Topic A

Multiplicative Patterns on the Place Value Chart

5.NBT.1, 5.NBT.2, 5.MD.1

Focus Standard:	5.NBT.1	Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.
	5.NBT.2	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.
	5.MD.1	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.
Instructional Days:	4	
Coherence -Links from:	G4–M1	Place Value, Rounding, and Algorithms for Addition and Subtraction
-Links to:	G6–M2	Arithmetic Operations Including Dividing by a Fraction

Topic A begins with a conceptual exploration of the multiplicative patterns of the base ten system. This exploration extends the place value work done with multi-digit whole numbers in Grade 4 to larger multi-digit whole numbers and decimals. Students use place value disks and a place value chart to build the place value chart from millions to thousandths. Students compose and decompose units crossing the decimal with a view toward extending students' knowledge of the *10 times as large* and *1/10 as large* relationships among whole number places to that of adjacent decimal places. This concrete experience is linked to the effects on the product when multiplying any number by a power of ten. For example, students notice that multiplying 0.4 by 1000 shifts the position of the digits to the left 3 places, changing the digits' relationships to the decimal point and producing a product with a value that is 10 x 10 x 10 as large (400.0) (**5.NBT.2**). Students explain these changes in value and shifts in position in terms of place value. Additionally, students learn a new and more efficient way to represent place value units using exponents, e. g., 1 thousand = 1000 = 10^3 (**5.NBT.2**). Conversions among metric units such as kilometers, meters, and centimeters give an opportunity to apply these extended place value relationships and exponents in a meaningful context by exploring word problems in the last lesson of Topic A (**5.MD.1**).

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A Teaching Sequence Towards Mastery of Multiplicative Patterns on the Place Value Chart	
Objective 1:	**Reason concretely and pictorially using place value understanding to relate adjacent base ten units from millions to thousandths.** **(Lesson 1)**
Objective 2:	**Reason abstractly using place value understanding to relate adjacent base ten units from millions to thousandths.** **(Lesson 2)**
Objective 3:	**Use exponents to name place value units and explain patterns in the placement of the decimal point.** **(Lesson 3)**
Objective 4:	**Use exponents to denote powers of 10 with application to metric conversions.** **(Lesson 4)**

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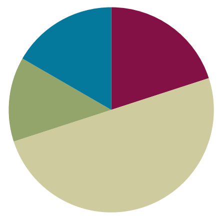
Lesson 1

Objective: Reason concretely and pictorially using place value understanding to relate adjacent base ten units from millions to thousandths.

Suggested Lesson Structure

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



NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Throughout *A Story of Units*, place value language is key. In earlier grades, teachers use units to refer to numbers such as 245 as two *hundred* forty five. Likewise, in Grades 4 and 5, decimals should be read emphasizing their unit form. For example, 0.2 would be read 2 *tenths* rather than *zero point two.* This emphasis on unit language not only strengthens student place value understanding, but also builds important parallel between whole number and decimal fraction understanding.

Fluency Practice (12 minutes)

- Multiply by 10 **4.NBT.1** (8 minutes)
- Rename the Units **2.NBT.1** (2 minutes)
- Decimal Place Value **4.NF.5–6** (2 minutes)

Sprint: Multiply by 10 (8 minutes)

Materials: (S) Multiply by 10 Sprint

Note: Reviewing this fluency will acclimate students to the Sprint routine, a vital component of the fluency program.

Please see *Sprints* in the Appendix for directions on administering.

Rename the Units—Choral Response (2 minutes)

Notes: This fluency will review foundations that will lead into today's lesson.

T: (Write 10 ones = _____ ten.) Say the number sentence.

S: 10 ones = 1 ten.

T: (Write 20 ones = _____ tens.) Say the number sentence.

S: 20 ones = 2 tens.

T: 30 ones.

S: 3 tens.

Repeat the process for 80 ones, 90 ones, 100 ones, 110 ones, 120 ones, 170, 270, 670, 640, and 830.

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Decimal Place Value (2 minutes)

Materials: (S) Personal white boards

Note: Reviewing this Grade 4 topic will help lay a foundation for students to better understand place value to bigger and smaller units.

T: (Project place value chart from millions to hundredths. Write 3 ten disks in the tens column.) How many tens do you see?

S: 3 tens.

T: (Write 3 underneath the disks.) There are 3 tens and how many ones?

S: Zero ones.

T: (Write 0 in the ones column. Below it, write 3 tens = ___.) Fill in the blank.

S: 3 tens = 30.

Repeat the process for 3 tenths = 0.3.

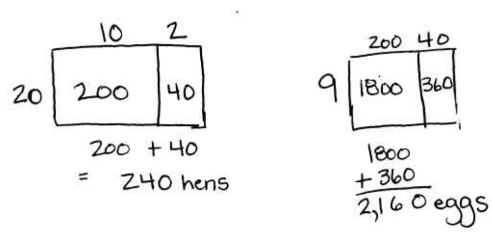
T: (Write 4 tenths = ___.) Show the answer in your place value chart.

S: (Students write four 1 tenth disks. Below it, they write 0.4.)

Repeat the process for 3 hundredths, 43 hundredths, 5 hundredths, 35 hundredths, 7 ones 35 hundredths, 9 ones 24 hundredths, and 6 tens 2 ones 4 hundredths.

Application Problem (8 minutes)

Farmer Jim keeps 12 hens in every coop. If Farmer Jim has 20 coops, how many hens does he have in all? If every hen lays 9 eggs on Monday, how many eggs will Farmer Jim collect on Monday? Explain your reasoning using words, numbers, or pictures.



Note: This problem is intended to activate prior knowledge from Grade 4 and offer a successful start to Grade 5. Some students may use area models to solve while others may choose to use the standard algorithm. Still others may draw tape diagrams to show their thinking. Allow students to share work and compare approaches.

Concept Development (30 minutes)

Materials: (S) Personal place value mats, disks, and markers

The place value chart and its *x 10* and relationships are familiar territory for students. New learning in Grade 5 focuses on understanding a new fractional unit of *thousandths* as well as the decomposition of larger units to those that are 1/10 as large. Building the place value chart from right (tenths) to left (millions) before

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beginning the following problem sequence may be advisable. Encourage students to multiply then bundle to form next largest place (e.g., 10 x 1 hundred = 10 hundreds, which can be bundled to form 1 thousand).

Problem 1

Divide single units by 10 to build the place value chart to introduce *thousandths.*

T: Show 1 million using disks on your chart. How can we show 1 million using hundred thousands? Work with your partner to show this on your mat.

S: 1 million is the same as 10 hundred thousands.

T: What is the result if I divide 10 hundred thousands by 10? Talk with your partner and use your mat to find the quotient.

T: (Circulate.) I saw that David put 10 disks in the hundred thousands place, then put them in 10 equal groups. How many are in each group?

S: When I divide 10 hundred thousands by 10, I get 1 hundred thousand in each group.

T: Let me record what I hear you saying. (Record on class board.)

10 hundred thousands ÷ 10 = 1 hundred thousand

1 million ÷ 10 = 1 hundred thousand

1 hundred thousand is 1/10 as large as 1 million

Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths
1	÷ 10								
	1								

T: Put 1 hundred thousand disk on your chart. What is the result if we divide 1 hundred thousand by 10? Show this on your mat and write a division sentence.

Continue this sequence until the hundredths place is reached emphasizing the unbundling for 10 of the smaller unit and then the division. Record the place values and equations (using unit form) on the board being careful to point out the *1/10 as large* relationship:

MP.7

1 million ÷ 10 = 1 hundred thousand

1 hundred thousand ÷ 10 = 1 ten thousand

1 ten thousand ÷ 10 = 1 thousand

1 thousand ÷ 10 = 1 hundred

(and so on, through 1 tenth ÷ 10 = 1 hundredth)

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Students who have limited experience with decimal fractions may be supported by a return to Grade 4's Module 6 to review decimal place value and symmetry with respect to the ones place.

Conversely, student understanding of decimal fraction place value units may be extended by asking for predictions of units 1/10 as large as the thousandths place, and those beyond.

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MP.8

T: What patterns do you notice in the way the units are named in our place value system?

S: The ones place is the middle. There are tens on the left and tenths on the right, hundreds on the left and hundredths on the right.

T: (Point to the chart.) Using this pattern, can you predict what the name of the unit that is to the right of the hundredths place (1/10 as large as hundredths) might be? (Students share. Label the thousandths place.)

T: Thinking about the pattern that we've seen with other adjacent places, talk with your partner and predict how we might show 1 hundredth using thousandths disks and show this on your chart.

S: Just like all the other places, it takes 10 of the smaller unit to make 1 of the larger so it will take 10 thousandths to make 1 hundredth.

T: Use your chart to show the result if we divide 1 hundredth by 10 and write the division sentence. (Students share. Add this equation to the others on the board.)

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:

Proportional materials such as base ten blocks can help children with language differences distinguish between place value labels like *hundredth* and *thousandth* more easily by offering clues to their relative sizes.

These students can be encouraged to name these units in their native language and then compare them to their English counterparts. Often the roots of these number words are very similar. These parallels enrich the experience and understanding of all students.

Problem 2

Multiply copies of one unit by 10, 100, and 1000.

0.4×10

0.04×10

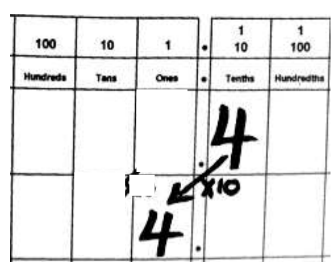
0.004×10

T: Draw number disks to represent 4 tenths at the top on your place value chart.

S: (Students write.)

T: Work with your partner to find the value of 10 times 0.4. Show your result at the bottom of your place value chart.

S: 4 tenths x 10 = 40 tenths, which is the same as 4 wholes. → 4 ones is 10 times as large as 4 tenths.



T: On your place value chart, use arrows to show how the value of the digits has changed. (On place value chart, draw an arrow to indicate the shift of the digit to the left, write *x 10* above arrow.)

T: Why does the digit move one place to the left?

S: Because it is 10 times as large, it has to be bundled for the next larger unit.

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Repeat with 0.03 x 10 and 0.003 x 1000. Use unit form to state each problem and encourage students to articulate how the value of the digit changes and why it changes position in the chart.

Problem 3

Divide copies of one unit by 10, 100, and 1000.

6 ÷ 10

6 ÷ 100

6 ÷ 1000

Follow similar sequence to guide students in articulating changes in value and shifts in position while showing on the place value chart.

Repeat with 0.7 ÷ 10; 0.7 ÷ 10; 0.05 ÷ 10; and 0.05 ÷ 100.

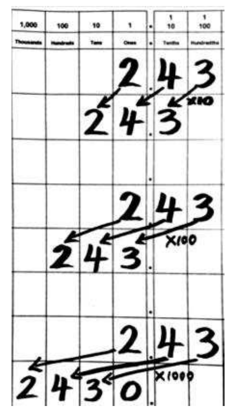
Problem 4

Multiply mixed units by 10, 100, and 1000.

2.43 × 10

2.43 × 100

2.43 × 1000



MP.4

T: Write the digits two and forty-three hundredths on your place value chart and multiply by 10, then 100, and then 1000. Compare these products with your partner.

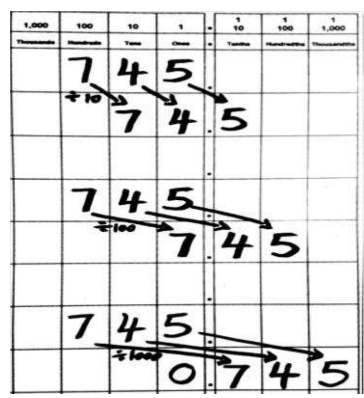
Lead students to discuss how the digits shift as a result in their change in value by isolating one digit, such as the 3, and comparing its value in each product.

Problem 5

745 ÷ 10

745 ÷ 100

745 ÷ 1000



Engage in a similar discussion regarding the shift and change in value for a digit in these division problems. See discussion above.

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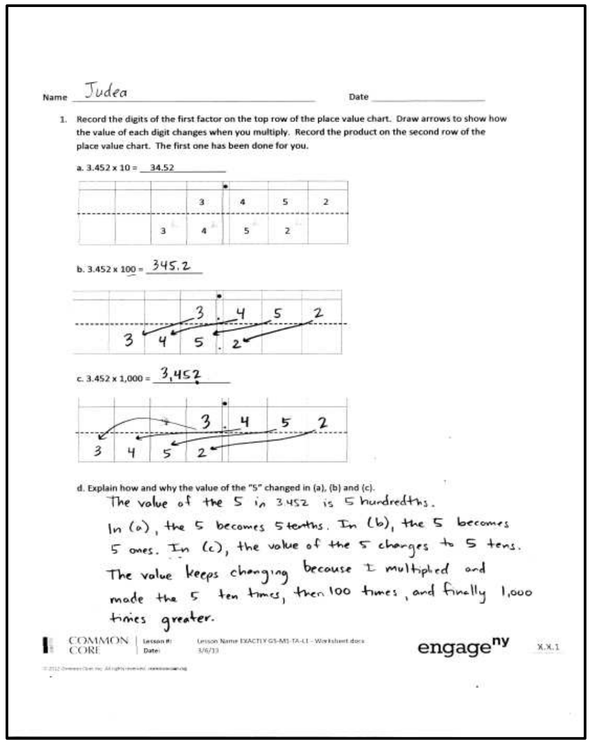
Problem Set (10 minutes)

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.


Name Judea Date

1. Record the digits of the first factor on the top row of the place value chart. Draw arrows to show how the value of each digit changes when you multiply. Record the product on the second row of the place value chart. The first one has been done for you.

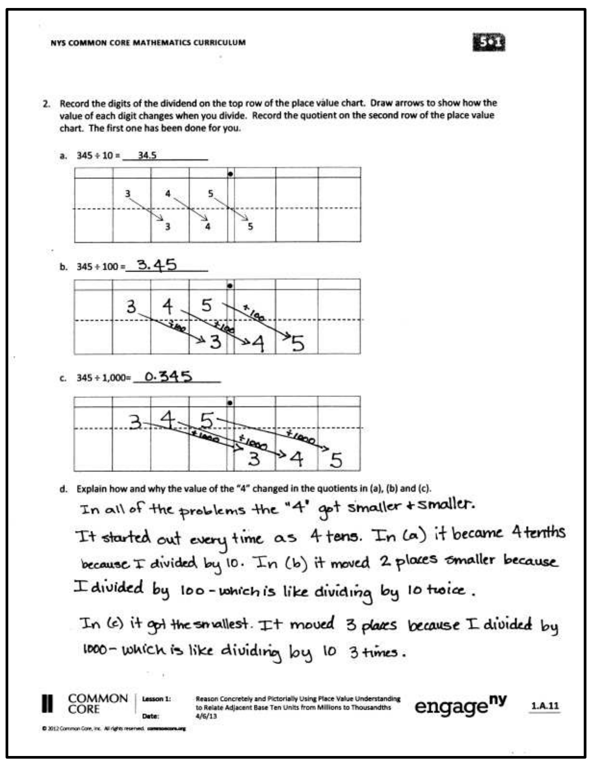
a. 3.452 x 10 = 34.52

b. 3.452 x 100 = 345.2

c. 3.452 x 1,000 = 3,452

d. Explain how and why the value of the "5" changed in (a), (b) and (c).

The value of the 5 in 3.452 is 5 hundredths. In (a), the 5 becomes 5 tenths. In (b), the 5 becomes 5 ones. In (c), the value of the 5 changes to 5 tens. The value keeps changing because I multiplied and made the 5 ten times, then 100 times, and finally 1,000 times greater.


NYS COMMON CORE MATHEMATICS CURRICULUM 5•1

2. Record the digits of the dividend on the top row of the place value chart. Draw arrows to show how the value of each digit changes when you divide. Record the quotient on the second row of the place value chart. The first one has been done for you.

a. 345 ÷ 10 = 34.5

b. 345 ÷ 100 = 3.45

c. 345 ÷ 1,000 = 0.345

d. Explain how and why the value of the "4" changed in the quotients in (a), (b) and (c).

In all of the problems the "4" got smaller + smaller. It started out every time as 4 tens. In (a) it became 4 tenths because I divided by 10. In (b) it moved 2 places smaller because I divided by 100 - which is like dividing by 10 twice. In (c) it got the smallest. It moved 3 places because I divided by 1000 - which is like dividing by 10 3 times.

Student Debrief (10 minutes)

Lesson Objective: Reason concretely and pictorially using place value understanding to relate adjacent base ten units from millions to thousandths.

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.

- Compare the solutions you found when multiplying by 10 and dividing by 10 (32 × 10 and 32 ÷ 10). How do the solutions relate to the value of the original quantity? How do they relate to each other?
- What do you notice about the number of zeros in your products when multiplying by 10, 100, and 1000 relative to the number of places the digits shift on the place value chart? What patterns do you notice?

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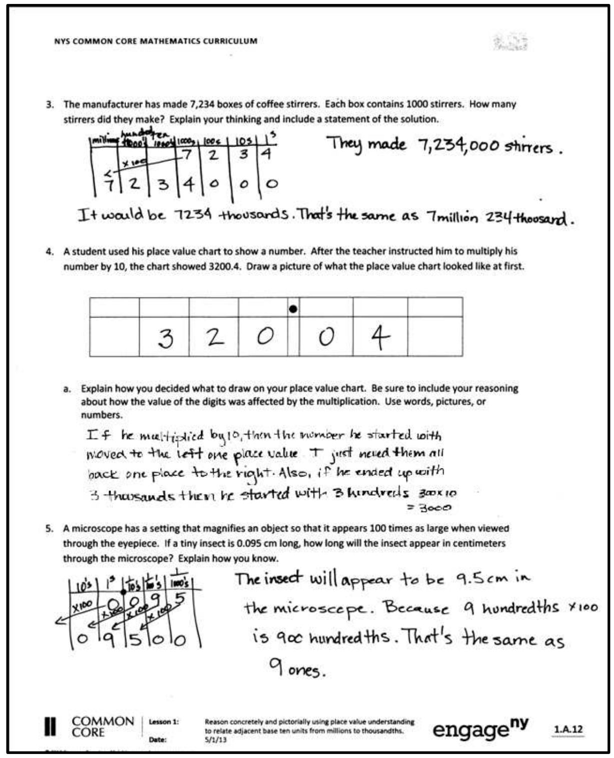
- What is the same and what is different about the products for Problems 1(a), 1(b), and 1(c)? (Encourage students to notice that digits are exactly the same, only the values have changed.)
- When solving Problem 2(c), many of you noticed the use of our new place value. (Lead brief class discussion to reinforce what value this place represents. Reiterate the symmetry of the places on either side of the ones place and the size of thousandths relative to other place values like tenths and ones.)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3. The manufacturer has made 7,234 boxes of coffee stirrers. Each box contains 1000 stirrers. How many stirrers did they make? Explain your thinking and include a statement of the solution.

They made 7,234,000 stirrers.

It would be 7234 thousands. That's the same as 7million 234thousand.

4. A student used his place value chart to show a number. After the teacher instructed him to multiply his number by 10, the chart showed 3200.4. Draw a picture of what the place value chart looked like at first.

			•			
	3	2	0	0	4	

a. Explain how you decided what to draw on your place value chart. Be sure to include your reasoning about how the value of the digits was affected by the multiplication. Use words, pictures, or numbers.

If he multiplied by 10, then the number he started with moved to the left one place value. I just moved them all back one place to the right. Also, if he ended up with 3 thousands then he started with 3 hundreds 300×10 = 3000

5. A microscope has a setting that magnifies an object so that it appears 100 times as large when viewed through the eyepiece. If a tiny insect is 0.095 cm long, how long will the insect appear in centimeters through the microscope? Explain how you know.

The insect will appear to be 9.5cm in the microscope. Because 9 hundredths ×100 is 900 hundredths. That's the same as 9 ones.

COMMON CORE Lesson 1: Reason concretely and pictorially using place value understanding to relate adjacent base ten units from millions to thousandths. Date: 5/1/13 engage^ny 1.A.12

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.

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A # Correct _____

Multiply.

1	12 x 10 =		23	34 x 10 =	
2	14 x 10 =		24	134 x 10 =	
3	15 x 10 =		25	234 x 10 =	
4	17 x 10 =		26	334 x 10 =	
5	81 x 10 =		27	834 x 10 =	
6	10 x 81 =		28	10 x 834 =	
7	21 x 10 =		29	45 x 10 =	
8	22 x 10 =		30	145 x 10 =	
9	23 x 10 =		31	245 x 10 =	
10	29 x 10 =		32	345 x 10 =	
11	92 x 10 =		33	945 x 10 =	
12	10 x 92 =		34	56 x 10 =	
13	18 x 10 =		35	456 x 10 =	
14	19 x 10 =		36	556 x 10 =	
15	20 x 10 =		37	950 x 10 =	
16	30 x 10 =		38	10 x 950 =	
17	40 x 10 =		39	16 x 10 =	
18	80 x 10 =		40	10 x 60 =	
19	10 x 80 =		41	493 x 10 =	
20	10 x 50 =		42	10 x 84 =	
21	10 x 90 =		43	96 x 10 =	
22	10 x 70 =		44	10 x 580 =	

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B Improvement _____ # Correct _____

Multiply.

1	13 x 10 =		23	43 x 10 =	
2	14 x 10 =		24	143 x 10 =	
3	15 x 10 =		25	243 x 10 =	
4	19 x 10 =		26	343 x 10 =	
5	91 x 10 =		27	743 x 10 =	
6	10 x 91 =		28	10 x 743 =	
7	31 x 10 =		29	54 x 10 =	
8	32 x 10 =		30	154 x 10 =	
9	33 x 10 =		31	254 x 10 =	
10	38 x 10 =		32	354 x 10 =	
11	83 x 10 =		33	854 x 10 =	
12	10 x 83 =		34	65 x 10 =	
13	28 x 10 =		35	465 x 10 =	
14	29 x 10 =		36	565 x 10 =	
15	30 x 10 =		37	960 x 10 =	
16	40 x 10 =		38	10 x 960 =	
17	50 x 10 =		39	17 x 10 =	
18	90 x 10 =		40	10 x 70 =	
19	10 x 90 =		41	582 x 10 =	
20	10 x 20 =		42	10 x 73 =	
21	10 x 60 =		43	98 x 10 =	
22	10 x 80 =		44	10 x 470 =	

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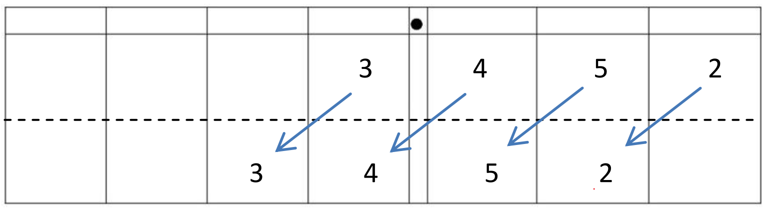
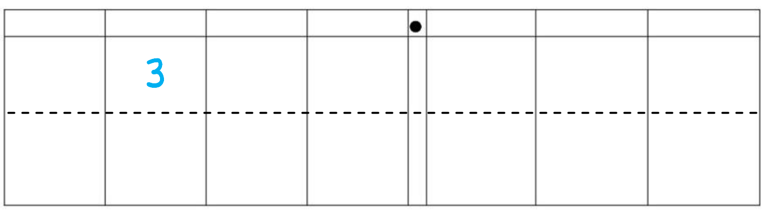
Name ______________________________ Date ____________________

1. Record the digits of the first factor on the top row of the place value chart. Draw arrows to show how the value of each digit changes when you multiply. Record the product on the second row of the place value chart. The first one has been done for you.

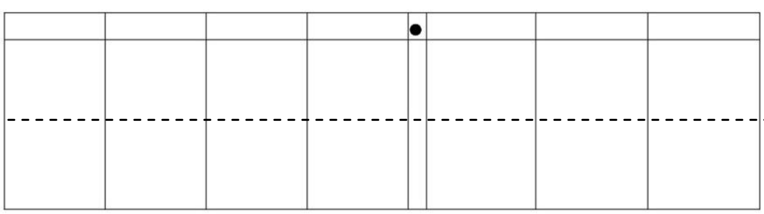
   a. 3.452 x 10 = 34.52



   b. 3.452 x 100 = ___________



   c. 3.452 x 1000 = _______________



   d. Explain how and why the value of the 5 changed in (a), (b), and (c).

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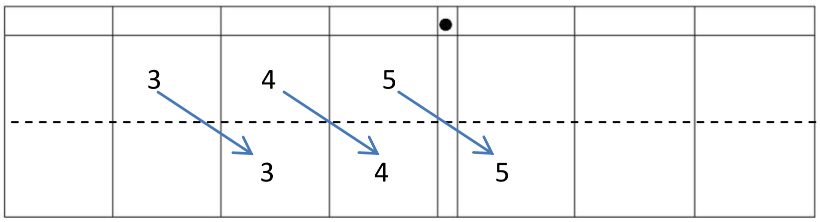
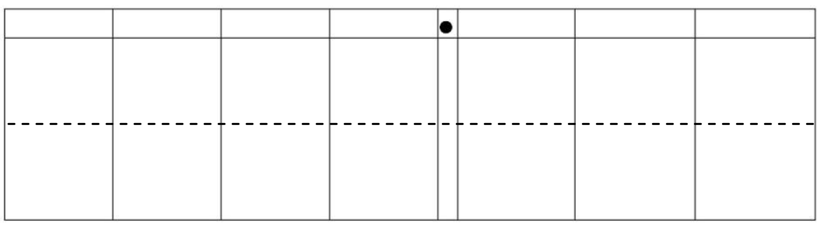
2. Record the digits of the dividend on the top row of the place value chart. Draw arrows to show how the value of each digit changes when you divide. Record the quotient on the second row of the place value chart. The first one has been done for you.

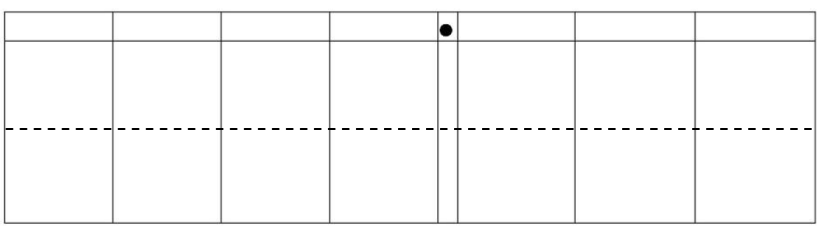
   a. 345 ÷ 10 = ___34.5___



   b. 345 ÷ 100 =________________



   c. 345 ÷ 1000= _________________



   d. Explain how and why the value of the 4 changed in the quotients in (a), (b), and (c).

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3. A manufacturer made 7,234 boxes of coffee stirrers. Each box contains 1000 stirrers. How many stirrers did they make? Explain your thinking and include a statement of the solution.

4. A student used his place value chart to show a number. After the teacher instructed him to multiply his number by 10, the chart showed 3200.4. Draw a picture of what the place value chart looked like at first.

				●			

a. Explain how you decided what to draw on your place value chart. Be sure to include your reasoning about how the value of the digits was affected by the multiplication. Use words, pictures, or numbers.

5. A microscope has a setting that magnifies an object so that it appears 100 times as large when viewed through the eyepiece. If a tiny insect is 0.095 cm long, how long will the insect appear in centimeters through the microscope? Explain how you know.

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Name ____ Date ______________________

1. Write the first factor above the dashed line on the place value chart and the product or quotient under the dashed line, using arrows to show how the value of the digits changed. Then write your answer in the blank.

   a. 6.671 × 100 = ___________

				•			

   b. 684 ÷ 1000 = _________________

				•			

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Name ____ Date ______________________

1. Record the digits of the first factor on the top row of the place value chart. Draw arrows to show how the value of each digit changes when you multiply. Record the product on the second row of the place value chart. The first one has been done for you.

a. 4.582 x 10 = ___45.82___

				•			
			2		5	8	2
		2	5		8	2	

b. 7.281 x 100 = ___________

				•			

c. 9.254 x 1000 = _______________

				•			

d. Explain how and why the value of the 2 changed in (a), (b), and (c).

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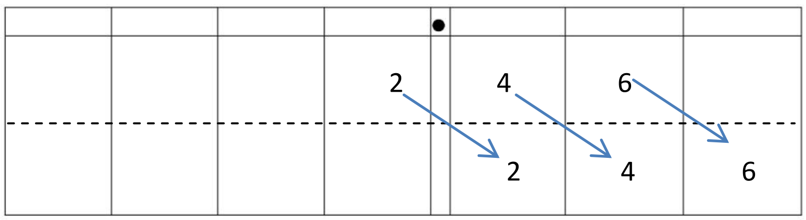
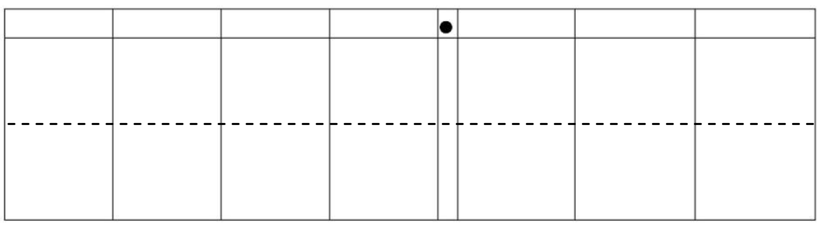
2. Record the digits of the dividend on the top row of the place value chart. Draw arrows to show how the value of each digit changes when you divide. Record the quotient on the second row of the place value chart. The first one has been done for you.

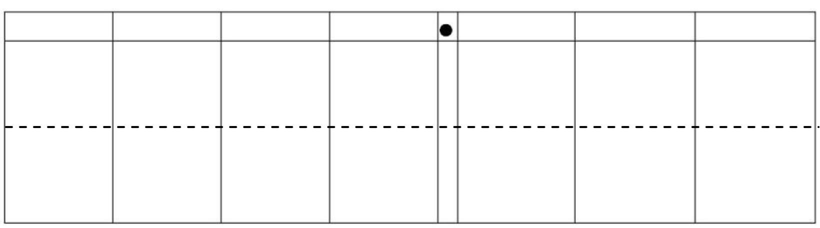
   a. 2.46 ÷ 10 = ____0.246____



   b. 678 ÷ 100 =________________



   c. 67 ÷ 1000= _________________



   d. Explain how and why the value of the 6 changed in the quotients in (a), (b), and (c).

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3. Researchers counted 8,912 monarch butterflies on one branch of a tree at a site in Mexico. They estimated that the total number of butterflies at the site was 1000 times as large. About how many butterflies were at the site in all? Explain your thinking and include a statement of the solution.

4. A student used his place value chart to show a number. After the teacher instructed him to divide his number by 100, the chart showed 28.003. Draw a picture of what the place value chart looked like at first.

				●			

   a. Explain how you decided what to draw on your place value chart. Be sure to include your reasoning about how the value of the digits was affected by the division.

5. On a map, the perimeter of a park is 0.251 meters. The actual perimeter of the park is 1000 times as large. What is the actual perimeter of the park? Explain how you know using a place value chart.

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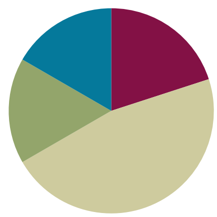
Lesson 2

Objective: Reason abstractly using place value understanding to relate adjacent base ten units from millions to thousandths.

Suggested Lesson Structure

- Fluency Practice (12 minutes)
- Application Problems (10 minutes)
- Concept Development (28 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)



Fluency Practice (12 minutes)

- Skip-Counting **3.OA.4–6** (3 minutes)
- Take Out the Tens **2.NBT.1** (2 minutes)
- Bundle Ten and Change Units **4.NBT.1** (2 minutes)
- Multiply and Divide by 10 **5.NBT.1** (5 minutes)

Skip-Counting (3 minutes)

Notes: Practicing skip-counting on the number line builds a foundation for accessing higher order concepts throughout the year.

Direct the students to count forward and backward by threes to 36, emphasizing the transitions of crossing the ten. Direct the students to count forward and backward by fours to 48, emphasizing the transitions of crossing the ten.

NOTES ON ALIGNMENT:

Fluency tasks are included not only as warm-ups for the current lesson, but also as opportunities to retain past number understandings and to sharpen those understandings needed for coming work. Skip-counting in Grade 5 provides support for the common multiple work covered in Grade 5's Module 3.

Additionally, returning to a familiar and well understood fluency can provide a student with a feeling of success before tackling a new body of work.

Consider including body movements to accompany skip counting exercises (e.g., jumping jacks, toe touches, arm stretches, or dance movements like the Macarena).

Take Out the Tens (2 minutes)

Materials: (S) Personal white boards

Note: Decomposing whole numbers into different units will lay a foundation to do the same with decimal fractions.

T: (Write 83 ones = ____ tens ____ ones.) Write the number sentence.

S: (Students write 83 ones = 8 tens 3 ones.)

Repeat process for 93 ones, 103 ones, 113 ones, 163 ones, 263 ones, 463 ones, and 875 ones.

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Bundle Ten and Change Units (2 minutes)

Note: Reviewing this fluency will help students work towards mastery of changing place value units in the base ten system.

T: (Write 10 hundreds = 1 ____.) Say the sentence, filling in the blank.

S: 10 hundreds = 1 thousand.

Repeat the process for 10 tens = 1 ____, 10 ones = 1 ____, 10 tenths = 1 ____, 10 thousandths = 1 ____, and 10 hundredths = 1 ____.

Multiply and Divide by 10 (5 minutes)

Materials: (S) Personal white boards

Note: Reviewing this skill from Lesson 1 will help students work towards mastery.

T: (Project place value chart from millions to thousandths.) Write three ones disks and the number below it.

S: (Write 3 ones disks in the ones column. Below it, write 3.)

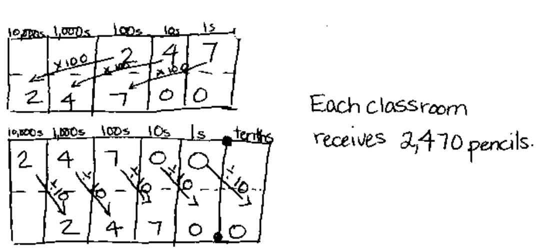
T: Multiply by 10. Cross out each disk and the number 3 to show that you're changing its value.

S: (Students cross out each ones disk and the 3. They draw arrows to the tens column and write 3 tens disks. Below it, they write 3 in the tens column and 0 in the ones column.)

Repeat the process for 2 hundredths, 3 tenths 2 hundredths, 3 tenths 2 hundredths 4 thousandths, 2 tenths 4 hundredths 5 thousandths, and 1 tenth 3 thousandths. Repeat the process for dividing by 10 for this possible sequence: 2 ones, 3 tenths, 2 ones 3 tenths, 2 ones 3 tenths 5 hundredths, 5 tenths 2 hundredths, and 1 ten 5 thousandths.

Application Problem (10 minutes)

A school district ordered 247 boxes of pencils. Each box contains 100 pencils. If the pencils are to be shared evenly amongst 10 classrooms, how many pencils will each class receive? Draw a place value chart to show your thinking.



NOTES ON APPLICATION PROBLEMS:

Application problems are designed to reach back to the learning in the prior day's lesson. As such, today's problem requires students to show thinking using the concrete–pictorial approach used in Lesson 1 to finding the product and quotient. This will act as an anticipatory set for today's lesson.

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Concept Development (28 minutes)

Materials: (S) Personal white boards

T: Turn and share with your partner. What do you remember from yesterday's lesson about how adjacent units on the place value chart are related?

S: (Students share.)

T: Moving one position to the left of the place value chart makes units 10 times larger. Conversely, moving one position to the right makes units 1 tenth the size.

As students move through the problem sets, encourage a move away from the concrete–pictorial representations of these products and quotients and a move toward reasoning about the patterns of the number of zeros in the products and quotients and the placement of the decimal.

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Although students are being encouraged toward more abstract reasoning in the lesson, it is important to keep concrete materials like place value mats and disks accessible to students while these place value relationships are being solidified. Giving students the freedom to move between levels of abstraction on a task by task basis can decrease anxiety when working with more difficult applications.

Problems 1–4

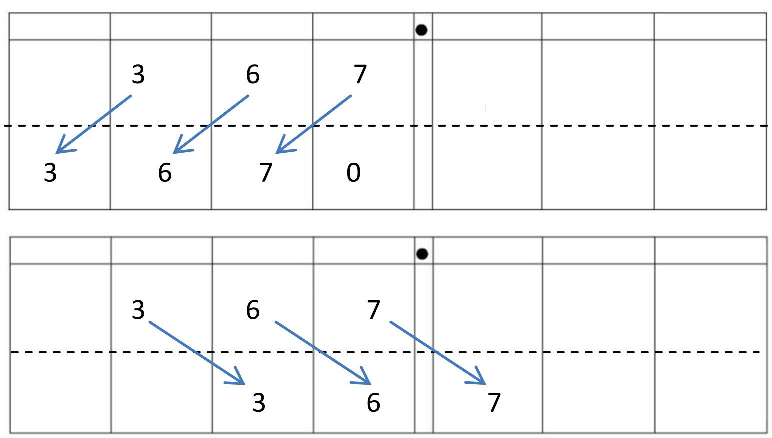
367 × 10

367 ÷ 10

4,367 × 10

4,367 ÷ 10

T: Work with your partner to solve these problems. Write two complete number sentences on your board.



S: 367 × 10 = 3670. 367 ÷ 10 = 36.7

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MP.3

T: Explain how you got your answers. What are the similarities and differences between the two answers?

S: Digits are the same but their values have changed so their position in the number is different. → The 3 is 10 times larger in the product than in the factor. It was 3 hundreds, now it is 3 thousands. → The six started out as 6 tens, but once it was divided by 10, it is now 1 tenth as large because it is 6 ones.

MP.2

T: What patterns do you notice in the number of zeros in the product and the placement of the decimal in the quotient? What do you notice about the number of zeros in your factors and the shift in places in you product? What do you notice about the number of zeros in your divisor and shift in places in your quotient?

S: (Students share.)

Repeat this sequence with the last pair of expressions. Encourage students with this pair to visualize the place value mat and attempt to find the product and quotient without drawing the mat. Circulate watching for misconceptions and students who are not ready to work on an abstract level. As students share thinking encourage the use of the language 10 times as large and 1/10 as large.

Problems 5–8

215.6 × 100

215.6 ÷ 100

3.7 × 100

3.7 ÷ 100

T: Now solve with your partner by visualizing your place value mat and recording only your products and quotients. You may check your work using a place value mat. (Circulate, looking for students who may still need the support of the place value mat.)

S: (Students solve.)

MP.7

T: Compare your work with your partner's. Do you agree? How many times did the digit shift in each problem and why? Share your thinking with your partner.

S: The digits shifted two places to the left when we multiply and shifted two places to the right when we divide. → This time the numbers each shifted 2 places because there are 2 zeros in 100. → The values of the products are 100 times as large, so the digits had to shift to larger units.

Problems 9–10

0.482 × 1000

482 ÷ 1000

Follow a similar sequence for these equations.

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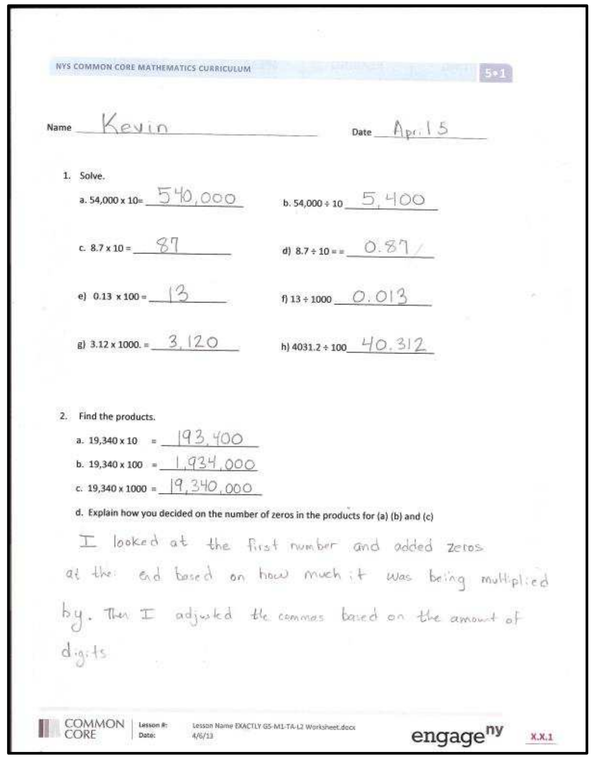
Problem Set (10 minutes)

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.


NYS COMMON CORE MATHEMATICS CURRICULUM 5•1

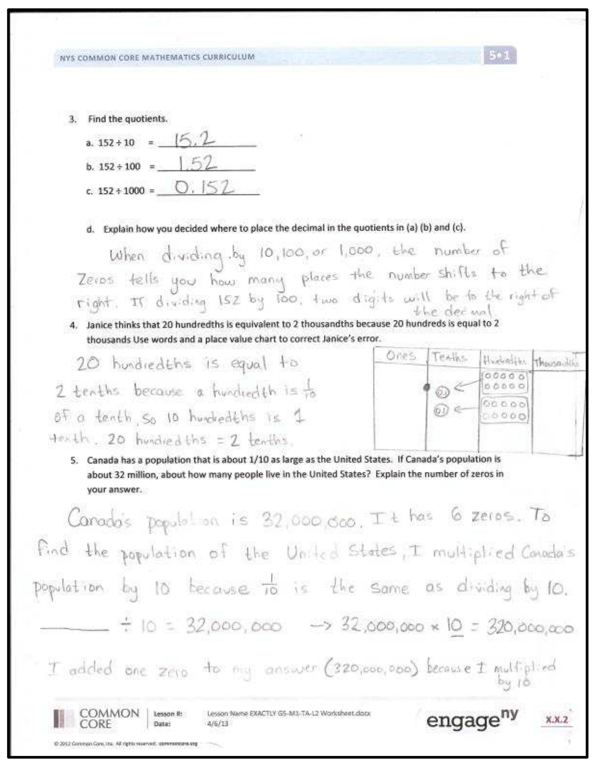
Name Kevin Date April 15

1. Solve.
   a. 54,000 x 10= 540,000 b. 54,000 ÷ 10 5,400
   c. 8.7 x 10 = 87 d) 8.7 ÷ 10 = = 0.87
   e) 0.13 x 100 = 13 f) 13 ÷ 1000 0.013
   g) 3.12 x 1000. = 3,120 h) 4031.2 ÷ 100 40.312

2. Find the products.
   a. 19,340 x 10 = 193,400
   b. 19,340 x 100 = 1,934,000
   c. 19,340 x 1000 = 19,340,000
   d. Explain how you decided on the number of zeros in the products for (a) (b) and (c)

I looked at the first number and added zeros at the end based on how much it was being multiplied by. Then I adjusted the commas based on the amount of digits

COMMON CORE Lesson #: Lesson Name EXACTLY G5-M1-TA-L2 Worksheet.docx Date: 4/6/13 engage^ny X.X.1


NYS COMMON CORE MATHEMATICS CURRICULUM 5•1

3. Find the quotients.
   a. 152 ÷ 10 = 15.2
   b. 152 ÷ 100 = 1.52
   c. 152 ÷ 1000 = 0.152
   d. Explain how you decided where to place the decimal in the quotients in (a) (b) and (c).

When dividing by 10, 100, or 1,000, the number of zeros tells you how many places the number shifts to the right. If dividing 152 by 100, two digits will be to the right of the decimal

4. Janice thinks that 20 hundredths is equivalent to 2 thousandths because 20 hundreds is equal to 2 thousands Use words and a place value chart to correct Janice's error.

20 hundredths is equal to 2 tenths because a hundredth is 1/10 of a tenth, so 10 hundredths is 1 tenth. 20 hundredths = 2 tenths.

5. Canada has a population that is about 1/10 as large as the United States. If Canada's population is about 32 million, about how many people live in the United States? Explain the number of zeros in your answer.

Canada's population is 32,000,000. It has 6 zeros. To find the population of the United States, I multiplied Canada's population by 10 because 1/10 is the same as dividing by 10.

_____ ÷ 10 = 32,000,000 → 32,000,000 x 10 = 320,000,000

I added one zero to my answer (320,000,000) because I multiplied by 10

COMMON CORE Lesson #: Lesson Name EXACTLY G5-M1-TA-L2 Worksheet.docx Date: 4/6/13 engage^ny X.X.2

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Student Debrief (10 minutes)

Lesson Objective: Reason abstractly using place value understanding to relate adjacent base ten units from millions to thousandths.

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.

- Compare and contrast answers in Problem 1(a) and (b), or (c) and (d)?
- What's similar about the process you used to solve Problem 1(a), (c), (e), and (g)?
- What's similar about the process you used to solve Problem 1(b), (d), (f), and (h)?
- When asked to find the number 1 tenth as large as another number, what operation would you use? Explain how you know.
- When solving Problem 2, how did the number of zeros in the factors help you determine the product?
- Can you think of a time when there will be a different number of zeros in the factors and the product? (If students have difficulty answering, give them the example of 4 x 5, 4 x 50, 40 x 50. Then ask if they can think of other examples.)

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- When dividing by 10, what happens to the digits in the quotient? What multiplying by 100, what happens to the places in the product?

Be prepared for students to make mistakes when answering Problem 4. (Using a place value chart to solve this problem may reduce the errors. Encourage discussion about the relative size of the units in relation to a whole and why hundredths are larger than thousandths.)

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.

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Name ____ Date ______________________

1. Solve.

   a. 54,000 x 10 = ___________________

   b. 54,000 ÷ 10 = __________________

   c. 8.7 x 10 = ___________________

   d. 8.7 ÷ 10 = ________________

   e. 0.13 x 100 = _______________

   f. 13 ÷ 1000 = ___________________

   g. 3.12 x 1000 = _________________

   h. 4031.2 ÷ 100 = _________________

2. Find the products.

   a. 19,340 x 10 = ___________________

   b. 19,340 x 100 = ___________________

   c. 19,340 x 1000 = ____________________

   d. Explain how you decided on the number of zeros in the products for (a), (b), and (c).

3. Find the quotients.

   a. 152 ÷ 10 = ___________________

   b. 152 ÷ 100 = ___________________

   c. 152 ÷ 1000 = ____________________

   d. Explain how you decided where to place the decimal in the quotients in (a), (b), and (c).

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4. Janice thinks that 20 hundredths is equivalent to 2 thousandths because 20 hundreds is equal to 2 thousands. Use words and a place value chart to correct Janice's error.

5. Canada has a population that is about 1/10 as large as the United States. If Canada's population is about 32 million, about how many people live in the United States? Explain the number of zeros in your answer.

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Name ____ Date ______________________

1. Solve.

   a. 32.1 x 10 = ___________________

   b. 3632.1 ÷ 10 = ____________________

2. Solve.

   a. 455 x 1000 = _______________

   b. 455 ÷ 1000 = __________________

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Name ____ Date ____________________

1. Solve.

a. 36,000 x 10 = ____________________

b. 36,000 ÷ 10 = ____________________

c. 4.3 x 10 = ____________________

d. 4.3 ÷ 10 = __________________

e. 0.24 x 100 = ________________

f. 24 ÷ 1000 = ____________________

g. 4.54 x 1000 = __________________

h. 3045.4 ÷ 100 = __________________

2. Find the products.

a. 14,560 x 10 = ____________________

b. 14,560 x 100 = ____________________

c. 14,560 x 1000 = _____________________

d. Explain how you decided on the number of zeros in the products for (a), (b), and (c).

3. Find the quotients.

a. 1.65 ÷ 10 = ___________________

b. 1.65 ÷ 100 = ___________________

c. Explain how you decided where to place the decimal in the quotients in (a), (b), and (c).

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4. Ted says that 3 tenths multiplied by 100 equal 300 thousandths. Is he correct? Use a place value chart to explain your answer.

5. Alaska has a land area of about 1,700,000 km^2. Florida has a land area 1/10 the size of Alaska. What is the land area of Florida? Explain how you found your answer.

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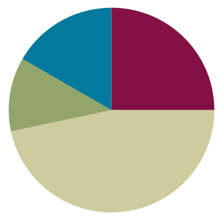
Lesson 3

Objective: Use exponents to name place value units and explain patterns in the placement of the decimal point.

Suggested Lesson Structure

Fluency Practice	(15 minutes)
Application Problems	(7 minutes)
Concept Development	(28 minutes)
Student Debrief	(10 minutes)
Total Time	**(60 minutes)**



Fluency Practice (15 minutes)

- Multiply by 3 **3.OA.7** (8 minutes)
- State the Unit as a Decimal **5.NBT.2** (4 minutes)
- Multiply by 10, 100, and 1000 **5.NBT.2** (3 minutes)

Sprint: Multiply by 3 (8 minutes)

Materials: (S) Multiply by 3 Sprint.

Notes: This fluency will review foundational skills learned in Grades 3 and 4.

State the Unit as a Decimal—Choral Response (4 minutes)

Notes: Reviewing these skills will help students work towards mastery of decimal place value, which will help them apply their place value skills to more difficult concepts.

T: (Write 9 tenths = ____.)
S: 0.9
T: (Write 10 tenths = ____.)
S: 1.0
T: Write 11 tenths = ____.)
S: 1.1
T: (Write 12 tenths = ____.)
S: 1.2
T: (Write 18 tenths = ____.)

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S: 1.8
T: (Write 28 tenths = ____.)
S: 2.8
T: (Write 58 tenths = ____.)
S: 5.8

Repeat the process for 9 hundredths, 10 hundredths, 20 hundredths, 60 hundredths, 65 hundredths, 87 hundredths, and 118 tenths. (This last item is an extension.)

Multiply and Divide by 10, 100, and 1000 (3 minutes)

Materials: (S) Personal white boards.

Notes: This fluency drill will review concepts taught in Lesson 2.

T: (Project place value chart from millions to thousandths.) Write two 1 thousandths disks and the number below it.
S: (Students write two 1 thousandths disks in the thousandths column. Below it, they write 0.002.)
T: Multiply by 10. Cross out each disk and the number 2 to show that you're changing its value.
S: (Students cross out each 1 thousandths disk and the 2. They draw arrows to the hundredths column and write two 1 hundredth disks. Below it, they write 2 in the hundredths column and 0 in the ones and tenths column.)

Repeat the process for the possible sequence: 0.004 x 100; 0.004 x 1000; 1.004 x 1000; 1.024 x 100; 1.324 x 100; 1.324 x 10; and 1.324 x 1000.

Repeat the process for dividing by 10, 100, and 1000 for this possible sequence: 4 ÷ 10; 4.1 ÷ 10; 4.1 ÷ 100; 41 ÷ 1000; and 123 ÷ 1000.

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Very large numbers like *one million* and beyond easily capture the imagination of students. Consider allowing students to research and present to classmates the origin of number names like *googol* and *googleplex.* Connections to literacy can also be made with books about large numbers, such as *How Much is a Million* by Steven Kellogg, *A Million Dots* by Andrew Clements, *Big Numbers and Pictures That Show Just How Big They Are* by Edward Packard and Sal Murdocca.

The following benchmarks may help students appreciate just how large a *googol* is.

- There are approximately 10^{24} stars in the observable universe.
- There are approximately 10^{80} atoms in the observable universe.
- A stack of 70 numbered cards can be ordered in approximately 1 *googol* different ways. That means that that the number of ways a stack of only 70 cards can be shuffled is more than the number of atoms in the observable universe.

Application Problem (7 minutes)

Jack and Kevin are creating a mosaic by using fragments of broken tiles for art class. They want the mosaic to have 100 sections. If each section requires 31.5 tiles, how many tiles will they need to complete the mosaic? Explain your reasoning with a place value chart.

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Concept Development (28 minutes)

Materials: (S) Personal white boards

Problem 1

T: (Draw or project chart, adding numerals as discussion unfolds.)

				100	10
				10 x 10	10 x 1

T: (Write 10 × ____ = 10 on the board.) On your personal board, fill in the missing factor to complete this number sentence.

S: (Students write.)

T: (Write 10 × ____ = 100 on the board.) Fill in the missing factor to complete this number sentence.

S: (Students write.)

T: This time, using only 10 as a factor, how could you multiply to get a product of 1000? Write the multiplication sentence on your personal board.

S: 10 x 10 x 10 = 1000.

T: Work with your partner. What would the multiplication sentence be for 10,000 using only 10 as a factor? Write on your personal board.

S: (Students write.)

MP.7

T: How many factors of 10 did we have to multiply to get to 1000?

S: 3.

T: How many factors of 10 do we have to multiply to get 10,000?

S: 4.

T: Say the number sentence.

S: 10 x 10 x 10 x 10 = 10,000.

T: How many zeros are in our product, 10,000?

S: 4 zeros.

T: What patterns do you notice? Turn and share with your partner.

S: The number of zeros is the same on both side of the equation. → The number of zeros in the product is the same as the number of zeros in the factors. → I see three zeros on the left side, and there are three zeros on the right side for 10 x 10 x 10 = 1000. → The 1 moves one place to the left every time we multiply by 10. → It's like a place value chart. Each number is 10 times as much as the last one.

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MP.7

T: Using this pattern, how many factors of 10 do we have to multiply to get 1 million? Work with your partner to write the multiplication sentence.

S: (Students write.)

T: How many factors of 10 did you use?

S: 6

T: Why did we need 6 factors of 10?

S: 1 million has 6 zeros.

T: We can use an *exponent* (write term on the board) to represent how many times we use 10 as a factor. We can write 10 x 10 as 10^2. (Add to the chart.) We say, "Ten to the second power." The *2* (point to exponent) is the exponent and it tells us how many times to use 10 as a factor.

T: How do you express 1000 using exponents? Turn and share with your partner.

S: We multiply 10 × 10 × 10, that's three times, so the answer is 10^3. → There are three zeros in 1000, so it's ten to the third power.

T: Working with your partner, complete the chart using the exponents to represent the each value on the place value chart.

1,000,000	100,000	10,000	1000	100	10
(10 x 10 x 10) x (10 x 10 x 10)	10x 10 x (10 x 10 x 10)	10 x (10 x 10 x 10)	(10 x 10 x 10)	10 x 10	10 x 1
10^6	10^5	10^4	10^3	10^2	10^1

After reviewing the chart with the students, challenge them to multiply 10 one hundred times. As some start to write it out, others may write 10^{100}, a *googol*, with exponents.

T: Now look at the place value chart; let's read our powers of 10 and the equivalent values.

S: Ten to the second power equals 100; ten to the third power equals 1000. (Continue to read chorally up to 1 million.)

T: Since a *googol* has 100 zeros, write it using an exponent on your personal board.

S: (Students write 10^{100}.)

NOTES ON MULTIPLE MEANS OF REPRESENTATIONS:

Providing non-examples is a powerful way to clear up mathematical misconceptions and generate conversation around the work. Highlight those examples such as 10^5 pointing out its equality to 10 x 10 x 10 x 10 x 10 but not to 10 x 5 or even 5^{10}.

Allowing students to explore a calculator and highlighting the functions used to calculate these expressions (e.g., 10^5 versus 10 x 5) can be valuable.

Problem 2

10^5

T: Write *ten to the fifth power* as a product of tens.

S: 10^5 = 10 x 10 x 10 x 10 x 10.

T: Find the product.

S: 10^5 = 100,000.

Repeat with more examples as needed.

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Problem 3

10 x 100

T: Work with your partner to write this expression using an exponent on your personal board. Explain your reasoning.

S: I multiply 10 x 100 to get 1000, so the answer is ten to the third power. → There are 3 factors of 10. → There are three 10's. I can see one 10 in the first factor and 2 more tens in the second factor.

Repeat with 100 x 1000 and other examples as needed.

Problems 4–5

3 x 10^2

3.4 x 10^3

T: Compare this expression to the ones we've already talked about.

S: These have factors other than 10.

T: Write 3 x 10^2 without using an exponent. Write it on your personal board.

S: 3 x 100.

T: What's the product?

S: 300.

T: If you know that 3 × 100 is 300, then what is 3 x 10^2? Turn and explain to your partner.

S: The product is also 300. 10^2 and 100 are same amount so the product will be the same.

T: Use what you learned about multiplying decimals by 10, 100, and 100 and your new knowledge about exponents to solve 3.4 x 10^3 with your partner.

S: (Students work.)

Repeat with 4.021 x 10^2 and other examples as needed.

Have students share their solutions and reasoning about multiplying decimal factors by powers of ten. In particular, students should articulate the relationship between the exponent and how the values of the digits change and placement of the decimal in the product.

Problems 6–7

700 ÷ 10^2

7.1 ÷ 10^2

T: Write 700 ÷ 10^2 without using an exponent and find the quotient. Write it on your personal board.

S: 700 ÷ 100 = 7

T: If you know that 700 ÷ 100 is 7, then what is 700 ÷ 10^2? Turn and explain to your partner.

S: The quotient is 7 because 10^2 = 100.

T: Use what you know about dividing decimals by multiples of 10 and your new knowledge about exponents to solve 7.1 ÷ 10^2 with your partner.

S: (Students work.)

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T: Tell your partner what you notice about the relationship between the exponents and how the values of the digits change. Also discuss how you decided where to place the decimal.

Repeat with more examples as needed.

Problems 8–9

Complete this pattern: 0.043 4.3 430 __________ __________ ___________

T: (Write the pattern on the board.) Turn and talk with your partner about the pattern on the board. How is the value of the 4 changing as we move to the next term in the sequence? Draw a place value chart to explain your ideas as you complete the pattern and use an exponent to express the relationships.

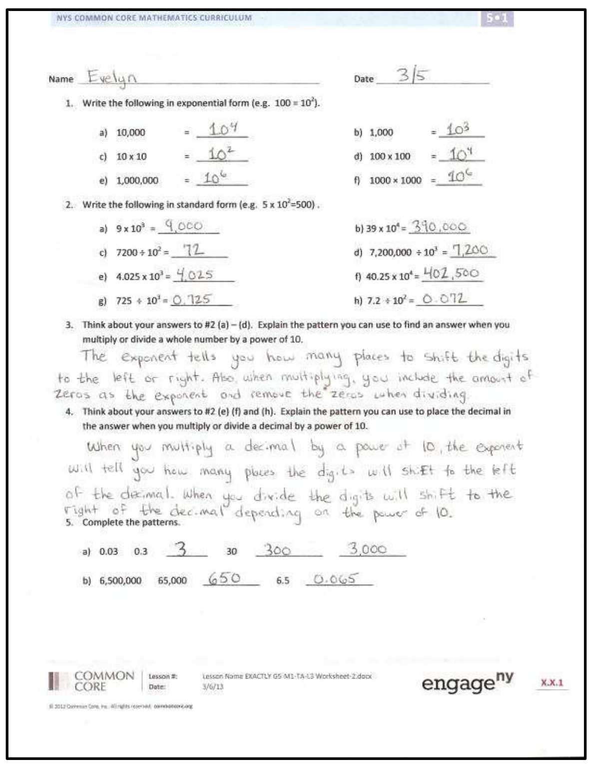
S: The 4 moved two places to the left. → Each number is being multiplied by 100 to get the next one. → Each number is multiplied by 10 twice. → Each number is multiplied by 10^2.

Repeat with 6,300,000; ____; 630; 6.3; _____ and other patterns as needed.

T: As you work on the Problem Set, be sure you are thinking about the patterns that we've discovered today.

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.


NYS COMMON CORE MATHEMATICS CURRICULUM 5•1

Name Evelyn Date 3/5

1. Write the following in exponential form (e.g. $100 = 10^2$).

a) 10,000 = 10^4 b) 1,000 = 10^3
c) 10 x 10 = 10^2 d) 100 x 100 = 10^4
e) 1,000,000 = 10^6 f) 1000 × 1000 = 10^6

2. Write the following in standard form (e.g. $5 \times 10^2 = 500$).

a) 9×10^3 = 9,000 b) 39×10^4 = 390,000
c) $7200 \div 10^2$ = 72 d) $7{,}200{,}000 \div 10^3$ = 7,200
e) 4.025×10^3 = 4,025 f) 40.25×10^4 = 402,500
g) $725 \div 10^3$ = 0.725 h) $7.2 \div 10^2$ = 0.072

3. Think about your answers to #2 (a) – (d). Explain the pattern you can use to find an answer when you multiply or divide a whole number by a power of 10.

The exponent tells you how many places to shift the digits to the left or right. Also, when multiplying, you include the amount of zeros as the exponent and remove the zeros when dividing.

4. Think about your answers to #2 (e) (f) and (h). Explain the pattern you can use to place the decimal in the answer when you multiply or divide a decimal by a power of 10.

When you multiply a decimal by a power of 10, the exponent will tell you how many places the digits will shift to the left of the decimal. When you divide the digits will shift to the right of the decimal depending on the power of 10.

5. Complete the patterns.

a) 0.03 0.3 3 30 300 3,000
b) 6,500,000 65,000 650 6.5 0.065

COMMON CORE Lesson #: Lesson Name EXACTLY G5-M1-TA-L3 Worksheet-2.docx Date: 3/6/13 engage^ny X.X.1

Student Debrief (10 minutes)

Lesson Objective: Use exponents to name place value units and explain patterns in the placement of the decimal point.

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.

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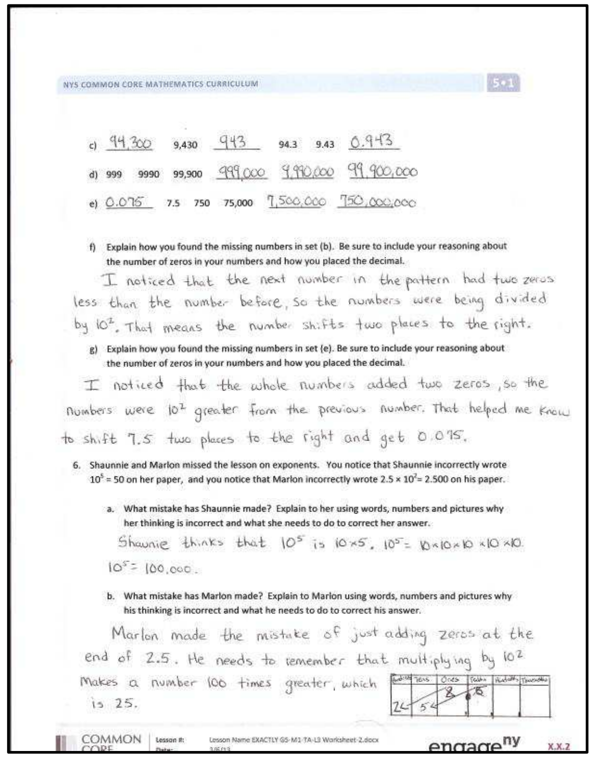
- What is an exponent and how can exponents be useful in representing numbers? (This question could also serve as a prompt for math journals. Journaling about new vocabulary throughout the year can be a powerful way for students to solidify their understanding of new terms.)
- How would you write 1000 using exponents? How would you write it as a multiplication sentence using only 10 as a factor?
- Explain to your partner the relationship we saw between the exponents and the number of the places the digit shifted when you multiply or divide by a power of 10.
- How are the patterns you discovered in Problem 3 and 4 in the Problem Set alike?

Give students plenty of opportunity to discuss the error patterns in Problem 6(a) and 6(b). These are the most common misconceptions students hold when dealing with exponents, so it is worth the time to see that they do not become firmly held.


NYS COMMON CORE MATHEMATICS CURRICULUM 5•1

c) 94,300 9,430 943 94.3 9.43 0.943

d) 999 9990 99,900 999,000 9,990,000 99,900,000

e) 0.075 7.5 750 75,000 7,500,000 750,000,000

f) Explain how you found the missing numbers in set (b). Be sure to include your reasoning about the number of zeros in your numbers and how you placed the decimal.

I noticed that the next number in the pattern had two zeros less than the number before, so the numbers were being divided by 10^2. That means the number shifts two places to the right.

g) Explain how you found the missing numbers in set (e). Be sure to include your reasoning about the number of zeros in your numbers and how you placed the decimal.

I noticed that the whole numbers added two zeros, so the numbers were 10^2 greater from the previous number. That helped me know to shift 7.5 two places to the right and get 0.075.

6. Shaunnie and Marlon missed the lesson on exponents. You notice that Shaunnie incorrectly wrote $10^5 = 50$ on her paper, and you notice that Marlon incorrectly wrote $2.5 \times 10^2 = 2.500$ on his paper.

a. What mistake has Shaunnie made? Explain to her using words, numbers and pictures why her thinking is incorrect and what she needs to do to correct her answer.

Shawnie thinks that 10^5 is 10×5. $10^5 = 10 \times 10 \times 10 \times 10 \times 10$. $10^5 = 100{,}000$.

b. What mistake has Marlon made? Explain to Marlon using words, numbers and pictures why his thinking is incorrect and what he needs to do to correct his answer.

Marlon made the mistake of just adding zeros at the end of 2.5. He needs to remember that multiplying by 10^2 makes a number 100 times greater, which is 25.

COMMON CORE Lesson #: Lesson Name EXACTLY G5-M1-TA-L3 Worksheet-2.docx engage ny X.X.2

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.

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A # Correct _____

Multiply.

1	1 x 3 =		23	10 x 3 =	
2	3 x 1 =		24	9 x 3 =	
3	2 x 3 =		25	4 x 3 =	
4	3 x 2 =		26	8 x 3 =	
5	3 x 3 =		27	5 x 3 =	
6	4 x 3 =		28	7 x 3 =	
7	3 x 4 =		29	6 x 3 =	
8	5 x 3 =		30	3 x 10 =	
9	3 x 5 =		31	3 x 5 =	
10	6 x 3 =		32	3 x 6 =	
11	3 x 6 =		33	3 x 1 =	
12	7 x 3 =		34	3 x 9 =	
13	3 x 7 =		35	3 x 4 =	
14	8 x 3 =		36	3 x 3 =	
15	3 x 8 =		37	3 x 2 =	
16	9 x 3 =		38	3 x 7 =	
17	3 x 9 =		39	3 x 8 =	
18	10 x 3 =		40	11 x 3 =	
19	3 x 10 =		41	3 x 11 =	
20	3 x 3 =		42	12 x 3 =	
21	1 x 3 =		43	3 x 13 =	
22	2 x 3 =		44	13 x 3 =	

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B Improvement _____ # Correct _____

Multiply.

1	3 x 1 =		23	9 x 3 =	
2	1 x 3 =		24	3 x 3 =	
3	3 x 2 =		25	8 x 3 =	
4	2 x 3 =		26	4 x 3 =	
5	3 x 3 =		27	7 x 3 =	
6	3 x 4 =		28	5 x 3 =	
7	4 x 3 =		29	6 x 3 =	
8	3 x 5 =		30	3 x 5 =	
9	5 x 3 =		31	3 x 10 =	
10	3 x 6 =		32	3 x 1 =	
11	6 x 3 =		33	3 x 6 =	
12	3 x 7 =		34	3 x 4 =	
13	7 x 3 =		35	3 x 9 =	
14	3 x 8 =		36	3 x 2 =	
15	8 x 3 =		37	3 x 7 =	
16	3 x 9 =		38	3 x 3 =	
17	9 x 3 =		39	3 x 8 =	
18	3 x 10 =		40	11 x 3 =	
19	10 x 3 =		41	3 x 11 =	
20	1 x 3 =		42	13 x 3 =	
21	10 x 3 =		43	3 x 13 =	
22	2 x 3 =		44	12 x 3 =	

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Name ______________________________ Date ______________

1. Write the following in exponential form (e.g., $100 = 10^2$).

   a. 10,000 = __________

   b. 1000 = _________

   c. 10 x 10 = __________

   d. 100 x 100 = _________

   e. 1,000,000 = __________

   f. 1000 × 1000 = _________

2. Write the following in standard form (e.g., $5 \times 10^2 = 500$).

   a. 9×10^3 = ____________

   b. 39×10^4 = ____________

   c. $7200 \div 10^2$ = ___________

   d. $7{,}200{,}000 \div 10^3$ = _________

   e. 4.025×10^3 = ____________

   f. 40.25×10^4 = ____________

   g. $725 \div 10^3$ = ____________

   h. $7.2 \div 10^2$ = _____________

3. Think about the answers to Problem 2(a–d). Explain the pattern used to find an answer when you multiply or divide a whole number by a power of 10.

4. Think about the answers to Problem 2(e–h). Explain the pattern used to place the decimal in the answer when you multiply or divide a decimal by a power of 10.

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5. Complete the patterns.

   a. 0.03 0.3 ________ 30 _____________ _____________

   b. 6,500,000 65,000 ___________ 6.5 _____________

   c. _________ 9,430 _________ 94.3 9.43 __________

   d. 999 9990 99,900 __________ __________ ___________

   e. _________ 7.5 750 75,000 __________ ___________

   f. Explain how you found the missing numbers in set (b). Be sure to include your reasoning about the number of zeros in your numbers and how you placed the decimal.

   g. Explain how you found the missing numbers in set (d). Be sure to include your reasoning about the number of zeros in your numbers and how you placed the decimal.

6. Shaunnie and Marlon missed the lesson on exponents. Shaunnie incorrectly wrote $10^5 = 50$ on her paper, and Marlon incorrectly wrote $2.5 \times 10^2 = 2.500$ on his paper.

   a. What mistake has Shaunnie made? Explain using words, numbers, and pictures why her thinking is incorrect and what she needs to do to correct her answer.

   b. What mistake has Marlon made? Explain using words, numbers, and pictures why his thinking is incorrect and what he needs to do to correct his answer.

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Name ____ Date ______________________

1. Write the following in exponential form and as a multiplication sentence using only 10 as a factor (e.g., $100 = 10^2 = 10 \times 10$).

   a. 1,000 = ______________ = ______________

   b. 100 × 100 = ______________ = ______________

2. Write the following in standard form (e.g., $4 \times 10^2 = 400$).

   a. $3 \times 10^2 =$ ______________

   b. $2.16 \times 10^4 =$ ______________

   c. $800 \div 10^2 =$ ______________

   d. $754.2 \div 10^3 =$ ______________

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Name ____ Date ______________

1. Write the following in exponential form (e.g., $100 = 10^2$).

a. 1000 = __________

b. 10 × 10 = _________

c. 100,000 = __________

d. 100 x 10 = _________

e. 1,000,000 = __________

f. 10,000 × 10 = _________

2. Write the following in standard form (e.g., $4 \times 10^2 = 400$).

a. 4×10^3 = ____________

b. 64×10^4 = ____________

c. $5300 \div 10^2$ = ___________

d. $5{,}300{,}000 \div 10^3$ = _________

e. 6.072×10^3 = ____________

f. 60.72×10^4 = ____________

g. $948 \div 10^3$ = ____________

h. $9.4 \div 10^2$ = _____________

3. Complete the patterns.

a. 0.02 0.2 __________ 20 __________ __________

b. 3,400,000 34,000 __________ 3.4 __________

c. __________ 8,570 __________ 85.7 8.57 __________

d. 444 4440 44,400 __________ __________ __________

e. __________ 9.5 950 95,000 __________ __________

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4. After a lesson on exponents, Tia went home and said to her mom, "I learned that 10^4 is the same as 40,000." She has made a mistake in her thinking. Use words, numbers or a place value chart to help Tia correct her mistake.

5. Solve $247 \div 10^2$ and 247×10^2.

   a. What is different about the two answers? Use words, numbers or pictures to explain how the decimal point shifts.

   b. Based on the answers from the pair of expressions above, solve $247 \div 10^3$ and 247×10^3.

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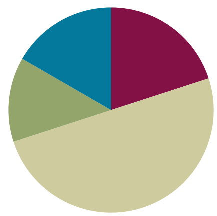
Lesson 4

Objective: Use exponents to denote powers of 10 with application to metric conversions.

Suggested Lesson Structure

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



Fluency Practice (12 minutes)

- Multiply and Divide Decimals by 10, 100, and 1000 **5.NBT.2** (5 minutes)
- Write the Unit as a Decimal **5.NBT.1** (2 minutes)
- Write in Exponential Form **5.NBT.2** (3 minutes)
- Convert Units **4.MD.1** (2 minutes)

Multiply and Divide Decimals by 10, 100, and 1000 (5 minutes)

Materials: (S) Personal white boards

Note: This fluency drill will review concepts taught in earlier lessons and help students work towards mastery in multiplying and dividing decimals by 10, 100, and 1000.

T: (Project place value chart from millions to thousandths. Write 3 disks in the tens column, 2 disks in the ones column, and 4 disks in the tenths column.) Say the value as a decimal.

S: 32.4 (thirty-two and four tenths).

T: Write the number on your personal boards and multiply it by ten.

Students write 32.4 on their place value charts, cross out each digit, and shift the number one place value to the left to show 324.

T: Show 32.4 divided by 10.

Students write 32.4 on their place value charts, cross out each digit, and shift the number one place value to the right to show 3.24.

Repeat the process and sequence for 32.4 x 100; 32.4 ÷ 100; 837 ÷ 1000; and 0.418 x 1000.

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Write the Unit as a Decimal (2 minutes)

Materials: (S) Personal white boards

Note: Reviewing these skills will help students work towards mastery of decimal place value, which will in turn help them apply their place value skills to more difficult concepts.

T: 9 tenths.
S: 0.9
T: 10 tenths.
S: 1.0

Repeat the process for 20 tenths, 30 tenths, 70 tenths, 9 hundredths, 10 hundredths, 11 hundredths, 17 hundredths, 57 hundredths, 42 hundredths, 9 thousandths, 10 thousandths, 20 thousandths, 60 thousandths, 64 thousandths, and 83 thousandths.

NOTES ON MULTIPLE MEANS OF ACTION AND ENGAGEMENT:

Consider posting a class-size place value chart as an aid to students in visualizing the unit work of this fluency activity.

It may also be fruitful to have students verbalize their reasoning about the equivalence of 10 tenths to 1.0, 20 tenths to 2.0, etc.

Write in Exponential Form (3 minutes)

Materials: (S) Personal white boards

Note: Reviewing this skill in isolation will lay a foundation for students to apply the skill in multiplication during the lesson.

T: (Write $100 = 10^?$.) Write 100 in exponential form.
S: (Students write $100 = 10^2$.)

Repeat the process for 1000, 10,000, and 1,000,000.

Convert Units (2 minutes)

Materials: (S) Personal white boards

Note: Reviewing conversions in isolation will lay a foundation for students to apply this knowledge through multiplication and division during the lesson.

Use this quick fluency to activate prior knowledge of these familiar equivalents.

T: (Write 1 km = ____ m.) Fill in the missing number.
S: (Students write 1 km = 1000 m.)

Repeat process and procedure for 1 kg = ____ g, 1 liter = ____ ml, 1 m = ____ cm.

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Application Problem (8 minutes)

Mr. Brown wants to withdraw $1,000 from his bank and in ten dollar bills. How many ten dollar bills should he receive?

Note: Use this problem with a familiar context of money to help students begin to use various units to rename the same quantity—the focus of today's lesson.

Concept Development (30 minutes)

Materials: (S) Meter strip, markers

Each problem set below includes conversions both from larger to smaller units and smaller to larger units. Allow students the time to reason about how the change in the size of the unit will affect the *quantity* of units needed to express an equivalent measure rather than giving rules about whether to multiply or divide.

NOTES ON MULTIPLE MEANS OF ACTION AND ENGAGEMENT:

As discussions ensue about conversions from meters to kilometers, centimeters and millimeters, take the opportunity to extend thinking by asking students to make a conversion to the unit that is 1/10 as large as a meter (decimeter) and the unit 10 times as large (decameter). Students can make predictions about the names of these units or do research about these and other metric units that are less commonly used. Students might also make connections to real world mathematics by investigating industry applications for the less familiar units.

Problem 1

Draw a line that is 2 meters long and convert it to centimeters and millimeters.

MP.3

T: Draw a line 2 meters long.

S: (Students draw.)

T: With your partner, determine how many centimeters equal 2 meters.

S: 200 centimeters.

T: How is it that the same line can measure both 2 meters and 200 centimeters?

T: Discuss with a partner how we convert from 2 meters to 200 centimeters?

S: (After talking with a partner.) Multiply by 100.

T: Why didn't the length change? Discuss that with your partner.

Repeat the same sequence with millimeters.

T: Can we represent the conversion from meters to centimeters or meters to millimeters with exponents? Discuss this with your partner.

Let them see that to convert to centimeters from meters, we multiplied by 10^2, while to convert from meters to millimeters we multiplied by 10^3. Repeat the same sequence in reverse so that students see that to convert from centimeters to meters we divide by 10^2 and to convert from millimeters to meters we divide by 10^3. If there seems to be a large lack of clarity do another conversion with 1 meter or 3 meters.

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Problem 2

Convert 1.37 meters to centimeters and millimeters.

MP.4
MP.5

T: Draw a line 1 meter 37 centimeters long.

S: (Students draw.)

T: What fraction of a whole meter is 37 centimeters?

S: 37 hundredths.

T: Write 1 and 37 hundredths as a decimal fraction.

T: With your partner, determine how many centimeters is equal to 1.37 meters both by looking at your meter strip and line and writing an equation using an exponent.

T: What is the equivalent measure in centimeters?

S: 137 centimeters.

T: Show the conversion using an equation with an exponent.

S: 1.37 meters = $1.37 \times 10^2 = 137$ centimeters.

T: What is the conversion factor?

S: 10^2 or 100.

Repeat the sequence with conversion to millimeters, both with multiplication by 10^3 and division by 10^3, 2.6, and 12.08.

Problem 3

A cat weighs 4.5 kilograms. Convert its weight to grams.
A dog weighs 6700 grams. Convert its weight to kilograms.

T: Work with a partner to find both the cat's weight in grams and the dog's weight in kilograms. Explain your reasoning with an equation using an exponent for each problem.

S: (Students solve.) 4.5 kg x 10^3 = 4500g and 6700 g ÷ 10^3 = 6.7 kg.

T: What is the conversion factor for both problems?

S: 10^3 or 1000.

Repeat this sequence with 2.75 kg to g, and then 6007 g to 6.007 kg and the analogous conversion dividing grams by 10^3 to find the equivalent amount of kilograms.

T: Let's relate our meter to millimeter measurements to our kilogram to gram conversions.

The most important concept is the equivalence of the two measurements—that is, the weight measurement, like that of the linear measurement, did not change. The change in the type of unit precipitates a change in the number of units. However, the weight has remained the same. Clarify this understanding before moving on to finding the conversion equation by asking, "How can 6007 and 6.007 be equal to each other?" (While the numeric values differ, the unit size is also different. 6007 is grams. 6.007 is kilograms. Kilograms are 1000 times as large as grams. Therefore it takes a lot fewer kilograms to make the same amount as something measured in grams.) Then, lead students to articulate that conversions from largest to smallest units we multiplied by 10^3, to convert from smallest to largest, we need to divide by 10^3.

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Problem 4

0.6 l x 10^3 = 600 ml; 0.6 x 10^2; 764 ml ÷ 10^3 = 0.764 liters

a. The baker uses 0.6 liter of vegetable oil to bake brownies. How many milliliters of vegetable oil did he use? He is asked to make 100 batches for a customer. How many liters of oil will he need?

b. After gym class, Mei Ling drank 764 milliliters of water. How many liters of water did she drink?

After solving the baker problem, have students share about what they notice with the measurement conversions thus far.

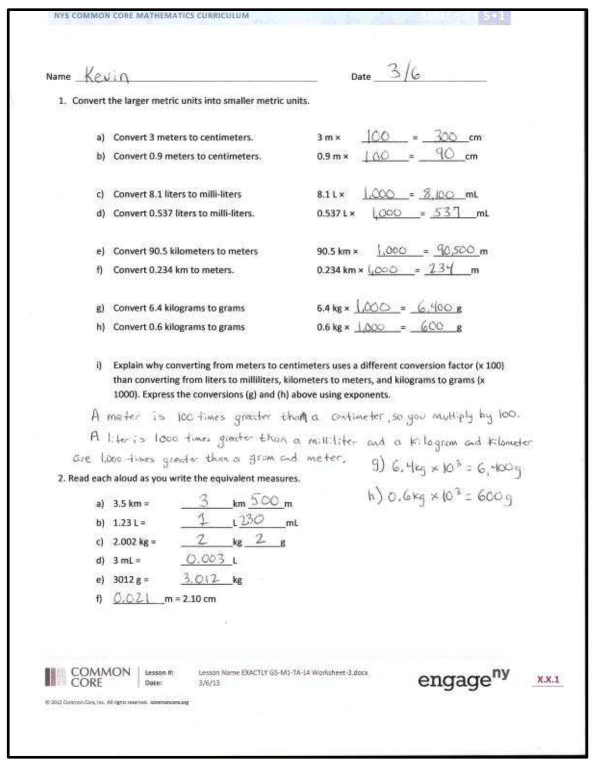
S: To convert from kilometers to meters, kilograms to grams, liters to milliliters, we multiplied by a conversion factor of 1000 to get the answer.
→ We multiply with a conversion factor of 100 to convert from meters to centimeters. → When we multiply by 1000, our number shifts 3 spaces to the left on the place value chart. When we divide by 1000, the number shifts 3 spaces to the right. → The smaller the unit is, the bigger the quantity we need to make the same measurement.

Repeat this sequence, converting 1,045 ml to liters and 0.008 l to milliliters. Ask students to make comparisons between and among conversions and conversion factors.

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.

In this Problem Set, we suggest all students begin with Problem 1 and leave Problem 6 to the end if they have time.


NYS COMMON CORE MATHEMATICS CURRICULUM

Name Kevin Date 3/6

1. Convert the larger metric units into smaller metric units.

a) Convert 3 meters to centimeters. 3 m × 100 = 300 cm
b) Convert 0.9 meters to centimeters. 0.9 m × 100 = 90 cm

c) Convert 8.1 liters to milli-liters 8.1 L × 1,000 = 8,100 mL
d) Convert 0.537 liters to milli-liters. 0.537 L × 1,000 = 537 mL

e) Convert 90.5 kilometers to meters 90.5 km × 1,000 = 90,500 m
f) Convert 0.234 km to meters. 0.234 km × 1,000 = 234 m

g) Convert 6.4 kilograms to grams 6.4 kg × 1,000 = 6,400 g
h) Convert 0.6 kilograms to grams 0.6 kg × 1,000 = 600 g

i) Explain why converting from meters to centimeters uses a different conversion factor (x 100) than converting from liters to milliliters, kilometers to meters, and kilograms to grams (x 1000). Express the conversions (g) and (h) above using exponents.

A meter is 100 times greater than a centimeter, so you multiply by 100. A liter is 1000 times greater than a milliliter and a kilogram and kilometer are 1,000 times greater than a gram and meter.

g) 6.4kg × 10^3 = 6,400g
h) 0.6kg × 10^3 = 600g

2. Read each aloud as you write the equivalent measures.

a) 3.5 km = 3 km 500 m
b) 1.23 L = 1 L 230 mL
c) 2.002 kg = 2 kg 2 g
d) 3 mL = 0.003 L
e) 3012 g = 3.012 kg
f) 0.021 m = 2.10 cm

COMMON CORE Lesson #: Lesson Name EXACTLY G5-M1-TA-L4 Worksheet-3.docx Date: 3/6/13 engage^ny X.X.1

Student Debrief (10 minutes)

Lesson Objective: Use exponents to denote powers of 10 and with application to metric conversions**.**

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 worksheet and process the

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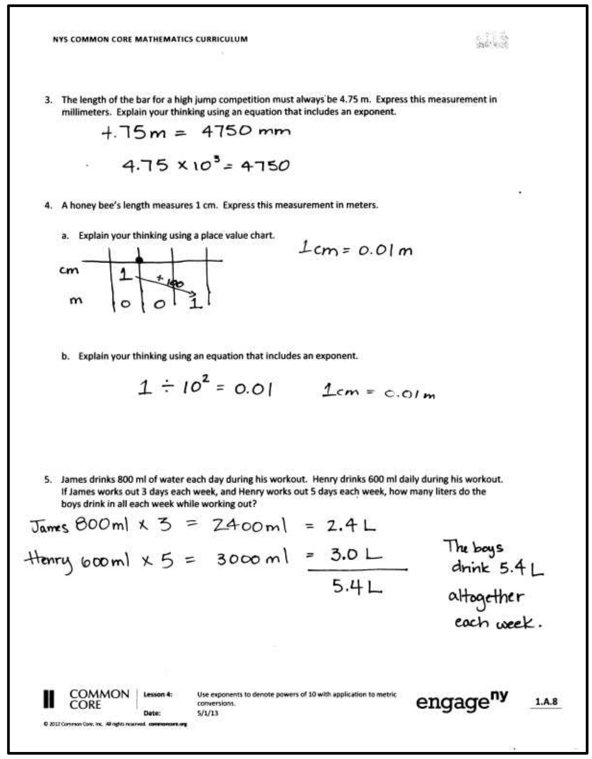
lesson. You may choose to use any combination of the questions below to lead the discussion.

- Reflect on the kinds of thinking you did on Task 1 and Task 2. How are they alike? How are they different?
- How did you convert centimeters to meters? What is the conversion factor?
- How did you convert meters to centimeters? What is the conversion factor?
- What can you conclude about the operation you use when converting from a small unit to a large unit? When converting from a large unit to a small unit?
- Students might journal about the meanings of *centi-*, *milli-* and even other units like *deci-* and *deca-*.
- Which is easier for you to think about: converting from larger to smaller units or smaller to larger units? Why? What is the difference in the thinking required to do each?


NYS COMMON CORE MATHEMATICS CURRICULUM

3. The length of the bar for a high jump competition must always be 4.75 m. Express this measurement in millimeters. Explain your thinking using an equation that includes an exponent.

4.75 m = 4750 mm

$4.75 \times 10^3 = 4750$

4. A honey bee's length measures 1 cm. Express this measurement in meters.

a. Explain your thinking using a place value chart.

1 cm = 0.01 m

b. Explain your thinking using an equation that includes an exponent.

$1 \div 10^2 = 0.01$ 1 cm = 0.01 m

5. James drinks 800 ml of water each day during his workout. Henry drinks 600 ml daily during his workout. If James works out 3 days each week, and Henry works out 5 days each week, how many liters do the boys drink in all each week while working out?

James 800 ml × 3 = 2400 ml = 2.4 L

Henry 600 ml × 5 = 3000 ml = 3.0 L

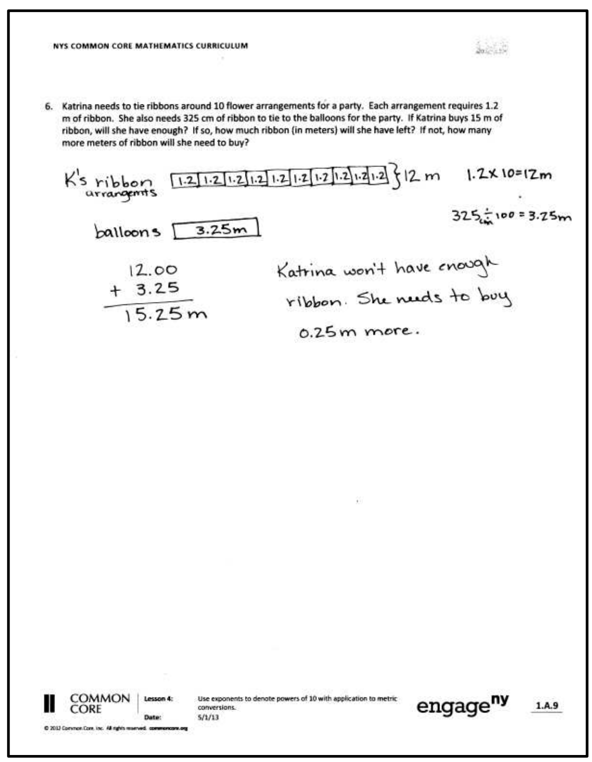
5.4 L

The boys drink 5.4 L altogether each week.

COMMON CORE Lesson 4: Use exponents to denote powers of 10 with application to metric conversions. Date: 5/1/13 engage^ny 1.A.8

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.


NYS COMMON CORE MATHEMATICS CURRICULUM

6. Katrina needs to tie ribbons around 10 flower arrangements for a party. Each arrangement requires 1.2 m of ribbon. She also needs 325 cm of ribbon to tie to the balloons for the party. If Katrina buys 15 m of ribbon, will she have enough? If so, how much ribbon (in meters) will she have left? If not, how many more meters of ribbon will she need to buy?

K's ribbon arrangements 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2 1.2 } 12 m 1.2 × 10 = 12 m

balloons 3.25 m 325 cm ÷ 100 = 3.25 m

12.00 + 3.25 = 15.25 m

Katrina won't have enough ribbon. She needs to buy 0.25 m more.

COMMON CORE Lesson 4: Use exponents to denote powers of 10 with application to metric conversions. Date: 5/1/13 engage^ny 1.A.9

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Name ____ Date ____________________

1. Convert using an equation with an exponent.

a. 3 meters to centimeters ________________ = ________ cm

b. 900 centimeters to meters ________________ = ________ m

c. 8.1 liters to milliliters ________________ = _________ ml

d. 537 milliliters to liters ________________ = _________ l

e. 90.5 kilometers to meters ________________ = ________ m

f. Convert 23 meters to kilometers. ________________ = ________ km

g. 0.4 kilograms to grams ________________ = ________ g

h. 80 grams to kilograms ________________ = ________ kg

i. Circle the conversion factor in each equation above. Explain why converting from meters to centimeters uses a different conversion factor than converting from liters to milliliters, kilometers to meters, and kilograms to grams.

2. Read each aloud as you write the equivalent measures.

a. 3.5 km = _________ km ______ m

b. 1.23 l = _________ l ________ ml

c. 2.002 kg = _________kg ______ g

d. 3 ml = _________ l

e. 3012 g = _________ kg

f. _____ m = 2.10 cm

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3. The length of the bar for a high jump competition must always be 4.75 m. Express this measurement in millimeters. Explain your thinking using an equation that includes an exponent.

4. A honey bee's length measures 1 cm. Express this measurement in meters.

   a. Explain your thinking using a place value chart.

   b. Explain your thinking using an equation that includes an exponent.

5. James drinks 800 ml of water each day during his workout. Henry drinks 600 ml daily during his workout. If James works out 3 days each week, and Henry works out 5 days each week, how many liters do the boys drink in all each week while working out?

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Name ____ Date ____________________

1. Convert:

   a. 2 meters to centimeters 2 m × _________ = _________ cm

   b. 40 milliliters to liters 40 ml ÷ _________ = _________ l

2. Read each aloud as you write the equivalent measures.

   a. 4.37 l = __________ l __________ ml

   b. 81.62 kg = __________ kg ________ g

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Name ____ Date ______________________

1. Convert:

a. 5 meters to centimeters 5 m × _________ = _________cm

b. 60 centimeters to meters 60 cm ÷ _________ = _________ m

c. 2300 milliliters to liters. 2.3 l ÷ _________ = _________ml

d. 0.462 liters to milliliters 0.462 l × _________ = _________ml

e. 80.4 kilometers to meters ___________________ = _________m

f. 0.725 kilometers to meters ___________________ = _________m

g. 456 grams to kilograms ___________________ = _________kg

h. 0.3 kilograms to grams ___________________ = _________g

2. Read each aloud as you write the equivalent measures.

a. 2.7 km = __________ km __________ m

b. 3.46 l = __________ l __________ ml

c. 5.005 kg = __________ kg __________ g

d. 8 ml = __________ l

e. 4079 g = __________ kg

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3. A dining room table measures 1.78 m long. Express this measurement in millimeters.

   a. Explain your thinking using a place value chart.

   b. Explain your thinking using an equation that includes an exponent.

4. Eric and YiTing commute to school every day. Eric walks 0.81 km and YiTing walks 0.65 km. How far did each of them walk in meters? Explain your answer using an equation that includes an exponent.

5. There were 9 children at a birthday party. Each child drank one 200 ml juice box. How many liters of juice did they drink altogether? Explain your answer using an equation that includes an exponent.

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