SESSION 3A.1

Multiplying Powers of 10

Math Focus Points

- Using representations and reasoning to multiply whole numbers by powers of 10 (including 1, 0.1, and 0.01)
- Explaining the patterns in the placement of the decimal point when a decimal is multiplied by a power of 10

Today's Plan		Materials
1 ACTIVITY **Multiplying Powers of 10**	40 MIN, CLASS, INDIVIDUALS	• *Student Activity Book,* p. 67 or **C70, Multiplying by Powers of 10** Make copies. (as needed) • **M21, Hundredths Grid for *Fill Two*** Make copies. (several per student); T68
2 DISCUSSION **Moving the Decimal Point**	20 MIN, CLASS	• *Student Activity Book,* p. 67 or C70 (completed)
3 SESSION FOLLOW-UP **Daily Practice**		• *Student Activity Book,* p. 68 or **C71, Money and Powers of 10** Make copies. (as needed)

Ten-Minute Math

Practicing Place Value Say "eighty-one and ninety-four hundredths," and have students practice writing the number. Make sure all students can read, write, and say this number correctly. Write the number on the board and ask students to write it in expanded notation. ($8 \times 10 + 1 \times 1 + 9 \times \frac{1}{10} + 4 \times \frac{1}{100}$) Ask students:

- What is 81.94 rounded to the nearest tenth? *(81.9)* Nearest one? *(82)* Nearest ten? *(80)*

After each answer, ask students to explain their reasoning and ask the class if everyone agrees. If time remains, repeat using 35.32, and ask students to round to the nearest tenth and ten.

Teaching Note

❶ **Emphasizing Place-Value Relationships** Some students are likely to shade in four hundredths on one grid, which is an appropriate representation. However, to emphasize the place-value relationship between one hundredth, one tenth, and one, shade in the grids as described.

ACTIVITY

1 Multiplying Powers of 10

40 MIN CLASS INDIVIDUALS

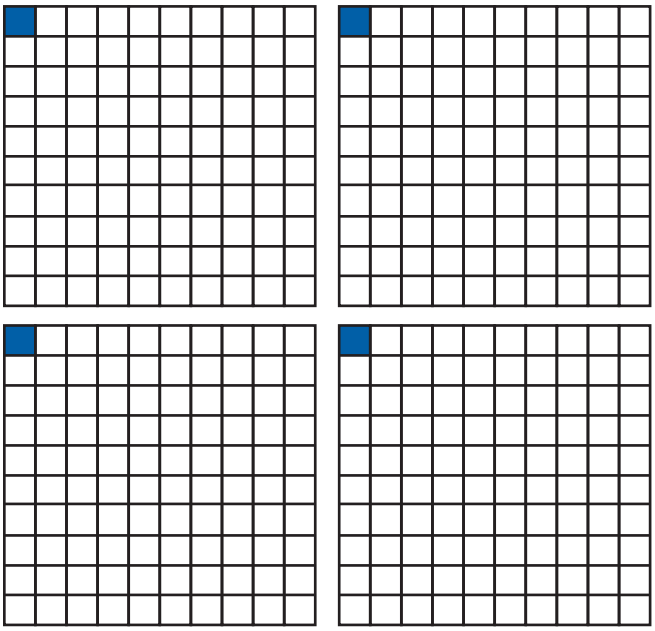
You have been adding and subtracting decimals, and now we are going to multiply decimal numbers. We're going to start by thinking about multiplying by different powers of 10. Who remembers what the powers of 10 are? That's right, it's numbers like 10, 100, and 1,000, but we're going to think about decimals that are also powers of 10; 0.1 and 0.01.

Distribute copies of Hundredths Grid for *Fill Two* (M21). Write the following on the board:

$4 \times 0.01 =$

How would you use the hundredths grids to show 4×0.01? What would the answer be? Think about what you know about multiplication and about decimals. You can work with a neighbor if you like.

Give students a moment to solve the problem. Ask a student to explain how he or she shaded in the grid(s) to show 4×0.01. On the transparency of Hundredths Grid for *Fill Two* (T68), shade in one hundredth in each of the four grids. ❶



Write $4 \times 0.01 = 0.04$ underneath the grids.

What would the equation be if we used the fraction for one hundredth instead of the decimal? *($4 \times \frac{1}{100} =$)* **Remember when we multiplied fractions? How would we write the answer to $4 \times \frac{1}{100}$?** *($\frac{4}{100}$)*

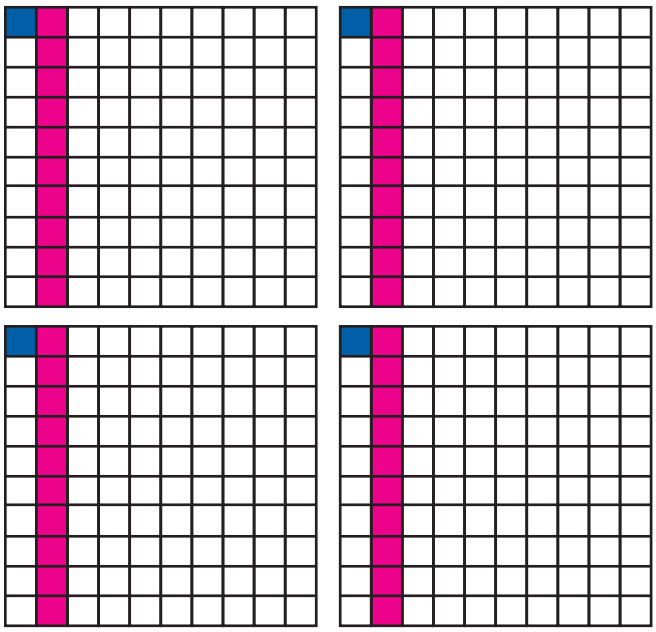
Write $4 \times \frac{1}{100} = \frac{4}{100}$ underneath the decimal notation. Make certain students understand these are equivalent. ❷

Under the previous equations, write the following:

$4 \times 0.1 =$

Use the grids again to show 4×0.1, and write two equations—one using a decimal and one using a fraction.

Give students time to solve the problem, then ask a volunteer to describe how they shaded in the grid. Using a different color, shade in the second column (0.1) on each of the four grids. Ask for the equations *($4 \times 0.1 = 0.4$; $4 \times \frac{1}{10} = \frac{4}{10}$)*, and write them under the grids.



Write the following equations on the board one at a time, underneath the previous equations. As you write each equation, ask students for the answer.

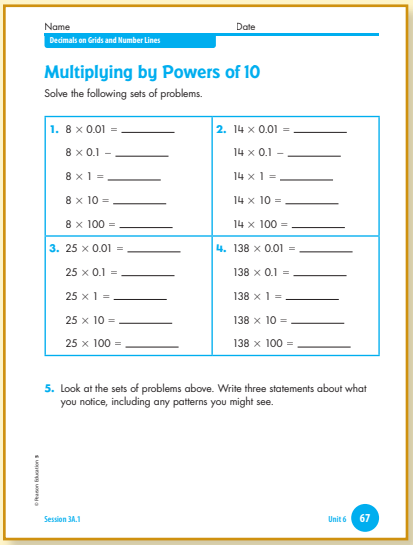
$4 \times 1 = 4$

$4 \times 10 = 40$

$4 \times 100 = 400$

Teaching Note

❷ **Fractions and Decimals** As students move into multiplying decimal numbers, continue pointing out fraction equivalents for the decimals. Students benefit from using knowledge of fractions as they work to understand multiplying decimals.



Name Date

Decimals on Grids and Number Lines

Multiplying by Powers of 10

Solve the following sets of problems.

1. 8 × 0.01 = _____ 8 × 0.1 = _____ 8 × 1 = _____ 8 × 10 = _____ 8 × 100 = _____	**2.** 14 × 0.01 = _____ 14 × 0.1 = _____ 14 × 1 = _____ 14 × 10 = _____ 14 × 100 = _____
3. 25 × 0.01 = _____ 25 × 0.1 = _____ 25 × 1 = _____ 25 × 10 = _____ 25 × 100 = _____	**4.** 138 × 0.01 = _____ 138 × 0.1 = _____ 138 × 1 = _____ 138 × 10 = _____ 138 × 100 = _____

5. Look at the sets of problems above. Write three statements about what you notice, including any patterns you might see.

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▲ **Student Activity Book, Unit 6, p. 67; Resource Masters, C70**

These problems are easier, so I'm not going to ask you to shade in the grids. If we were going to shade them in, how many grids would we shade in, and how many pages of the grids would we need for: 4 × 1? *(4 grids, 1 page)* 4 × 10? *(40 grids, 10 pages)* 4 × 100? *(400 grids, 100 pages)*

Take a minute to look at these two representations and the five equations. How are these problems related? What do you notice?

[Mitch] says that each answer is 10 times the one before it. Do you agree? Where do you see that in the grids for 4 × 0.01 and 4 × 0.1? Is it also in the number of pages of grids we need for 4 × 1, 4 × 10, and 4 × 100?

Have students complete *Student Activity Book* page 67 or C70.

You're going to solve some similar problems on *Student Activity Book* page 67 or C70. As you solve the problems, think about what patterns you're noticing, as well as what it means to multiply by a power of 10. You may use additional hundredths grids if you think that would be helpful.

ONGOING ASSESSMENT: Observing Students at Work

Students multiply whole numbers by powers of 10 and look for patterns in their answers.

- **How are students solving the problems?** Do they use grids for multiplying by 0.1 and 0.01?
- **What patterns do students notice?** Do they realize the numbers are increasing by a power of 10 each time? Do they notice how the decimal point is moving?

DIFFERENTIATION: Supporting the Range of Learners

Intervention Some students may benefit from continuing to shade in the grids for the problems involving tenths and hundredths.

ELL Pair English Language Learners to discuss and practice statements about what they notice in the problems, including any patterns.

Extension Students needing a challenge should extend the factors to 10,000 and 0.0001.

DISCUSSION

2 Moving the Decimal Point

20 MIN CLASS

Math Focus Points for Discussion

- Using representations and reasoning to multiply whole numbers by powers of 10 (including 1, 0.1, and 0.01)
- Explaining the patterns in the placement of the decimal point when a decimal is multiplied by a power of 10

Have students look at Problem 3 from *Student Activity Book* page 67 or C70. Write the following equations from Problem 3 on the board:

$25 \times 0.01 = 0.25$

$25 \times 0.1 = 2.5$

$25 \times 1 = 25$

$25 \times 10 = 250$

$25 \times 100 = 2{,}500$

Point to 25×1 and 25×10.

The 25 is the same in these problems. How else are these problems related? Talk to a neighbor about what you notice.

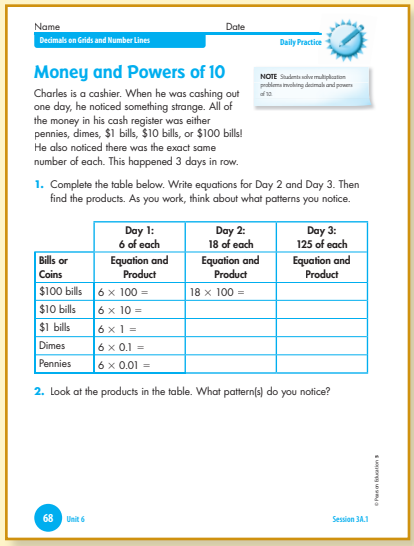
After a minute or so, ask for student responses. Students should recognize that 25 is in both problems, and because 10 is ten times 1, the answer to 25×10 *(250)* is ten times the answer to 25×1 *(25)*.

Is that also true of 25×10 and 25×100—that because 100 is ten times 10, the product of 25×100 will be ten times the product of 25×10? Is it the same relationship between 0.01 and 0.1? 0.1 and 1? How do you know?

Give students a brief amount of time to discuss these last two questions with a partner. Students should recognize the relationship is the same; that you need 10 one hundredths to make one tenth, or 10 tenths to make 1, and so on.

When you multiplied by these powers of 10, what did you notice? What patterns did you see? Let's use the problems with 25 that we have up on the board already for any examples.

As students share their observations, ask others to say if they agree or disagree and why.



Name Date

Decimals on Grids and Number Lines Daily Practice

Money and Powers of 10

NOTE Students solve multiplication problems involving decimals and powers of 10.

Charles is a cashier. When he was cashing out one day, he noticed something strange. All of the money in his cash register was either pennies, dimes, $1 bills, $10 bills, or $100 bills! He also noticed there was the exact same number of each. This happened 3 days in row.

1. Complete the table below. Write equations for Day 2 and Day 3. Then find the products. As you work, think about what patterns you notice.

	Day 1: 6 of each	Day 2: 18 of each	Day 3: 125 of each
Bills or Coins	Equation and Product	Equation and Product	Equation and Product
$100 bills	6 × 100 =	18 × 100 =	
$10 bills	6 × 10 =		
$1 bills	6 × 1 =		
Dimes	6 × 0.1 =		
Pennies	6 × 0.01 =		

2. Look at the products in the table. What pattern(s) do you notice?

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▲ Student Activity Book, Unit 6, p. 68; Resource Masters, C71

Students might say:

"It's sort of like you're multiplying by one—you always see 25 in the answer. If it's times 10 or 100, you put zeros after the 25. If it's times one tenth or one hundredth, you use the decimal point. But it's still using the 2 and the 5."

"When you multiply by a tenth or a hundredth, the answer gets smaller. 2.5 is smaller than 25, and 0.25 is a lot smaller than 25."

"If you think of 25 as 25.00, then you can see a pattern in the way the decimal point moves. When the power of 10 is less than 1, count the digits after the decimal point. Then move the decimal point in 25.00 to the left the same number of places. When the power of 10 is greater than 1, count the zeros. Then move the decimal point to the right that number of places."

3 SESSION FOLLOW-UP
Daily Practice

Daily Practice: For reinforcement of this unit's content, have students complete *Student Activity Book* page 68 or C71.

Multiplying by Powers of 10

Solve the following sets of problems.

1. $8 \times 0.01 =$ _____ $8 \times 0.1 =$ _____ $8 \times 1 =$ _____ $8 \times 10 =$ _____ $8 \times 100 =$ _____	**2.** $14 \times 0.01 =$ _____ $14 \times 0.1 =$ _____ $14 \times 1 =$ _____ $14 \times 10 =$ _____ $14 \times 100 =$ _____
3. $25 \times 0.01 =$ _____ $25 \times 0.1 =$ _____ $25 \times 1 =$ _____ $25 \times 10 =$ _____ $25 \times 100 =$ _____	**4.** $138 \times 0.01 =$ _____ $138 \times 0.1 =$ _____ $138 \times 1 =$ _____ $138 \times 10 =$ _____ $138 \times 100 =$ _____

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$10 bills	$6 \times 10 =$		
$1 bills	$6 \times 1 =$		
Dimes	$6 \times 0.1 =$		
Pennies	$6 \times 0.01 =$		

2. Look at the products in the table. What pattern(s) do you notice?