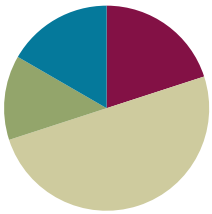
Lesson 4

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

Suggested Lesson Structure

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



Fluency Practice (12 minutes)

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

Perimeter and Area (4 minutes)

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

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

NOTES ON STANDARDS ALIGNMENT:

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

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

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

S: 6 units.
T: What is the sum of the four sides of the rectangle?
S: 16 units.
T: How many square units are in one row?
S: 5 square units.
T: How many rows of 5 square units are there?
S: 3 rows.
T: Let's find how many square units there are in the rectangle, counting by fives.
S: 5, 10, 15.
T: How many square units in all?
S: 15 square units.

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

Add Meters and Centimeters (2 minutes)

Materials: (S) Add Meters and Centimeters Pattern Sheet

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

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

Convert Units (2 minutes)

Materials: (S) Personal white board

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

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

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

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

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

Unit Counting (4 minutes)

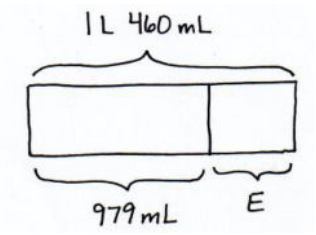
Note: This fluency activity deepens student understanding of the composition and decomposition of unit conversions, laying a foundation for adding and subtracting liters and milliliters. The numbers in bold type indicate the point at which the direction of the counting changes.

Direct students to count by liters in the following sequence:

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

Application Problem (8 minutes)

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



1 L 460 mL = 1,460 mL

481 mL evaporated.

Solution A

1,460 mL
− 979 mL
481 mL

E = 481 mL

Solution B

1460 mL − 979 mL = 481 mL

1000 mL + 460 mL

21 mL

Solution C

979 mL → (+21 mL) 1,000 mL → (+460 mL) 1,460 mL

21 mL + 460 mL = 481 mL

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

Concept Development (30 minutes)

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

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

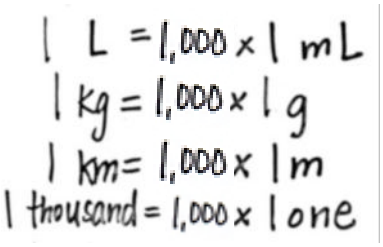
T: Turn and tell your neighbor the units for mass, length, and capacity that we have learned so far.

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

T What relationship have you discovered between milliliters and liters?

S 1 liter is 1,000 milliliters. → 1 liter is 1,000 times as much as 1 milliliter.

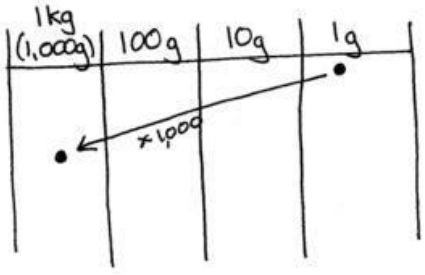
T: (Write 1 L = 1,000 × 1 mL.) What do you notice about the relationship between grams and kilograms? Meters and kilometers? Write your answers as equations.



S: 1 kilogram is 1,000 times as much as 1 gram. (Write 1 kg = 1,000 × 1 g.) 1 kilometer is 1,000 times as much as 1 meter. (Write 1 km = 1,000 × 1 m.)

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

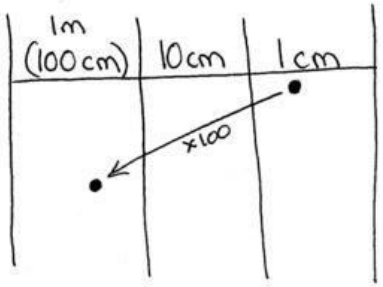
S: Ones, tens, hundreds, thousands, ten thousands, hundred thousands, and millions.



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

S: Yes. 1 kilogram is 1,000 times as much as 1 gram, like 1 thousand is 1,000 times as much as 1 one. → 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: (Write 1 meter = 100 × 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. 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.) 1 meter is equal to 100 centimeters. What unit is 100 ones?

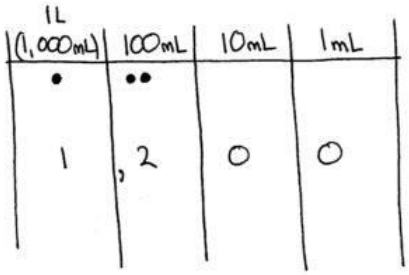
S: 1 hundred equals 100 ones.

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

S: 1 thousand equals 1,000 ones.

T: You can rename 1,200 milliliters as 1 liter 200 milliliters. How could you break 1,200 into place value units?

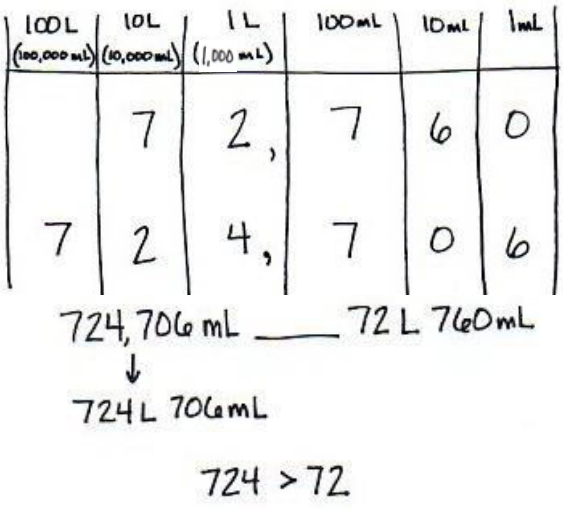
S: 1,200 is 1 thousand 200 ones.



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

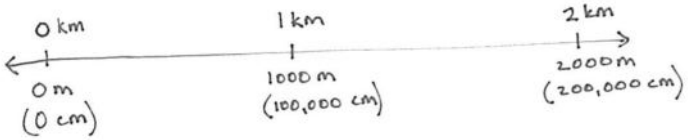
Problem 3: Compare metric units using place value knowledge and a number line.

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.

T: Draw a number line from 0 kilometers to 2 kilometers. 1 kilometer is how many meters?



NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

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

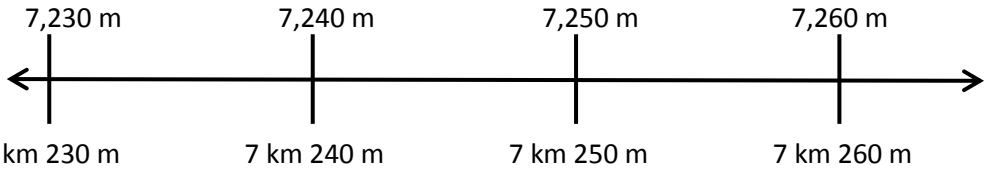
S: 1,000 meters.

T: 2 kilometers is equal to how many meters?

S: 2,000 meters.

T: Discuss with your partner how many centimeters are equal to 1 kilometer.

S: 1 meter is 100 centimeters. 1 kilometer is 1 thousand meters. → So, 1 thousand times 1 hundred is 100 thousand. → 2 meters is 200 centimeters, so 10 meters is 1,000 centimeters. 100 meters is ten of those, 10,000 centimeters. Ten of those is 100,000 centimeters.



Display a number line as pictured above.

T: (Write 7,256 m, 7 km 246 m, and 725,900 cm.) Work with your partner to place these measurements on a number line. Explain how you know where they are to be placed.

S: I know that 100 centimeters equals 1 meter. In the number 725,900, there are 7,259 hundreds. That means that 725,900 cm equals 7,259 m. Now, I am able to place 725,900 cm on the number line.

S: 7,256 m is between 7,250 m and 7,260 m. It is less than 7,259 m. 7 km 246 m is between 7 km 240 m (7,240 m) and 7 km 250 m (7,250 m).

S: Since all the measurements have 7 kilometers, I can compare meters. 256 is more than 246, and 259 is more than 256.

S: 7 km 246 m is less than 7,256 m, which is less than 725,900 cm.

T: Order the measurements from least to greatest.

Problem Set (10 minutes)

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

Student Debrief (10 minutes)

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

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

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

NOTES ON MULTIPLE MEANS OF REPRESENTATION:

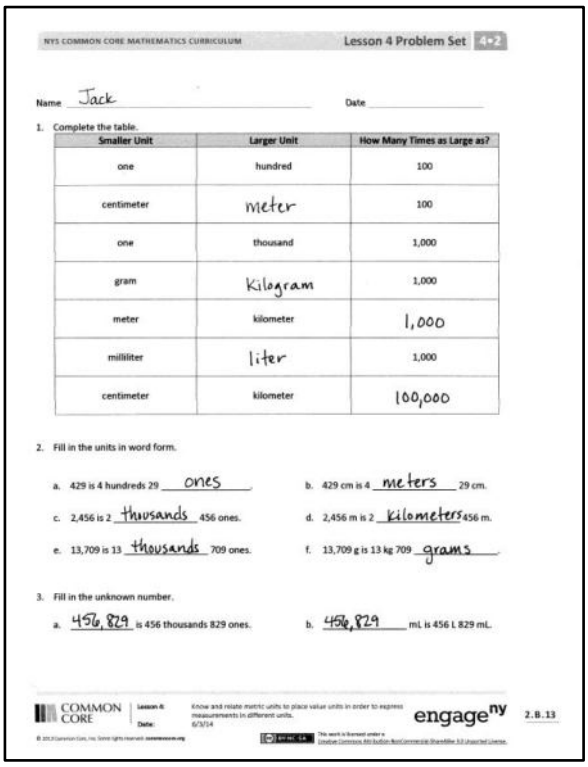
Clarify math vocabulary during the Debrief using pictures, gestures, and students' first languages. Give students multiple opportunities to articulate their math thinking. Offer English language learners the option of expressing themselves in the language most comfortable to them. Some students may feel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

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

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

Exit Ticket (3 minutes)

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



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

Name Jack Date

1. Complete the table.

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

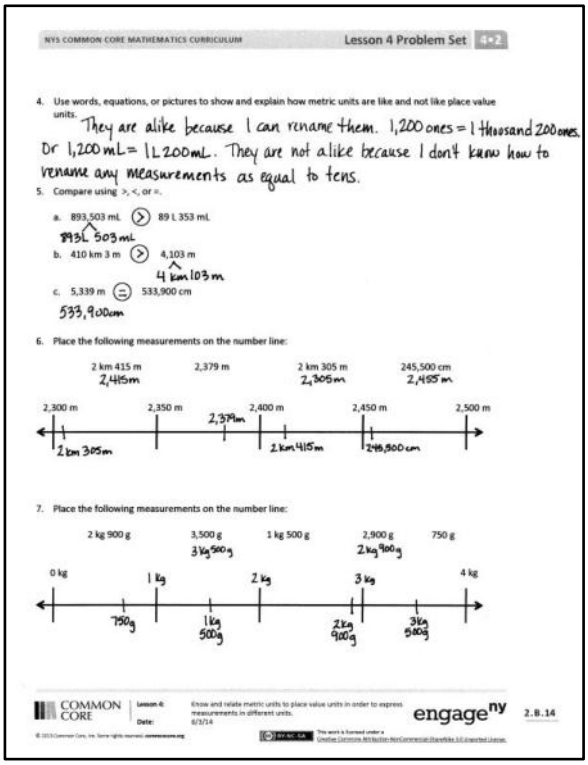
2. Fill in the units in word form.

a. 429 is 4 hundreds 29 ones
b. 429 cm is 4 meters 29 cm.
c. 2,456 is 2 thousands 456 ones.
d. 2,456 m is 2 kilometers 456 m.
e. 13,709 is 13 thousands 709 ones.
f. 13,709 g is 13 kg 709 grams

3. Fill in the unknown number.

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

COMMON CORE Lesson 4 Date: 6/3/14 Know and relate metric units to place value units in order to express measurements in different units. engage^ny 2.B.13



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

4. Use words, equations, or pictures to show and explain how metric units are like and not like place value units.
They are alike because I can rename them. 1,200 ones = 1 thousand 200 ones. Or 1,200 mL = 1 L 200 mL. They are not alike because I don't know how to rename any measurements as equal to tens.

5. Compare using >, <, or =.

a. 893,503 mL (>) 89 L 353 mL
893 L 503 mL
b. 410 km 3 m (>) 4,103 m
4 km 103 m
c. 5,339 m (=) 533,900 cm
533,900 cm

6. Place the following measurements on the number line:

2 km 415 m 2,415 m; 2,379 m; 2 km 305 m 2,305 m; 245,500 cm 2,455 m

7. Place the following measurements on the number line:

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

COMMON CORE Lesson 4 Date: 6/3/14 Know and relate metric units to place value units in order to express measurements in different units. engage^ny 2.B.14

Correct _____

Write in meters and centimeters.

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

Name _____ Date _____

1. Complete the table.

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

2. Fill in the units in word form.

a. 429 is 4 hundreds 29 _____.

b. 429 cm is 4 _____ 29 cm.

c. 2,456 is 2 _____ 456 ones.

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

e. 13,709 is 13 _____ 709 ones.

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

3. Fill in the unknown number.

a. _____ is 456 thousands 829 ones.

b. _____ mL is 456 L 829 mL.

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

5. Compare using >, <, or =.

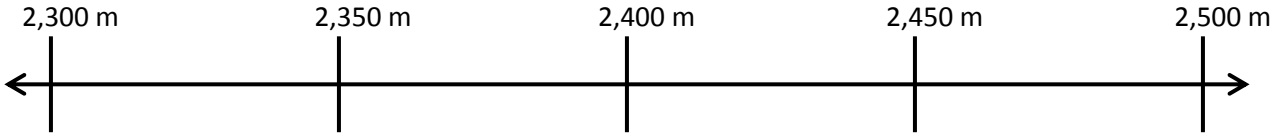
   a. 893,503 mL ◯ 89 L 353 mL

   b. 410 km 3 m ◯ 4,103 m

   c. 5,339 m ◯ 533,900 cm

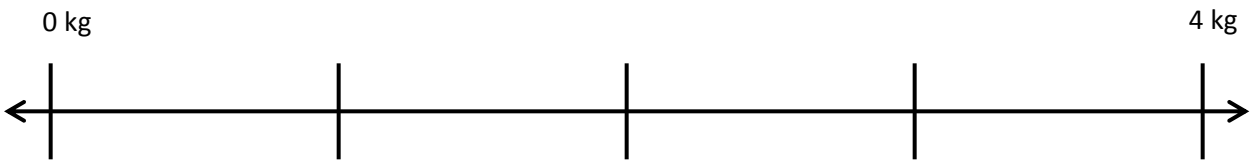
6. Place the following measurements on the number line:

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



7. Place the following measurements on the number line:

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



Name _____ Date _____

1. Fill in the unknown unit in word form.

   a. 8,135 is 8 _____ 135 ones.

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

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

3. Compare using >, <, or =.

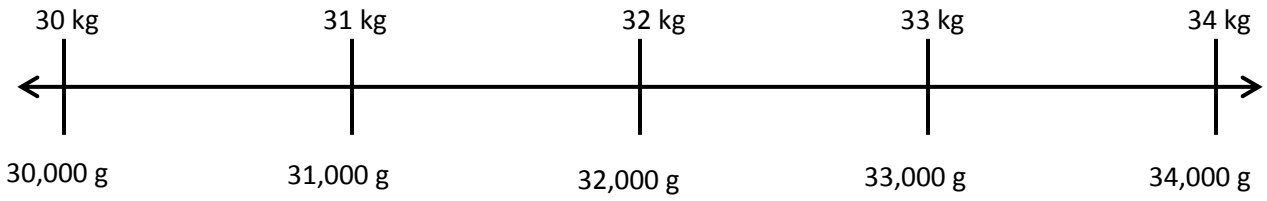
   a. 23 km 40 m ◯ 2,340 m

   b. 13,798 mL ◯ 137 L 980 mL

   c. 5,607 m ◯ 560,701 cm

4. Place the following measurements on the number line:

   33 kg 100 g 31,900 g 32,350 g 30 kg 500 g



Name _____ Date _____

1. Complete the table.

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

2. Fill in the unknown unit in word form.

a. 135 is 1 _____ 35 ones.

b. 135 cm is 1 _____ 35 cm.

c. 1,215 is 1 _____ 215 ones.

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

e. 12,350 is 12 _____350 ones.

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

3. Write the unknown number.

a. _____ is 125 thousands 312 ones.

b. _____ mL is 125 L 312 mL.

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

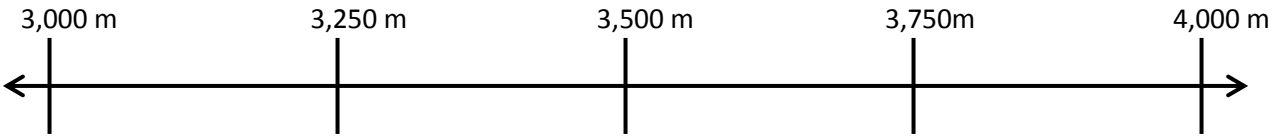
   a. 890,353 mL ◯ 89 L 353 mL

   b. 2 km 13 m ◯ 2,103 m

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

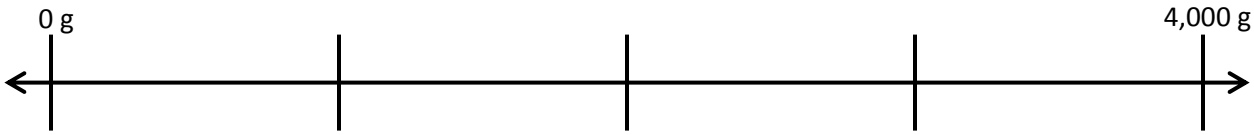
6. Place the following measurements on the number line:

3 km 275 m 3,500 m 3 km 5 m 394,000 cm



7. Place the following measurements on the number line:

1 kg 379 g 3,079 g 2 kg 79 g 3,579 g 579 g



unlabeled hundred thousands place value chart