 1 liter, and Container 4 holds more than 1 liter. Then have students complete Problem B.

Part 2: Decompose 1 liter.

T: (Arrange empty cups A–J on the ten-frame, shown below. Measure and label the water levels on Cup K at 100 milliliters and Cup L at 10 milliliters.)

T: We just compared capacities using a **liquid volume** of 1 liter. We call an amount of liquid *liquid volume*. Whisper the words *liquid volume*.

S: Liquid volume.

T: Now we're going to partition 1 liter into smaller units called **milliliters**. Say the word *milliliter*. (Students say the word.)

T: To abbreviate *milliliter* we write *mL*. (Model.) Write the abbreviation in the air.

T: We'll partition our liter into 10 parts. Each square of our ten-frame shows 1 part. (Show Cup K.) This cup is marked at 100 milliliters. We'll use it to measure the liquid volume that goes into each cup on the ten-frame.

Labeled Cups A–J on a ten-frame.

T: (Fill Cup K to the 100 mL mark. Empty Cup K into Cup A.) How much water is in Cup A?

S: 100 milliliters!

T: (Repeat with Cups B–J.) How many cups are filled with 100 milliliters?

S: 10 cups!

T: Is there any water left in the bottle?

S: No!

T: We partitioned 1 liter of water into 10 parts, each with a liquid volume of about 100 milliliters. Skip-count hundreds to find the total milliliters on the ten-frame. (Point to each cup as students count.)

S: 100, 200, 300, 400, 500, 600, 700, 800, 900, 1,000.

T: How many milliliters of water are in 1 liter?

S: 1,000 milliliters!

T: Talk to your partner about how this equation describes our work. (Write: 1,000 mL ÷ 10 = 100 mL.)

S: (Discuss.)

T: Answer Problem C on your Problem Set. Include the equation written on the board.

S: (Students skip-count as 9 cups are emptied back into the bottle. Empty the final cup into Cup K.)

T: Let's partition again. This time we'll pour the 100 milliliters in Cup K into 10 equal parts using the ten-frame. How many milliliters will be in each of the 10 cups?

S: 10 milliliters. 10 groups of 10 makes 100.

T: Cup L is marked at 10 milliliters. (Show Cups K and L side by side.) How do the marks on each cup compare?

S: The mark on Cup L is closer to the bottom.

T: Why is Cup L's mark lower than Cup K's?

S: Cup L shows 10 milliliters. That is less than 100 milliliters. → Cup L shows a smaller liquid volume.

T: (Repeat the process of partitioning outlined above.)

NOTES ON MULTIPLE MEANS OF REPRESENTATION:

Support students to differentiate between the meanings of *capacity* and *liquid volume*. *Capacity* refers to a container, and how much the container holds. *Liquid volume* refers to the amount of liquid itself.

A NOTE ON STANDARDS ALIGNMENT:

The standards do not introduce milliliters until Grade 4 (**4.MD.1**).

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

As you partition, pause to ask students to estimate whether you've poured *more than half*, *half,* or *less than half* of the liter. Encourage them to reason about estimations using the number of cups on the ten-frame.

T: What number sentence represents dividing 100 milliliters into 10 parts?

S: 100 ÷ 10 = 10. → 100 mL ÷ 10 = 10 mL.

T: (Write equation using units.) Complete Problem D on your Problem Set. Include the equation.

S: (Students skip-count as 9 cups are emptied back into the bottle. Empty the final cup into Cup L. Repeat the process used for partitioning 100 milliliters into 10 milliliters, using a dropper to partition 10 milliliters into cups of 1 milliliter.)

T: How many droppers full of water would it take to fill an entire liter of water?

S: 1,000 droppers full!

T: Answer Problem E. Include the equation.

Measure 1mL with dropper.

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.

Students should only need to complete Problems F and G. You may choose to work through these problems as a class, have students work in pairs, or have students work individually.

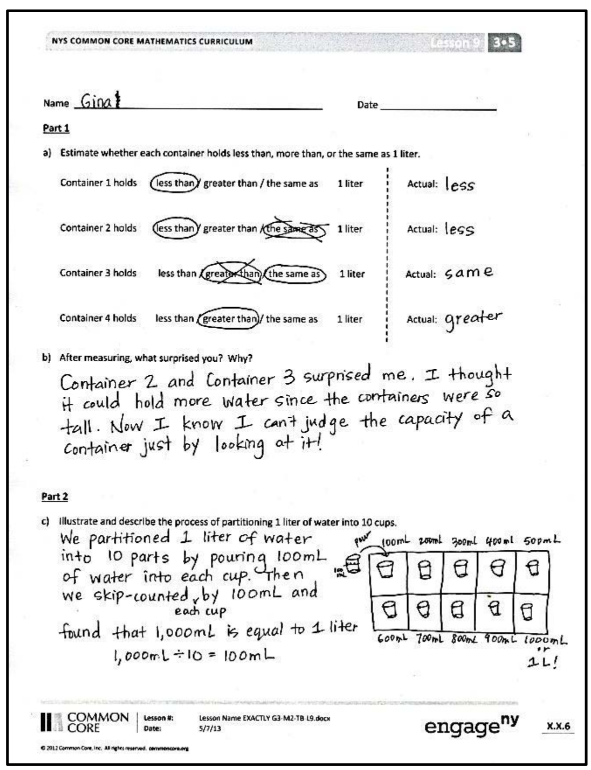
Student Debrief (10 minutes)

Lesson Objective: Decompose a liter to reason about the size of 1 liter, 100 milliliters, 10 milliliters, and 1 milliliter.

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.

- Revisit predictions from Part 1. Lead a discussion about why students may have thought taller containers had larger **capacities**. Guide students to articulate understanding about conservation and capacity.



NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 9 3•5

Name Gina Date

Part 1

a) Estimate whether each container holds less than, more than, or the same as 1 liter.

Container 1 holds less than / greater than / the same as 1 liter Actual: less

Container 2 holds less than / greater than / the same as 1 liter Actual: less

Container 3 holds less than / greater than / the same as 1 liter Actual: same

Container 4 holds less than / greater than / the same as 1 liter Actual: greater

b) After measuring, what surprised you? Why?

Container 2 and Container 3 surprised me. I thought it could hold more water since the containers were so tall. Now I know I can't judge the capacity of a container just by looking at it!

Part 2

c) Illustrate and describe the process of partitioning 1 liter of water into 10 cups.

We partitioned 1 liter of water into 10 parts by pouring 100mL of water into each cup. Then we skip-counted by 100mL and each cup found that 1,000mL is equal to 1 liter

1,000mL ÷ 10 = 100mL

100mL 200mL 300mL 400mL 500mL

600mL 700mL 800mL 900mL 1000mL or 1L!

COMMON CORE Lesson #: Lesson Name EXACTLY G3-M2-TB L9.docx Date: 5/7/13 engage ny X.X.6

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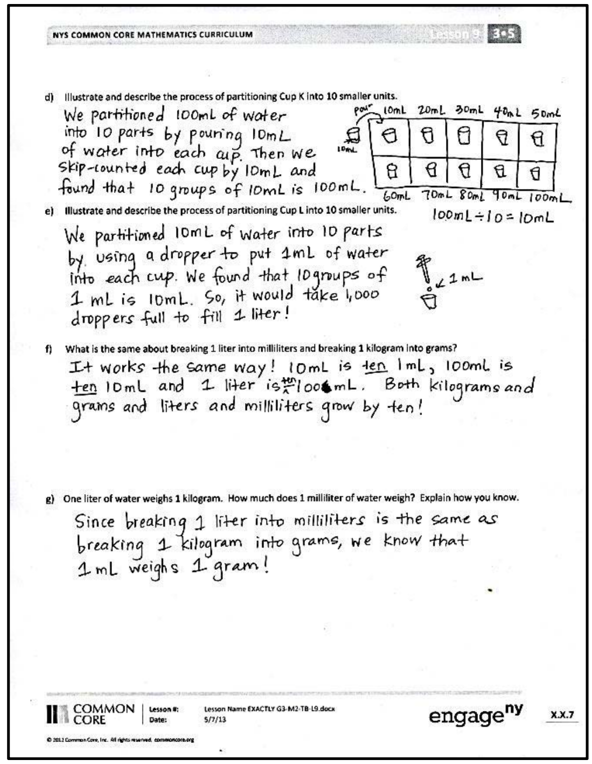
- Review the difference between capacity and **liquid volume**.
- In the equations for Part 2, why are the first number and quotient in each followed by the word **milliliters**? Why not the 10?
- How is decomposing 1 **liter** similar to decomposing 1 kilogram?
- How do our decompositions of 1 liter and 1 kilogram remind you of the place value chart?



NYS COMMON CORE MATHEMATICS CURRICULUM Lesson 9 3•5

d) Illustrate and describe the process of partitioning Cup K into 10 smaller units.

We partitioned 100mL of water into 10 parts by pouring 10mL of water into each cup. Then we skip-counted each cup by 10mL and found that 10 groups of 10mL is 100mL.

10mL 20mL 30mL 40mL 50mL 60mL 70mL 80mL 90mL 100mL

100mL ÷ 10 = 10mL

e) Illustrate and describe the process of partitioning Cup L into 10 smaller units.

We partitioned 10mL of water into 10 parts by using a dropper to put 1mL of water into each cup. We found that 10 groups of 1 mL is 10mL. So, it would take 1,000 droppers full to fill 1 liter!

1 mL

f) What is the same about breaking 1 liter into milliliters and breaking 1 kilogram into grams?

It works the same way! 10mL is ten 1mL, 100mL is ten 10mL and 1 liter is ten 100mL. Both kilograms and grams and liters and milliliters grow by ten!

g) One liter of water weighs 1 kilogram. How much does 1 milliliter of water weigh? Explain how you know.

Since breaking 1 liter into milliliters is the same as breaking 1 kilogram into grams, we know that 1 mL weighs 1 gram!

COMMON CORE Lesson #: Lesson Name EXACTLY G3-M2-TB-L9.docx Date: 5/7/13 engage ny X.X.7

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 ____________________

Part 1

a. Estimate whether each container holds less than, more than, or the same as 1 liter.

Container 1 holds	less than / greater than / the same as	1 liter.	Actual:
Container 2 holds	less than / greater than / the same as	1 liter.	Actual:
Container 3 holds	less than / greater than / the same as	1 liter.	Actual:
Container 4 holds	less than / greater than / the same as	1 liter.	Actual:

b. After measuring, what surprised you? Why?

Part 2

c. Illustrate and describe the process of partitioning 1 liter of water into 10 cups.

d. Illustrate and describe the process of partitioning Cup K into 10 smaller units.

e. Illustrate and describe the process of partitioning Cup L into 10 smaller units.

f. What is the same about breaking 1 liter into milliliters and breaking 1 kilogram into grams?

g. One liter of water weighs 1 kilogram. How much does 1 milliliter of water weigh? Explain how you know.

Name ____ Date ______________________

1. Morgan fills a 1-liter jar with water from the pond. She uses a 100-mL cup to scoop water out of the pond and pour it into the jar. How many times will Morgan scoop water from the pond to fill the jar?

2. How many groups of 10 mL are in 1 liter? Explain.

There are _____________groups of 10 mL in 1 liter.

Name ____ Date ____________________

1. Find containers at home that have a capacity of about 1 liter. Use the labels on containers to help you identify them.

   a.

Name of Container
Example: Carton of Orange Juice

   b. Sketch the containers. How do their size and shape compare?

2. The doctor prescribes Mrs. Larson 5 milliliters of medicine each day for 3 days. How many milliliters of medicine will she take altogether?

3. Mrs. Goldstein pours 3 juice boxes into a bowl to make punch. Each juice box holds 236 milliliters. How much juice does Mrs. Goldstein pour into the bowl?

4. Daniel's fish tank holds 24 liters of water. He uses a 4-liter bucket to fill the tank. How many buckets of water are needed to fill the tank?

5. Sheila buys 15 liters of paint to paint her house. She pours the paint equally into 3 buckets. How many liters of paint are in each bucket?