BRIDGES IN MATHEMATICS 5

GRADE 5 SUPPLEMENT

Set A11 Number & Operations: Multiplying & Dividing Decimals

Includes

Skills & Concepts

★ round numbers to the nearest 0.1, 0.01, and 0.001
★ multiply and divide by powers of 10, including 0.01, 0.1, 1, 10, 100, and 1,000
★ multiply whole numbers and decimal numbers by decimal numbers
★ apply fraction, decimal, and percent equivalencies to solve problems
★ describe the effect of place value when multiplying whole numbers and decimals
★ multiply decimal using concrete models, drawing and strategies
★ estimate solutions to arithmetic problems in order to assess reasonableness of results
★ divide decimals using concrete models or drawings and strategies based on place value, properties of operations.
★ relate the strategy to a written method and explain the reasoning used.

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Bridges in Mathematics Grade 5 Supplement
Set A11 Number & Operations: Multiplying & Dividing Decimals

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Bridges in Mathematics is a standards-based K–5 curriculum that provides a unique blend of concept development and skills practice in the context of problem solving. It incorporates the Number Corner, a collection of daily skill-building activities for students.

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Set A11 ★ Activity 1

ACTIVITY

Multiplying by Powers of Ten

Overview

Students complete a string of calculations with fractions and decimals and then discuss the relationships among those calculations to build greater computational fluency and a stronger number sense with decimals. Then they explore what happens, and why, when they multiply by powers of 10 (0.01, 0.1, 1, 10, etc.).

Skills & Concepts

- ★ multiply by powers of 10, including 0.01, 0.1, 1, 10, 100, and 1,000
- ★ describe the effect of place value when multiplying whole numbers and decimals by 0.01, 0.1, 1, 10, 100, and 1,000
- ★ apply fraction and decimal equivalencies to solve problems

You'll need

- ★ Patterns in Multiplying by Powers of Ten (pages A11.4 and A11.5, run 1 copy for display, plus a class set)
- ★ Multiplying by Powers of Ten Practice (page A11.6, run 1 copy for display, plus a class set)
- ★ base ten pieces for each pair of students, plus a set for display
- ★ Great Wall of Base Ten saved from Unit Six

Advance Preparation Try to find some copies of Bridges Student Book pages 160 and 161, Fraction & Decimal Equivalents, which students completed in Unit Six, Session 10. You might also fill in Display Master 6.10, Fraction & Decimal Equivalencies, which you used in Session 12. Both of these resources may jog students' memory of the fraction equivalents of common decimals in steps 1 and 3 below.

Instructions for Multiplying by Powers of Ten

1. Explain to students that they're going to be multiplying decimal numbers in the next few days and that they'll begin with powers of 10, like 0.1, 10, and 100. Write the following problems one at a time where students can see them (answers included in parentheses for your reference). Ask students to work in pairs for a minute or two to solve one problem at a time, and then have students share their answers and strategies as a whole group.

- ½ × 10 (5)
- 0.5 × 10 (5)
- ¼ × 10 (2.5)
- 0.25 × 10 (2.5)
- 0.75 × 10 (7.5)

When they have solved all five problems, ask students to discuss the relationships they noticed among the problems. Students are likely to note equivalencies between ½ and 0.5, and between ¼ and 0.25. They may also have noticed that they could halve half of 10 to find one-fourth of 10, and that three-fourths (0.75) is three times one-fourth. They might also notice that when multiplying a decimal number by 10, you move the decimal point one place to the right (e.g., 0.25 × 10 = 2.5).

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Actvity 1 Multiplying by Powers of Ten (cont.)

Describing the relationships among the problems should help students begin to develop efficient strategies for computing with decimal numbers. Students will solve similar sets of problems at the beginning of each activity in this set.

2. Place Patterns in Multiplying by Powers of Ten on display and give each student a copy. Review the sheet with the class. Discuss the sample equations in each table and have students connect the elements of each equation to the problem situation. Also be sure students remember how to write each decimal (0.01 and 0.1) as a fraction. Invite them to refer to Bridges Student Book pages 160 and 161, Fraction and Decimal Equivalents, or a filled in copy of Display Master 6.10, Fraction and Decimal Equivalencies, if you were able to retrieve these resources from Unit Six.

Set A11 Number & Operations: Mu t p ying & Div ding Dec ma s Blackl ne Run 1 copy for d sp ay, plus a class set

NAME _____ DATE _____

Patterns in Multiplying by Powers of Ten, page 1 of 2

1a The post office sells one-cent stamps. Fill out the table below to show how much it would cost to buy different quantities of one-cent stamps.

Number of Stamps	Decimal Equation	Fraction Equation	Total Cost
1 stamp	$1 \times 0.01 = 0.01$	$1 \times {}^{1}/_{100} = {}^{1}/_{100}$	$0.01
2 stamps	$2 \times 0.01 = 0.02$	$2 \times {}^{2}/_{100} = {}^{2}/_{100}$	$0.02
10 stamps			
20 stamps			
45 stamps			
321 stamps			
404 stamps			

b What do you notice about multiplying by 0.01?

3. Give students time to complete the sheet in pairs. Then reconvene the class as a whole group and open the discussion by asking what they noticed about multiplying by 0.01, 0.1, and 10. Discuss each multiplier one at a time, and encourage students to explain why the patterns they see (e.g., "When you multiply by 0.01, the decimal point moves two places to the left") make sense. Encourage students to refer to the Great Wall of Base Ten and to use the base ten pieces to explain the patterns they see. Remember that when modeling decimals, the mat represents 1, the strip 0.10, and the unit 0.01.

> ***Josie*** *I saw when you multiply a number by 0.01, like in the first problem, you can just move the decimal point two places to the left like this. It works every time.*
>
> $45 \times 0.01 = 0.45$
>
> 45.0 becomes 0.45
>
> ***Teacher*** *Why does it work? Can you use the Great Wall of Base Ten or these base ten pieces to explain?*
>
> ***Josie*** *Well, 45 times one-hundredth is 45 hundredths. 40 hundredths is the same as four-tenths. That's the .4 part of the answer. And 5 hundredths is just 5 hundredths. So it's like each part of the first number gets a hundred times smaller: 40 becomes four-tenths and 5 becomes five-hundredths. Or you could just think 45 hundredths, really. That's a hundred times smaller than 45.*

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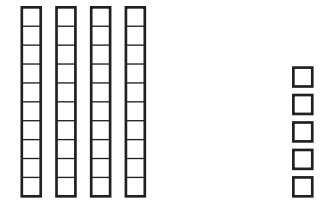
Actvity 1 Multiplying by Powers of Ten (cont.)



40 hundredths is 4 tenths

5 hundredths is just 5 hundredths

4. After students have discussed the patterns that emerged when multiplying by 0.01, 0.1, and 10, give each student a copy of Multiplying by Powers of Ten Practice. Explain that they'll complete it independently, and then select a couple of problems from the sheet to do together before asking students to work on their own.

Extensions

- If students finish early, ask them to turn their papers over and write problems for each other in this form:

  $45 \times \_\_\_\_\_ = 0.045$ $45 \times \_\_\_\_\_ = 4{,}500$ $45 \times \_\_\_\_\_ = 4.5$

  Then they can trade papers and fill in the missing powers of 10 in each equation.

- Clarify the term "power of ten" using the Great Wall of Base Ten, and introduce exponent notation. A power of ten is a number resulting from multiplying 10 by itself any number of times. We use exponents to show how many times a number, in this case 10, is multiplied by itself. A negative exponent indicates a number less than 1 (a fraction or a decimal).

  $1000 = 10^3$ $100 = 10^2$ $10 = 10^1$ $1 = 10^0$ $0.1 = 10^{-1}$ $0.01 = 10^{-2}$

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NAME _____ **DATE** _____

Patterns in Multiplying by Powers of Ten, page 1 of 2

1a The post office sells one-cent stamps. Fill out the table below to show how much it would cost to buy different quantities of one-cent stamps.

Number of Stamps	Decimal Equation	Fraction Equation	Total Cost
1 stamp	$1 \times 0.01 = 0.01$	$1 \times \frac{1}{100} = \frac{1}{100}$	\$0.01
2 stamps	$2 \times 0.01 = 0.02$	$2 \times \frac{1}{100} = \frac{2}{100}$	\$0.02
10 stamps			
20 stamps			
45 stamps			
321 stamps			
404 stamps			

b What do you notice about multiplying by 0.01?

2a Amelia feeds her pet lizard crickets. The pet store sells crickets for ten cents each. Fill out the table below to show how much it would cost to buy different quantities of crickets.

Number of Crickets	Decimal Equation	Fraction Equation	Total Cost
1 cricket	$1 \times 0.10 = 0.10$	$1 \times \frac{1}{10} = \frac{1}{10}$	\$0.10
2 crickets	$2 \times 0.10 = 0.20$	$2 \times \frac{1}{10} = \frac{2}{10}$	\$0.20
10 crickets			
20 crickets			

(Continued on next page.)

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NAME _____ **DATE** _____

Patterns in Multiplying by Powers of Ten, page 2 of 2 (cont.)

2a (cont.)

Number of Crickets	Decimal Equation	Fraction Equation	Total Cost
45 crickets			
321 crickets			
404 crickets			

b What do you notice about multiplying by 0.10?

3a Alfonso's company sells T-shirts to soccer teams. Each T-shirt costs ten dollars. Fill out the table below to show how much it would cost to buy different quantities of T-shirts.

Number of Shirts	Equation	Total Cost
1 shirt	$1 \times 10 = 10$	$10
2 shirts	$2 \times 10 = 20$	$20
10 shirts		
20 shirts		
45 shirts		
321 shirts		
404 shirts		

b What do you notice about multiplying by 10?

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NAME _____ **DATE** _____

Multiplying by Powers of Ten Practice

Complete the following equations.

106 × 0.01 = _____ 47 × 0.01 = _____ 3 × 0.01 = _____

0.6 × 0.01 = _____ 0.32 × 0.01 = _____ 0.1 × 0.01 = _____

10 × 0.01 = _____

452 × 0.1 = _____ 302 × 0.1 = _____ 64 × 0.1 = _____

0.9 × 0.1 = _____ 0.57 × 0.1 = _____ 0.04 × 0.1 = _____

0.1 × 0.1 = _____

360 × 10 = _____ 23 × 10 = _____ 4 × 10 = _____

0.7 × 10 = _____ 0.54 × 10 = _____ 0.01 × 10 = _____

0.32 × 100 = _____ 4.3 × 100 = _____ 4 × 100 = _____

45 × 100 = _____ 309 × 100 = _____ 0.1 × 100 = _____

0.17 × 1,000 = _____ 0.34 × 1,000 = _____ 9.6 × 1,000 = _____

603 × 1,000 = _____ 0.01 × 1,000 = _____

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Set A11 ★ Activity 2

ACTIVITY

Dividing by Powers of Ten

Overview

Students complete a string of calculations with fractions and decimals and then discuss the relationships among those calculations to build greater computational fluency and a stronger number sense with decimals. Then they explore what happens, and why, when they divide by powers of 10 (0.01, 0.1, 1, 10, etc.).

Skills & Concepts

- ★ divide by powers of 10, including 0.01, 0.1, 1, 10, 100, and 1,000
- ★ describe the effect of place value when dividing whole numbers and decimals by 0.01, 0.1, 1, 10, 100, and 1,000
- ★ apply fraction and decimal equivalencies to solve problems

You'll need

- ★ Patterns in Dividing by Powers of Ten (pages A11.10–A11.12, run 1 copy for display, plus a class set)
- ★ Dividing by Powers of Ten Practice (page A11.13, run 1 copy for display, plus a class set)
- ★ base ten pieces for each pair of students, plus a set for display
- ★ Great Wall of Base Ten saved from Unit Six

Instructions for Dividing by Powers of Ten

1. Write the following problems one at a time where students can see them (answers included in parentheses for your reference). Ask students to work in pairs for a minute or two to solve one problem at a time, and then have students share their answers and strategies as a whole group.

- 10×0.1 (1)
- 10×0.6 (6)
- 600×0.01 (6)
- 600×0.04 (24)
- 40×0.8 (32)

2. When they have solved all five problems, ask students to discuss the relationships they noticed among the problems. Students are likely to note that multiplying by 0.1 is like dividing by 10, just as multiplying by 0.01 is like dividing by 100. With this in mind, they can solve 600×0.04, for example, in the following way: $600 \div 100 = 6$ and $6 \times 4 = 24$.

3. Now explain to students that today they're going to be dividing by powers of 10, like 0.1, 10, and 100. Place Patterns in Dividing by Powers of Ten on display and give each student a copy. Review the sheet with the class. Discuss the sample equations in each table and have students connect the elements of each equation to the problem situation. Also be sure students remember how to write each decimal as a fraction.

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Activity 2 Dividing by Powers of Ten (cont.)

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NAME _____ DATE _____

Patterns in Dividing by Powers of Ten, page 1 of 3

1a Alfonso's company sells T-shirts to soccer teams. Each T-shirt costs ten dollars. If you spent $1030, how many shirts could you buy?

b Fill out the table below to show how many T-shirts you could buy with different amounts of money.

Total Cost	Equation	Number of Shirts
$10	10 ÷ 10 = 1	1
$20	20 ÷ 10 = 2	2
$100		
$200		
$450		
$3210		
$1020		

c What do you notice about dividing by 10?

2a Amelia feeds her pet lizard crickets. The pet store sells crickets for ten cents each. If Amelia spent $1.30 on crickets last week, how many crickets did she buy?

(Continued on next page.)

Set A11 Number & Operations: Mult plying & D viding Decimals Run 1 copy for display, plus a class set

Patterns in Dividing by Powers of Ten, page 2 of 3

2b Fill out the table below to show how much it would cost to buy different quantities of crickets.

Total Cost	Decimal Equation	Fraction Equation	Number of Crickets
$0.10	0.10 ÷ 0.10 = 1	$^1/_{10} \div {}^1/_{10} = 1$	1 cricket
$0.20	0.20 ÷ 0.10 = 2	$^2/_{10} \div {}^1/_{10} = 2$	2 crickets
$1.00			
$2.00			
$3.30			
$5.20			

c What do you notice about dividing by 0.10?

3a The post office sells one-cent stamps. If you spent $2.08, how many one-cent stamps could you buy?

b Fill out the table below to show how many stamps you could buy with different amounts of money.

Total Cost	Decimal Equation	Fraction Equation	Number of Stamps
$0.01	0.01 ÷ 0.01 = 1	$^1/_{100} \div {}^1/_{100} = 1$	1 stamp
$0.02	0.02 ÷ 0.01 = 2	$^2/_{100} \div {}^1/_{100} = 2$	2 stamps
$0.10			
$0.40			

(Continued on next page.)

As you review the sheet, discuss how to write the numbers that are greater than 1 as a fraction. In this case, students will probably find it most useful to write them as improper fractions. For example, they would write 2.47 as $^{247}/_{100}$ in the first table. This will probably make dividing by $^1/_{100}$ more sensible to them.

4. Now ask students to complete the sheet in pairs. Encourage them to use the base ten pieces to think about the problems if that helps. Then reconvene the class as a whole group and open the discussion by asking what they noticed about dividing by 0.01, 0.1, and 10. Discuss each divisor one at a time, and encourage students to explain why the patterns they see make sense. (e.g., "When you divide by 0.01, the decimal point moves two places to the right. That's what happens when you multiply by 100 too!") Invite students to refer to the Great Wall of Base Ten and to use the base ten pieces to explain the patterns they see. Remember that when modeling decimals, the mat represents 1, the strip 0.10, and the unit 0.01.

> ***Sydney*** *When you divide by a decimal number, it's like multiplying by the reverse whole number, so you move the decimal point that many places to the right.*
>
> ***Teacher*** *Please use the base ten pieces to show us what you mean and why this is true.*
>
> ***Sydney*** *Well, think about these strips. They show 40. So if you divide by 0.1, it's like asking, how many tenths in 40? There are 10 tenths in each little unit and 40 units altogether, so you go 10 × 40 = 400. So 40 ÷ 0.1 = 400. 400 is like 40 with the decimal one place to the right.*

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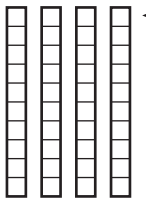
Activity 2 Dividing by Powers of Ten (cont.)



Students' verbal explanations will vary considerably in their clarity, so encourage them to show their thinking with base ten pieces and equations. This will allow you to get a clearer sense of what they understand and will make their explanations more comprehensible to other students.

5. After students have discussed the patterns that emerged when dividing by 0.01, 0.1, and 10, give each student a copy of Dividing by Powers of Ten Practice. Explain that they'll complete it independently, and then select a couple of problems from the sheet to do together before asking students to work on their own.

Extensions

- If students finish early, ask them to turn their papers over and write problems for each other in this form:

  45 ÷ _____ = 0.045 45 ÷ _____ = 450 45 ÷ _____ = 4.5

  Then they can trade papers and fill in the missing powers of 10 in each equation.

- You might also consider asking them to write their problems in this form:

  45 ÷ 10 = 45 × _____ 45 ÷ 0.10 = 45 × _____ 45 ÷ 0.01 = 45 × _____

- Help students understand powers of 10 in a graphic way. The Molecular Expressions web site (see URL below) features a photographic display called Secret Worlds: The Universe Within that illustrates powers of 10 starting with the Milky Way, 10 million light years (10^{20} meters) from Earth. A series of photos move closer and closer to Earth, decreasing in distance by a power of 10 each time, until you reach a tall oak tree seen at a distance of 1 meter (10^{0} meter). The photos don't stop there, however. The powers of 10 go negative as the series moves in the microscopic world of an oak leaf, and finally into a subatomic universe of electrons and protons.
  http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/

INDEPENDENT WORKSHEET

Use Set A11 Independent Worksheets 1–3 on pages A11.59–A11.64 to provide students with more practice multiplying and dividing by powers of ten, as well as rounding and doing calculations with decimals.

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NAME _____ **DATE** _____

Patterns in Dividing by Powers of Ten, page 1 of 3

1 Alfonso's company sells T-shirts to soccer teams. Each T-shirt costs ten dollars.

a If you spent $1030, how many shirts could you buy?

b Fill out the table below to show how many T-shirts you could buy with different amounts of money.

Total Cost	Equation	Number of Shirts
$10	10 ÷ 10 = 1	1
$20	20 ÷ 10 = 2	2
$100		
$200		
$450		
$3210		
$1020		

c What do you notice about dividing by 10?

2 Amelia feeds her pet lizard crickets. The pet store sells crickets for ten cents each.

a If Amelia spent $1.30 on crickets last week, how many crickets did she buy?

(Continued on next page.)

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NAME _____ **DATE** _____

Patterns in Dividing by Powers of Ten, page 2 of 3 (cont.)

b Fill out the table below to show how much it would cost to buy different quantities of crickets.

Total Cost	Decimal Equation	Fraction Equation	Number of Crickets
$0.10	0.10 ÷ 0.10 = 1	$\frac{1}{10} \div \frac{1}{10} = 1$	1 cricket
$0.20	0.20 ÷ 0.10 = 2	$\frac{2}{10} \div \frac{1}{10} = 2$	2 crickets
$1.00			
$2.00			
$3.30			
$5.20			

c What do you notice about dividing by 0.10?

3 The post office sells one-cent stamps.

a If you spent $2.08, how many one-cent stamps could you buy?

b Fill out the table below to show how many stamps you could buy with different amounts of money.

Total Cost	Decimal Equation	Fraction Equation	Number of Stamps
$0.01	0.01 ÷ 0.01 = 1	$\frac{1}{100} \div \frac{1}{100} = 1$	1 stamp
$0.02	0.02 ÷ 0.01 = 2	$\frac{2}{100} \div \frac{1}{100} = 2$	2 stamps
$0.10			
$0.40			

(Continued on next page.)

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NAME _____ **DATE** _____

Patterns in Dividing by Powers of Ten, page 3 of 3 (cont.)

3b Cont.

Total Cost	Decimal Equation	Fraction Equation	Number of Stamps
$0.86			
$2.47			
$3.05			

C What do you notice about dividing by 0.01?

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NAME _____ **DATE** _____

Dividing by Powers of Ten Practice

Complete the following equations.

3000 ÷ 1000 = _____

2504 ÷ 1000 = _____

372 ÷ 1000 = _____

0.6 ÷ 1000 = _____

0.03 ÷ 1000 = _____

900 ÷ 100 = _____

406 ÷ 100 = _____

7 ÷ 100 = _____

3.2 ÷ 100 = _____

0.08 ÷ 100 = _____

405 ÷ 10 = _____

0.63 ÷ 10 = _____

87 ÷ 0.1 = _____

6 ÷ 0.1 = _____

0.5 ÷ 0.1 = _____

0.48 – 0.1 = _____

3 ÷ 0.01 = _____

6.9 ÷ 0.01 = _____

0.8 ÷ 0.01 = _____

409 ÷ 0.01 = _____

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Set A11 ★ Activity 3

ACTIVITY

Using Decimals to Calculate Sale Prices

Overview

As a whole group, students review how to find a sale price, as well as fraction, decimal, and percent equivalences. Then students work in pairs to complete a set of related problems. At the end of the activity, students share their strategies for solving some of the more difficult problems.

Skills & Concepts

★ multiply whole numbers and decimal numbers by decimal numbers to the hundredths place

★ apply fraction, decimal, and percent equivalencies to solve problems

You'll need

★ The Game Sale (pages A11.18 and A11.19, 1 copy for display, plus a class set)

★ Fraction, Decimal & Percent Number Line from Unit Six, Session 16 (See Advance Preparation.)

Advance Preparation Find the Fraction, Decimal & Percent Number Line, which you created with the class in Unit Six, Session 16. If you no longer have it, make an enlarged photocopy of the picture on page 881, Bridges Teacher's Guide, Vol. 3. You might also consider playing the Number Line Game from Unit Six, Session 16 if you think students will need a refresher on equivalent fractions, decimals, and percents.

Instructions for using Decimals to Calculate Sale Prices

1. Write the following problems one at a time where students can see them (answers included in parentheses for your reference). Ask students to work in pairs for a minute or two to solve one problem at a time, and then have students share their answers and strategies as a whole group.

- $1/2 \times 28$ (14)
- 0.50×28 (14)
- $1/4 \times 28$ (7)
- 0.25×28 (7)
- 0.50×0.08 (0.04)
- 0.25×0.08 (0.02)

2. When they have solved all six problems, ask students to discuss the relationships they noticed among the problems. Students are likely to note that $1/2$ is equal to 0.50 and that $1/4$ is equal to 0.25. They may also have solved 0.50×0.08 by reasoning that half of eight-hundredths is four-hundredths (0.04) and then halved again to solve 0.25×0.08. Such strategies show a good understanding of the relationship between fractions, decimals, and division.

3. Explain that today's activity involves finding the sale prices of different items. Invite students to share some examples of things they have purchased on sale. How much did the item cost originally? How was the sale expressed: in terms of a new price or a certain amount off?

4. After students have shared some examples, ask them to imagine that a bike that originally cost $120 is on sale for 10% off. How could fractions and decimals help them think about the new price for the

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Activity 3 Using Decimals to Calculate Sale Prices (cont.)

bike? (Write the scenario on the board.) Ask students to think about it quietly and then talk to a partner about their ideas. After a few moments, invite partners to share their thoughts with the whole group. Be sure students are clear that they need to calculate the discount (the percent taken off) and then subtract it from the original price to find the sale price, unless, of course, they calculate 120 × 0.90 to find the sale price.

After they have shared some ideas, which will likely involve thinking about fractions and division, refer students to the Fraction, Decimal and Percent Number Line from Unit Six, Session 16. Explain that they can use this number line to refresh their memories of fractions, decimals, and percents that are equivalent during today's activity.

5. Place The Game Sale on display and give each student a copy. Review the sheet with the class. In particular, you'll need to discuss the idea of recording a decimal equation for each row. Students are likely to use what they know about fractions and division to solve each problem, but writing an equation with the discount expressed as a decimal will prompt them to connect their work to multiplication with decimal numbers.

Set A11 Number & Operations: Multiplying & Dividing Decimals Blackline Run 1 copy for d splay, plus a class set

NAME _____ DATE _____

The Game Sale

1a Rosa owns a game store, and she wants to put some of the older games in the store on sale to sell them quickly. If Rosa marks a board game that costs $38.50 at 50% off, what will be the sale price of the board game?

b If Rosa marks the same board game at 10% off, what will be the sale price of the board game?

c If Rosa marks the same board game at 20% off, what will be the sale price of the board game?

d If Rosa marks the same board game at 30% off, what will be the sale price of the board game?

(Continued on next page.)

Set A11 Number & Operations: Multiplying & Dividing Decimals Run 1 copy for d splay, plus a class set

The Game Sale (cont.)

2 Fill out the table below to show what the sale price would be for some different items in Rosa's store if she marked them at different sale rates.

a A puzzle that is originally priced at $16.50

Sale	Your work	Equation	New Price
50% off	Half of 16.50 is 8.25	16.50 ×_____ = _____ 16.50 – _____ = _____	$8.25
10% off		16.50 ×_____ = _____ 16.50 – _____ = _____	
20% off		16.50 ×_____ = _____ 16.50 – _____ = _____	
30% off		16.50 ×_____ = _____ 16.50 – _____ = _____	

b A video game that is originally priced at $64

Sale	Your work	Equation	New Price
50% off		64 × _____ = _____ 64 – _____ = _____	
25% off		64 × _____ = _____ 64 – _____ = _____	
10% off		64 × _____ = _____ 64 – _____ = _____	

6. Circulate around the room while students work on the sheets in pairs. Take time to provide support, and reconvene the class as a group to discuss some of the problems if more than a few children are confused. Watch how students are working, and think about which problems you'd like to discuss as a whole group.

7. When you have about 15 minutes left in the session, reconvene the class as a whole group to discuss students' strategies for solving a few select problems from the sheets. If you saw students using a valuable or noteworthy strategy, invite them to share their work with the class.

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Activity 3 Using Decimals to Calculate Sale Prices (cont.)

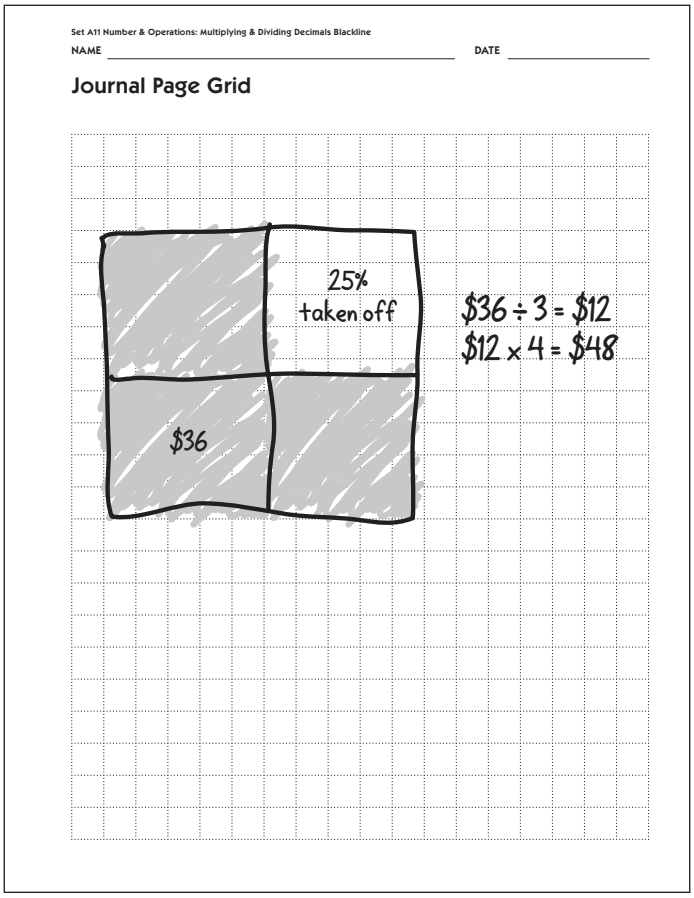
Extension

Invite students to work on some more challenging sale problems. For example:

- A cell phone was 10% off. The sale price was $90. What was the original price?
- A digital camera was 10% off. The sale price was $225. What was the original price?
- A jacket was 25% off. The sale price was $36. What was the original price?

Students will come up with a variety of ways to solve these problems. Here is an example of how a fifth grader might solve the last problem.

This big square is the original price of the jacket. 25 percent is one-fourth of the total. The rest of it is $36. That's the sale price. It's made up of three-fourths of the original price. So I divided $36 by 3 to see how much each part was worth. $12 is one-fourth of the total original price, so that makes the original price $48.



NAME _____ **DATE** _____

The Game Sale, page 1 of 2

1 Rosa owns a game store, and she wants to put some of the older games in the store on sale to sell them quickly.

a If Rosa marks a board game that costs $38.50 at 50% off, what will be the sale price of the board game?

b If Rosa marks the same board game at 10% off, what will be the sale price of the board game?

c If Rosa marks the same board game at 20% off, what will be the sale price of the board game?

d If Rosa marks the same board game at 30% off, what will be the sale price of the board game?

(Continued on next page.)

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The Game Sale, page 2 of 2

2 Fill out the table below to show what the sale price would be for some different items in Rosa's store if she marked them at different sale rates.

a A puzzle that is originally priced at $16.50

Sale	Your work	Equation	New Price
50% off	Half of 16.50 is 8.25	16.50 × 0.50 = 8.25 16.50 – 8.25 = 8.25	$8.25
10% off		16.50 × _____ = _____ 16.50 – _____ = _____	
20% off		16.50 × _____ = _____ 16.50 – _____ = _____	
30% off		16.50 × _____ = _____ 16.50 – _____ = _____	

b A video game that is originally priced at $64

Sale	Your work	Equation	New Price
50% off		64 × _____ = _____ 64 – _____ = _____	
25% off		64 × _____ = _____ 64 – _____ = _____	
10% off		64 × _____ = _____ 64 – _____ = _____	
40% off		64 × _____ = _____ 64 – _____ = _____	

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Set A11 ★ Activity 4

ACTIVITY

Multiplying Decimals

Overview

Students complete a string of related decimal calculations and then discuss the relationships among those calculations. Then they find the area of a computer chip to think about multiplying two decimal numbers. Finally, students solve two more story problems that require them to multiply decimal numbers, as well as a few straight calculations in which they multiply two decimal numbers using an algorithm, an array, or both.

Skills & Concepts

★ multiply decimal numbers to the hundredths place in a variety of ways, including using models

★ estimate solutions to arithmetic problems in order to assess reasonableness of results

You'll need

★ Decimal Grid (page A11.26, run 2 copies for display, a double-sided class set, plus extra)

★ Area of a Computer Chip (page A11.27, run 1 copy for display)

★ Using the Area Model to Multiply Decimal Numbers (page A11.28, run 1 copy for display, plus a class set)

Instructions for Multiplying Decimals

1. Write the following problems one at a time where students can see them (answers included in parentheses for your reference). Ask students to work in pairs for a minute or two to solve one problem at a time, and then have students share their answers and strategies as a whole group.

- 0.10×43 (4.3)
- 0.20×43 (8.6)
- 0.10×4.3 (0.43)
- 0.30×4.3 (1.29)

2. When they have solved all four problems, ask students to discuss the relationships they noticed among the problems. Students are likely to note that they can use one-tenth of a number (0.10) to determine any number of tenths (e.g., 0.20 and 0.30 in this case) of that same number.

3. Now explain that mental calculations like the ones they've been doing for the past few days aren't as helpful when multiplying certain combinations of decimal numbers. Today they'll be using the area model to help multiply some less friendly decimal numbers.

4. Display a copy of the Decimal Grid on the projector and give each student a double-sided copy of the grid. Ask students what the dimensions of the square must be if the total area is 1. After students have identified each dimension as 1 linear unit, ask them to identify what length each division on the grid indicates. (The heavier lines show tenths of a linear unit, and the finest grid lines show hundredths of a linear unit.) Label your grid to show these lengths, and have students do the same.

5. Then have them identify the fraction of the total area represented by the larger and smaller squares (hundredths and ten thousandths, respectively). Then ask students to identify what portion of the grid

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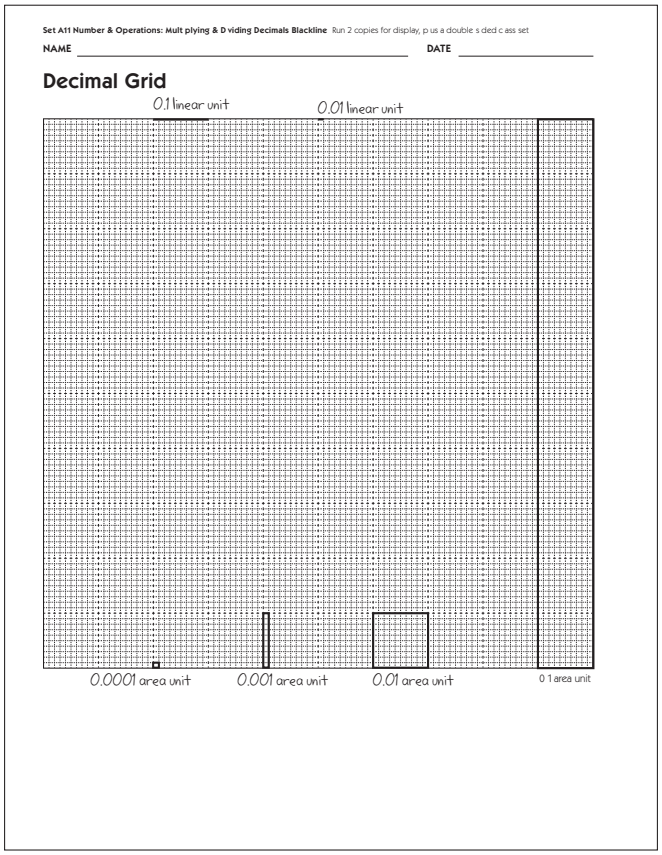
represents one-tenth and one-thousandth of the total area (a strip of 10 large squares and a strip of 10 small squares, respectively). Label these areas on your grid, and ask students to do the same.


Set A11 Number & Operations: Mult plying & D viding Decimals Blackline Run 2 copies for display, p us a double s ded c ass set

NAME _____ DATE _____

Decimal Grid

0.1 linear unit

0.01 linear unit

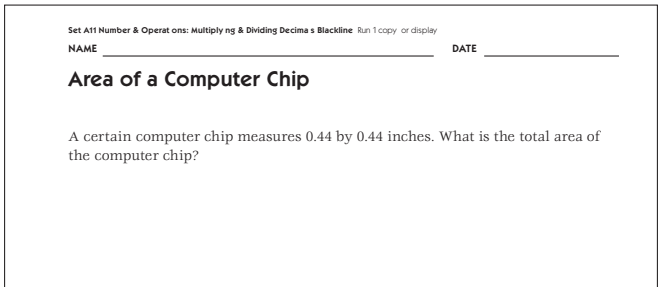
0.0001 area unit

0.001 area unit

0.01 area unit

0 1 area unit

6. Post the Area of a Computer Chip problem on the projector, and ask students to turn their papers over and draw an array on their second Decimal Grid to represent the problem.


Set A11 Number & Operat ons: Multiply ng & Dividing Decima s Blackline Run 1 copy or display

NAME _____ DATE _____

Area of a Computer Chip

A certain computer chip measures 0.44 by 0.44 inches. What is the total area of the computer chip?

Before students continue, ask them to check their work with a partner and then make an estimate of the total area of their array with their partner. Tell them to refer to their labeled Decimal Grids or the one you have displayed at the overhead as needed.

7. Now ask a volunteer to help you label the dimensions of the array on another projected copy of the Decimal Grid. When the dimensions have been correctly labeled, outline the array and make lines to show the partial products within the array.

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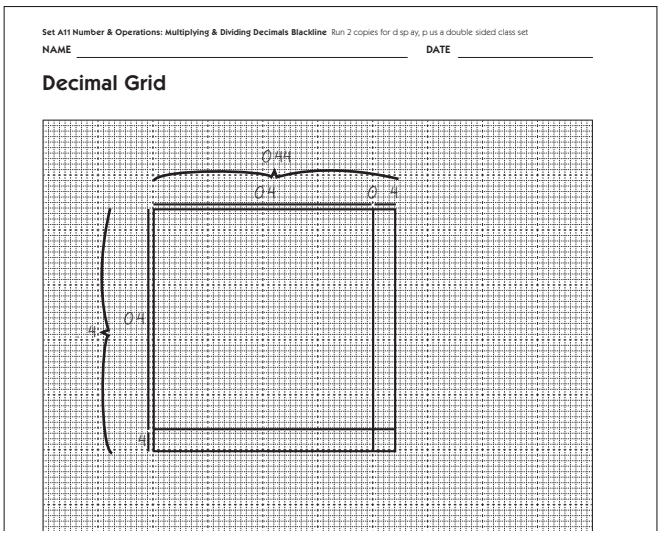
Activity 4 Multiplying Decimals (cont.)


Set A11 Number & Operations: Multiplying & Dividing Decimals Blackline Run 2 copies for d sp ay, p us a double sided class set

NAME _____ DATE _____

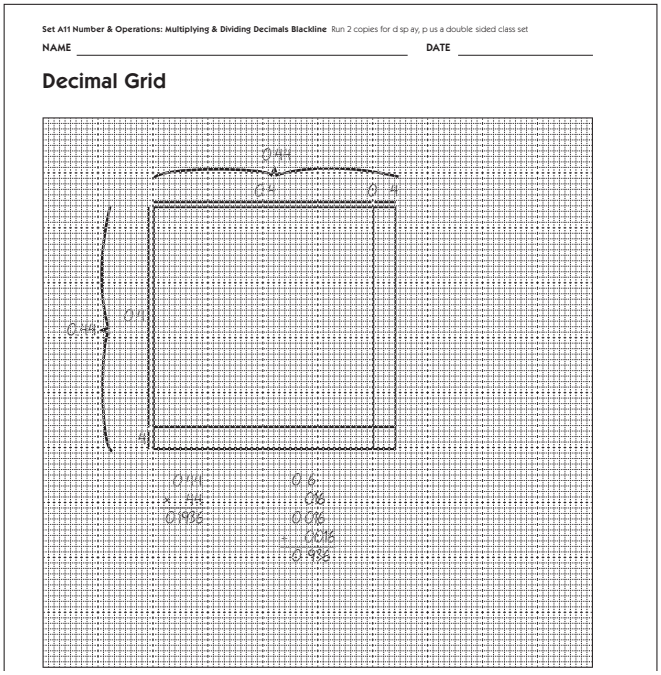
Decimal Grid

8. Before continuing, ask students to share their estimates of the total area of the array. When they do, encourage them to justify their thinking, and help them write each estimate in the form of an inequality. (You may need to invite them to refer to their labeled grids to remind them how big each piece of the grid is.)

$$0.44 \times 0.44 < 0.25 \qquad 0.44 \times 0.44 > 0.16$$

9. Now ask students to divide their arrays into partial products as you have on the projected Decimal Grid. Then give them time to work in pairs to find the total area of the computer chip. Circulate while they work to listen in on their conversations. Reconvene the class to clarify any confusion that may arise. Otherwise, let them work, and reconvene the group when most have finished.

10. Invite volunteers to help you label the partial products on the array, and then ask them how they found the total area.


Set A11 Number & Operations: Multiplying & Dividing Decimals Blackline Run 2 copies for d sp ay, p us a double sided class set

NAME _____ DATE _____

Decimal Grid

Activity 4 Multiplying Decimals (cont.)

11. After they have shared their strategies, ask what they notice about the process or result of this calculation. Students may be surprised or interested to find that the total area is considerably smaller in relation to the area of the unit than the dimensions are in relation to the linear unit. Encourage them to use the Decimal Grid to explore why this is so. (The linear unit has been divided just once for each dimension, but the area unit has been divided twice, once at each linear dimension.)

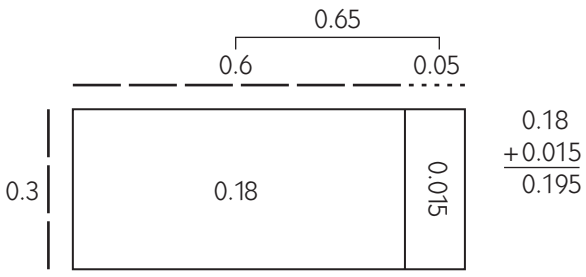
You might also ask them to investigate why the product goes to four decimal places when the dimensions each go to just two decimal places. You might also want to wait until students have completed a few more problems before investigating this phenomenon. If they can discern and explain some patterns related to where the decimal point goes in the product, they will be able to use the standard algorithm to multiply decimal numbers. Prompting them to estimate a reasonable answer before they calculate will also help students be able to place the decimal point in the products based on what makes sense for the numbers they are multiplying.

12. Now give each student a copy of Using the Area Model to Multiply Decimal Numbers and ask them to complete the problems in pairs. These problems require students to sketch an array for each problem, rather than use a Decimal Grid. If students seem to be having trouble with their sketches, gather everyone together as a group to make the sketches together before having them continue solving the problems in pairs. (If necessary, allow students who need extra support to make their sketches on Decimal Grid paper and attach them to the worksheet.) A sketch of each problem is shown below for your convenience.

Without the entire Decimal Grid, students may have difficulty determining the area of each partial product, struggling to recall whether each unit of area in a given region is one hundredth or one thousandth of the total, for example. Encourage them to break the numbers apart to apply the associative property and use what they know about multiplying by powers of 10. For example, students might calculate the area of the larger partial product in the first example below in one of the following ways:

$0.3 \times 0.6 = 3 \times 0.1 \times 0.6$
$3 \times 0.1 \times 0.6 = 3 \times 0.06$
$3 \times 0.06 = 0.18$

$0.3 \times 0.6 = 3 \times 0.1 \times 6 \times 0.1$
$3 \times 0.1 \times 6 \times 0.1 = 3 \times 6 \times 0.1 \times 0.1$
$3 \times 6 \times 0.1 \times 0.1 = 18 \times 0.01$
$18 \times 0.01 = 0.18$



$0.3 \text{ m} \times 0.65 \text{ m} = 0.195 \text{ m}^2$

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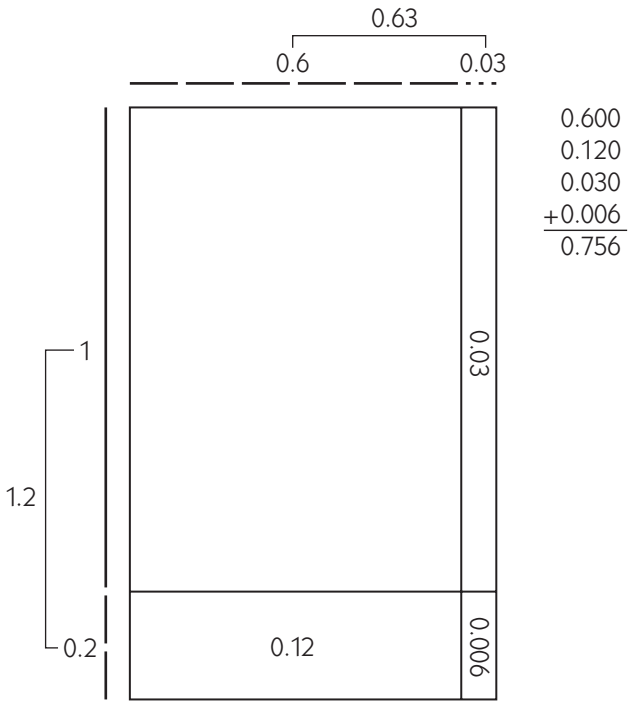
Activity 4 Multiplying Decimals (cont.)



1.2 km by 0.63 km = 0.756 km^2

13. Extend students' work into a second day if needed. After watching them work, consider opening the second day's lesson with a mini-lesson focusing on whatever elements of these calculations were most challenging for them the first day.

INDEPENDENT WORKSHEET

Use Set A11 Independent Worksheets 4 and 5 on pages A11.65–A11.68 to provide students with more practice multiplying decimals.

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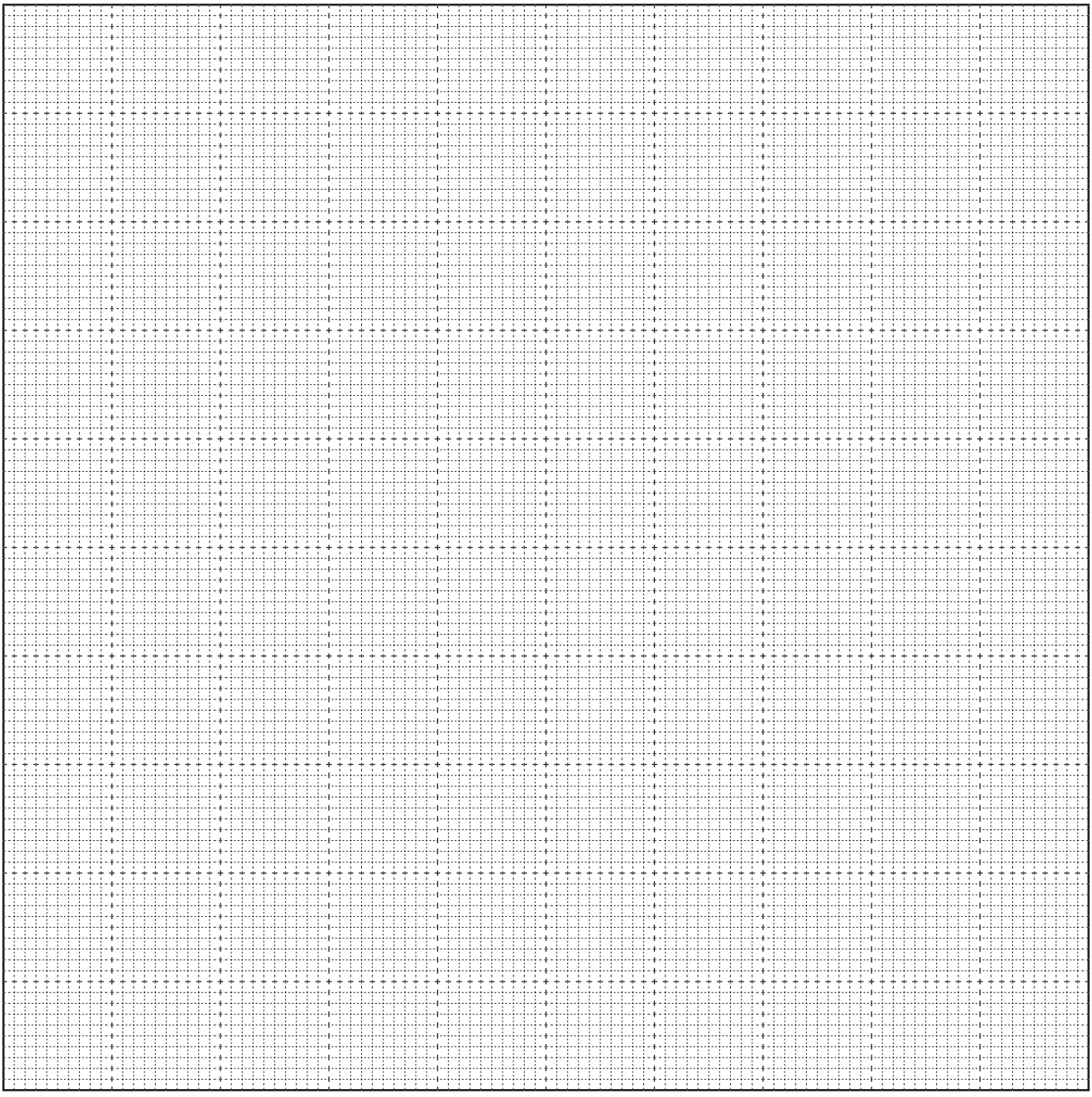
Decimal Grid



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Area of a Computer Chip

A certain computer chip measures 0.44 by 0.44 inches. What is the total area of the computer chip?

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Using the Area Model to Multiply Decimal Numbers

1 A piece of paper measures 0.3 m by 0.65 m.

a Estimate the total area of the piece of paper.

b Make a labeled sketch of the piece of paper and use it to calculate an exact answer.

2 The city park measures 1.2 km by 0.63 km.

a Estimate the total area of the park.

b Make a labeled sketch of the park and use it to calculate an exact answer.

3 Use an algorithm or sketch arrays on another piece of paper to find the products below.

1.6	1.5	4.5	2.43
× 0.7	× 0.2	× 2.3	× 1.8

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Set A11 ★ Activity 5

ACTIVITY

Building a Deck Using Partial Products & Arrays for Decimal Multiplication

Overview

Students continue to share strategies for estimating and multiplying two decimal numbers in the context of building a deck. They become more comfortable sketching an array and using an algorithm as a written method for their reasoning.

Skills & Concepts

★ Multiply decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between multiplication and division (CCSS 5.NBT.7)

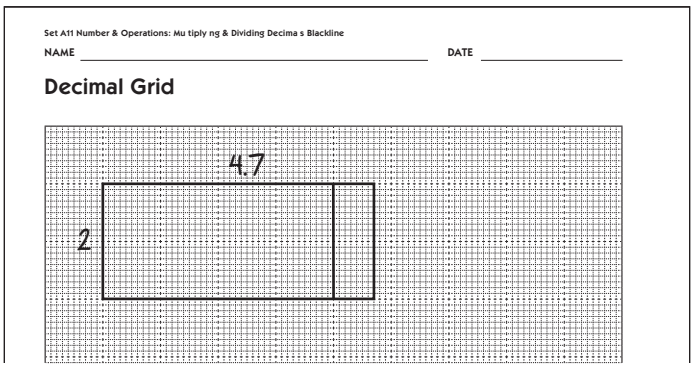
★ Relate the strategy to a written method and explain the reasoning used. (CCSS 5.NBT.7)

You'll Need

★ Decimal Grid (page A11.33, run a double-sided class set and additional copies as needed)

Instructions for Decimal Multiplication

1. Show the outline of a quick sketch for 2 × 4.7 and ask students to consider how much deck material you need to purchase if you want to build a deck that is 2 meters by 4.7 meters wide. Ask students to use the sketch to estimate a reasonable answer.



Teacher *Looking at this model, can you estimate a reasonable product?*

Amelia *Sure, 4.7 is closer to 5 than it is to 4, and 2 times 5 is 10. Since it's not quite 5, the area is going to be a little less than 10.*

2. Then, ask students to find the area and record their thinking on their decimal grid page. After a minute or two, have students pair share, and then invite a few students to share their thinking with the class.

Francisco *I made a sketch and split it into two parts. Then I could see 2 times 4, which is 8, and 2 times 0.7, which is 1.4. I added those two areas together, 8 + 1.4, and got 9.4 square meters for the deck.*

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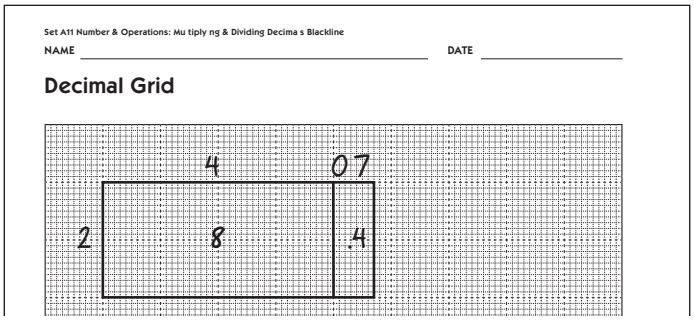
Activity 5 Building a Deck (cont.)



Teacher *Let me see if I can record your thinking using equations.*

$$2 \times 4 = 8$$
$$2 \times 0.7 = 1.4$$
$$8 + 1.4 = 9.4 \text{ square meters}$$

Here is another way we can write this:

$$(2 \times 4) + (2 \times .7) = 8 + 1.4 = 9.4$$
$$2 \text{ meters} \times 4.7 \text{ meters} = 9.4 \text{ square meters}$$

What if we wrote the problem this way to solve it? Take a moment to work with this problem in your journals.

$$\begin{array}{r} 4.7 \\ \times\ 2 \\ \hline \end{array}$$

Corbin *I tried solving just like a multiplication problem with whole numbers, but I wasn't really sure what to do with the decimal point at first. I knew 7 times 2 was 14, and I wrote the 4 in the ones column and carried the 1 to the tens. Then 4 times 2 plus 1 was 9, so I had 94. I knew the answer had to be a little less than 10, so the answer was 9.4.*

$$\begin{array}{r} {}^{1}4.7 \\ \times\ 2 \\ \hline 9.4 \end{array}$$

3. Let students know that you have a bit more space and could make the deck just a bit bigger. What if the deck was 2.1 by 4.7 meters? As students consider the extra region, ask them What size will the new region be? Would they prefer to think about it as one region or make two regions? Why?

Teacher *How much area would I be adding to my deck? How do you know?*

Chloe *I sketched the area across the bottom of the first deck, and I could see that there were four tenths across the bottom plus another tenth of 0.7.*

Teacher *How did you figure out what a tenth of 0.7 was?*

Lilly *I remembered that whenever you multiply a number by 0.1, the product is ten times smaller. You can just move the decimal point one place to the left, so I did, and I got 0.07. The new part of the deck is 0.4 + 0.07 = 0.47 square meters.*

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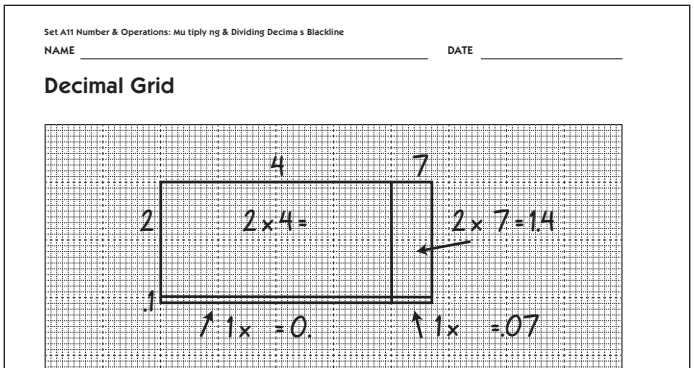
Activity 5 Building a Deck (cont.)



2.1 × 4.7 = 8 + 1.4 + 0.4 + 0.07 = 9.87 square meters

Teacher *That's interesting. When we multiplied 2 × 4.7 our answer only included tenths, 9.4, but now that we're multiplying 2.1 × 4.7 our answer includes hundredths. Why do you suppose that is?*

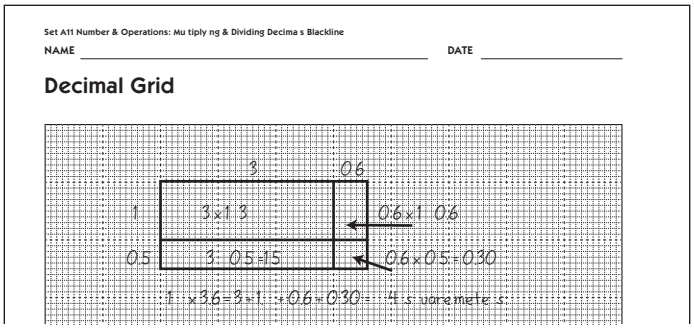
Carter *Now we have to multiply tenths by tenths, and that gives us hundredths.*

Teacher *Let's record the problem with partial products and look at that.*

4.7
× 2.1
8 (2 × 4)
1.4 (2 × 0.7)
0.4 (0.1 × 4)
0.07 (0.1 × 0.7
9.87 square meters)

4. Ask students to imagine that the neighbor down the street has a deck, too. Ask students to sketch a rectangle in their student journals and label the sides 1.5 meters and 3.6 meters. Ask them to pair share an estimate of the area with a neighbor and then find the area of the deck.

5. Share both the array and algorithm for multiplying decimals and ask students to make a connection to the partial products in the algorithm and the area in the array. What do they notice?



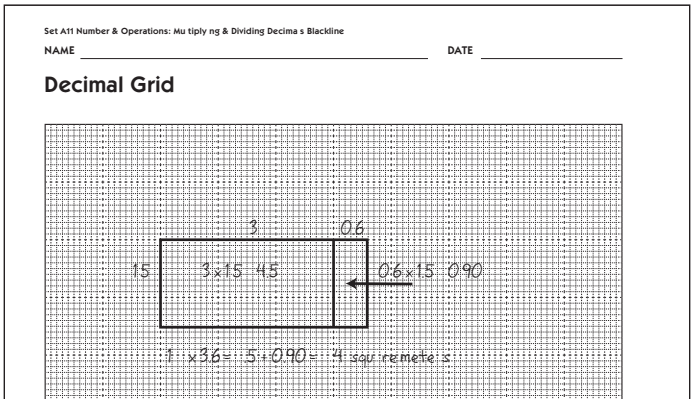
3.6
× 1.5
3 (3 × 1)
1.5 (3 × 0.5)
0.6 (0.6 × 1)
+ 0.30 (0.6 × 0.5)
5.4 square meters

$^{1}{}^{3}$3.6
× 1.5
90
+^{1}450
5.4 square meters

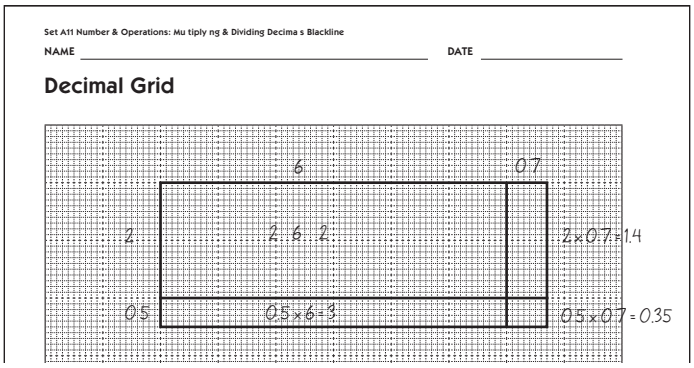
Activity 5 Building a Deck (cont.)

Teacher *Let's take a look at the multiplication algorithm for a minute. Where can we find the products 90 and 450 in our sketch?*

Students *It's kind of like when we multiplied whole numbers, only we didn't write the decimals on the algorithm until the end, and that makes it kind of confusing*
Yeah, the 90 is really 0.90 from 1.5 × 6, and the 450 is really 4.5 from 3 × 1.5. You just think of the array in two parts instead of four. So (3 × 1) + (3 × 0.5) = 4.5



6. Finally, pose one more deck design, with the dimensions 2.5 meters by 6.7 meters. Will this deck be larger or smaller? By how much? What would be a good estimate of the product or area?



7. Share both the array and algorithm for multiplying decimals and ask students to make a connection to the partial products in the algorithm and the area in the array. What do they notice?

8. Close the session by asking students to respond to the following prompt in their student journals: How is solving a decimal multiplication problem the same or different than solving a whole number multiplication problem?

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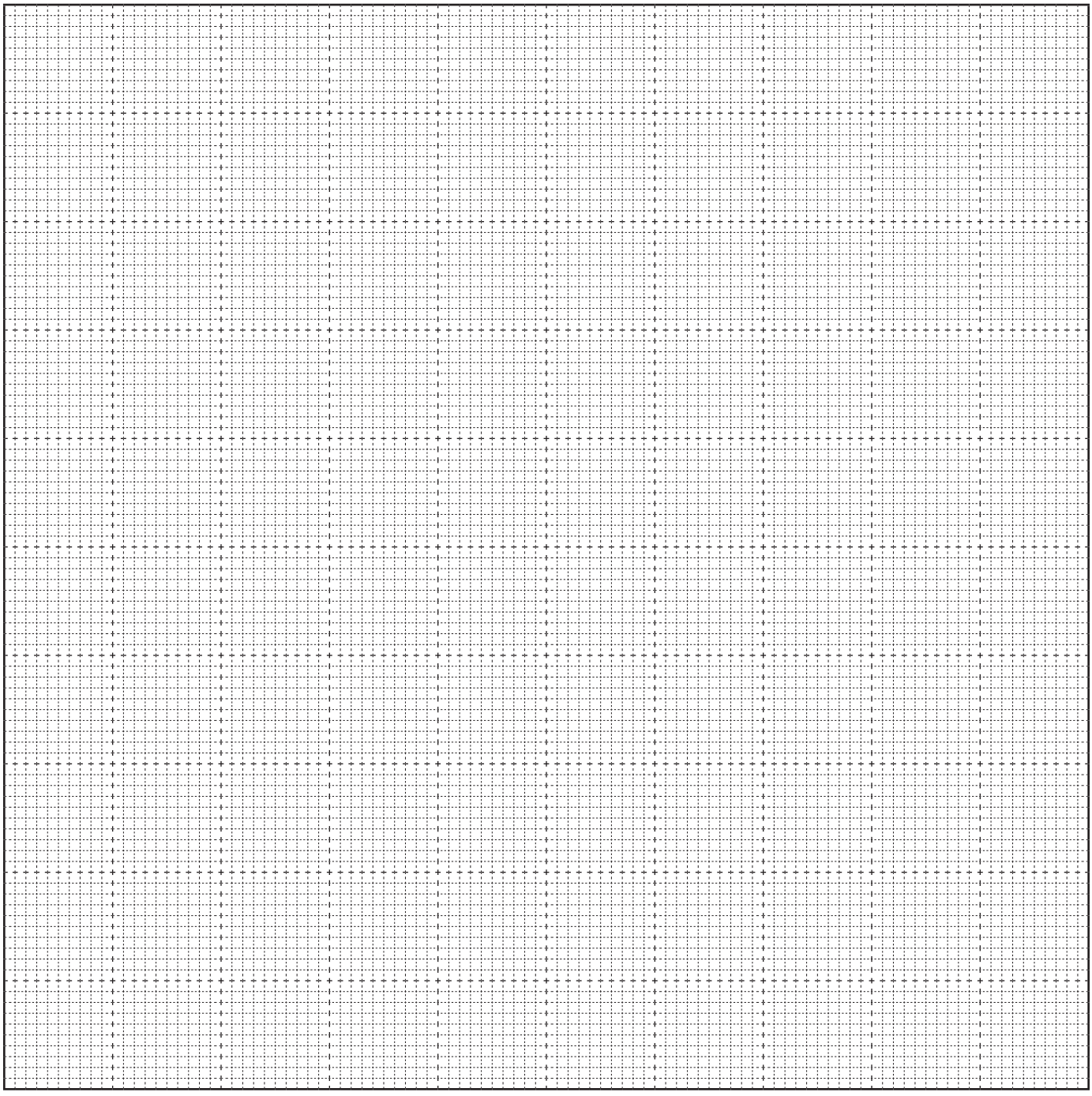
NAME _____ **DATE** _____

Decimal Grid



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Set A11 ★ Activity 6

ACTIVITY

Multiplying Decimals, More/Less

Overview

In this session, students play three rounds of Multiplying Decimals, More/Less to develop fluency with multiplication of decimals. The player with the combined largest products at the end of the game wins.

Skills & Concepts

★ Estimate the product of multiplying whole and decimal numbers to determine a reasonable answer.

★ Multiply decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between multiplication and division (CCSS 5.NBT.7)

★ Relate the strategy to a written method and explain the reasoning used. (CCSS 5.NBT.7)

You'll Need

★ More/Less die, half class-set

★ Domino Cards (page A11.39–A11.41 run a half class set on cardstock. See note.)

★ Student Math Journal or Journal Grid Page (page A11.42 optional, run 1 copy for display plus addional copies as needed)

★ Decimal Grid (page A11.43, run 1 copy for display, plus a double-sided class set)

Note If you saved the half-class set of Domino cards from Supplement Set A9, Activity 6, please reuse them instead of creating additional sets.

Instructions for Multiplying Decimals, More/Less

Game 1 Demonstration

1. Introduce the game Multiplying Decimals, by playing one game against the class.

- Roll the more/less die to determine if you are playing for the greatest product or the lesser product.
- Create a t-chart for you and your opponent in a student journal page. Label one side for Player One (teacher) and the second side as Player Two (students).

> ***Teacher*** *I'm going to choose a student to roll the die to determine if they team with more or less wins the game, the total of our products will decide.*
>
> ***Armando*** *It says LESS!*
>
> ***Teacher*** *In the first round of this game, I'll draw two domino cards. I'll read them as a decimal, and then multiply my two decimals to determine the product. But, I'll need to consider how I read the domino. For example, should I use 5.3 or 3.5? And 6.8 or 8.6? Hmm… if I want a smaller product how should I read the decimals? Think privately… now share with your partner. What should I do?*

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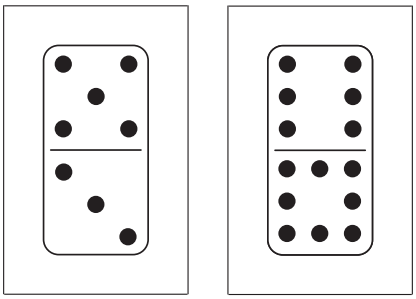
Activity 6 Multiplying Decimals, More/Less (cont.)



Maya *You can make a quick estimate of the product. 5 × 8 would be 40, and 3 × 6 would be 18.*

Cooper *Yeah, if you want less, you better make the decimal 3.5 and 6.8.*

Jude *6.8 is almost 7, so I think the product is going to be more than 21.*

Teacher *Ok, so I figured 3 × 6.8 = 20.40 and then .5 × 6.8 = 3.4. I added 20.40 + 3.4 and I have a total of 23.80. Let's see what the students get!*

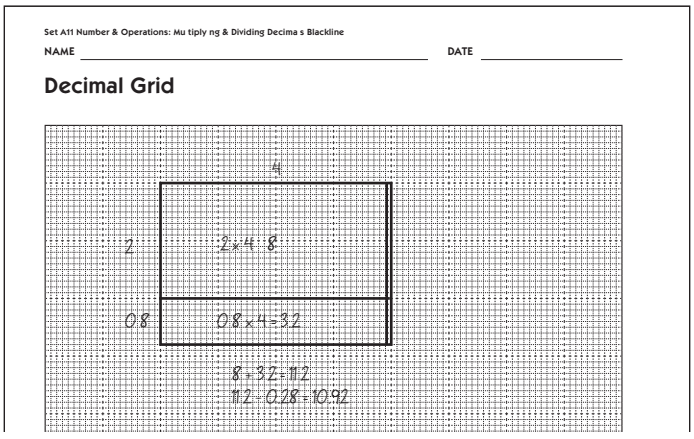
2. Invite a student to draw two domino cards and show them to the rest of the class. Give students a moment to configure the best decimal combinations depending on the more/less die. Have students estimate the product, pair share and then invite a few students to share their thinking.

Parker *8 and 2, 3 and 9… if we want the least, we better multiply 2.8 × 3.9.*

3. Then, have students compute the total at their desks and share their strategies. If necessary, sketch the problem with student input onto decimal grid paper, or record the steps numerically.

Tarin *I have an idea… 3.9 is close to 4, so that's like 2.8 × 4 and then you subtract one tenth or .28 to get the final product.*

Mason *Wow, we are really winning. You have twice as much as we do!*


Set A11 Number & Operations: Mu tiply ng & Dividing Decima s Blackline

NAME _____ DATE _____

Decimal Grid

4

2 2×4=8

0.8 0.8×4=3.2

8+3.2=11.2

11.2-0.28=10.92

4. Record your product and your partners. Which product is more/less?

5. Continue the game until three rounds are played. Compute the total products from all three rounds. The player with the least wins this round, but if the die rolled for more, the player with the greatest decimal product would win.

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Activity 6 Multiplying Decimals, More/Less (cont.)

Set A9 Number & Operations: Multiplying Fract ons Blacki ne Optional Run cop es as needed

Journal Page Grid

Player 1	Player 2
3.5 x 6.8 = ? 3 x 6.8 = 20.40 0.5 x 6.8 = 3.4 20.40 + 3.4 = 23.80	2.8 x 3.9 = ? 2.8 x 4 = 11.20 11.20 - 0.28 = 10.92
4 7 x 2.6 = ? 4 x 2.6 = 10 40 0.7 x 2.6 = 1.82 10.40 + 1.82 = 12.22	4.5 x 6.9 = ? 4 x 6 9 = 27 60 0.5 x 6.9 = 3.45 3.45 + 27.60 = 31.05
2 4 x 5.9 = ? 2 4 x 6 = 14.40 14.40 .24 = 14.6	3.7 x 3.4 = ? 3 x 3.4 = 10.2 0.7 x 3.4 = 2.38 10.2 + 2.38 = 12 58
23.80 12 22 + 14.16 50.18 Total	10 92 31.05 + 12.58 54.55 Total

More or Less

Game 2: Partners

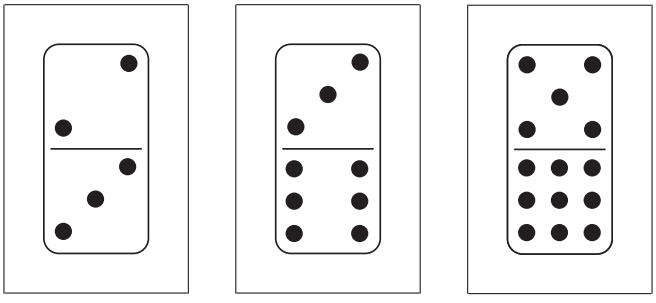
6. Pass out the Domino Blackline from Supplement Set A9 Activity 6, or pass out a new set for students to cut out and use for this game.

7. Have students roll the more/less die, and play 3 rounds with their partner. Remind students to estimate the product before they compute the total. Will the total be more or less than their estimate? Why?

8. When three turns have been played out, have players compute their totals and the player with the greatest or lesser total wins the game.

Game 3: More Challenge

9. Introduce a variation of the game. Tell students that this new game is played much the same way, but this time one domino will be used to create a whole number while the second domino is used to create the decimal. The third domino will become the multiplier. The four-digit number will be multiplied by a two-digit decimal number. For example, 23.36 × 0.59



Activity 6 Multiplying Decimals, More/Less (cont.)

10. Roll the die to determine if you are playing for more or less.

11. Estimate the product and then compute the actual answer. Keep track of your work and your partners.

12. Add up the total from three rounds to determine the winner!

Note *You may want to save the domino cards and use them for additional Work Place practice.*

INDEPENDENT WORKSHEET

See Supplement Set A11 Independent Worksheet 6 on page A11.69 for more practice multiplying decimals.

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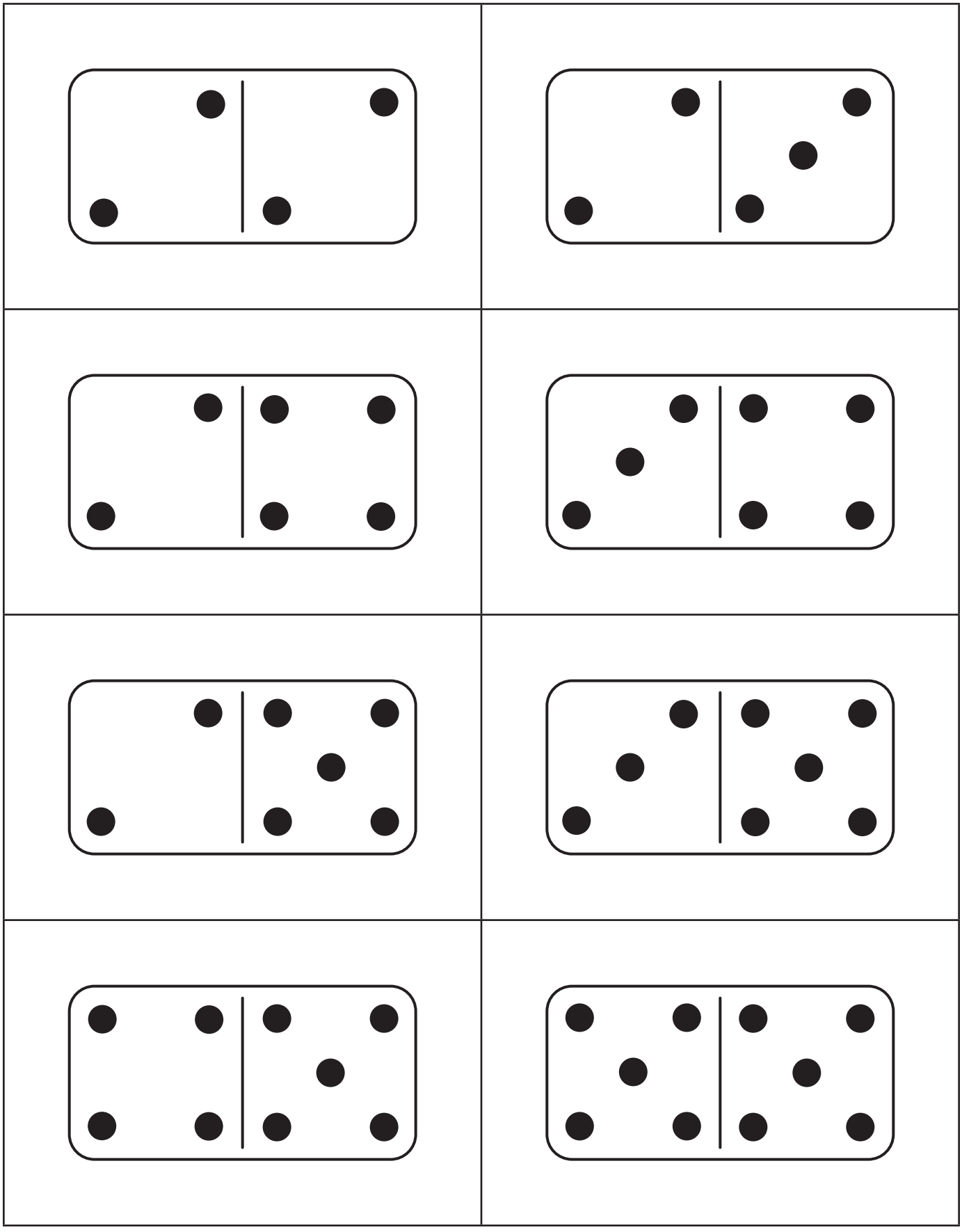
Domino Cards page 1 of 3



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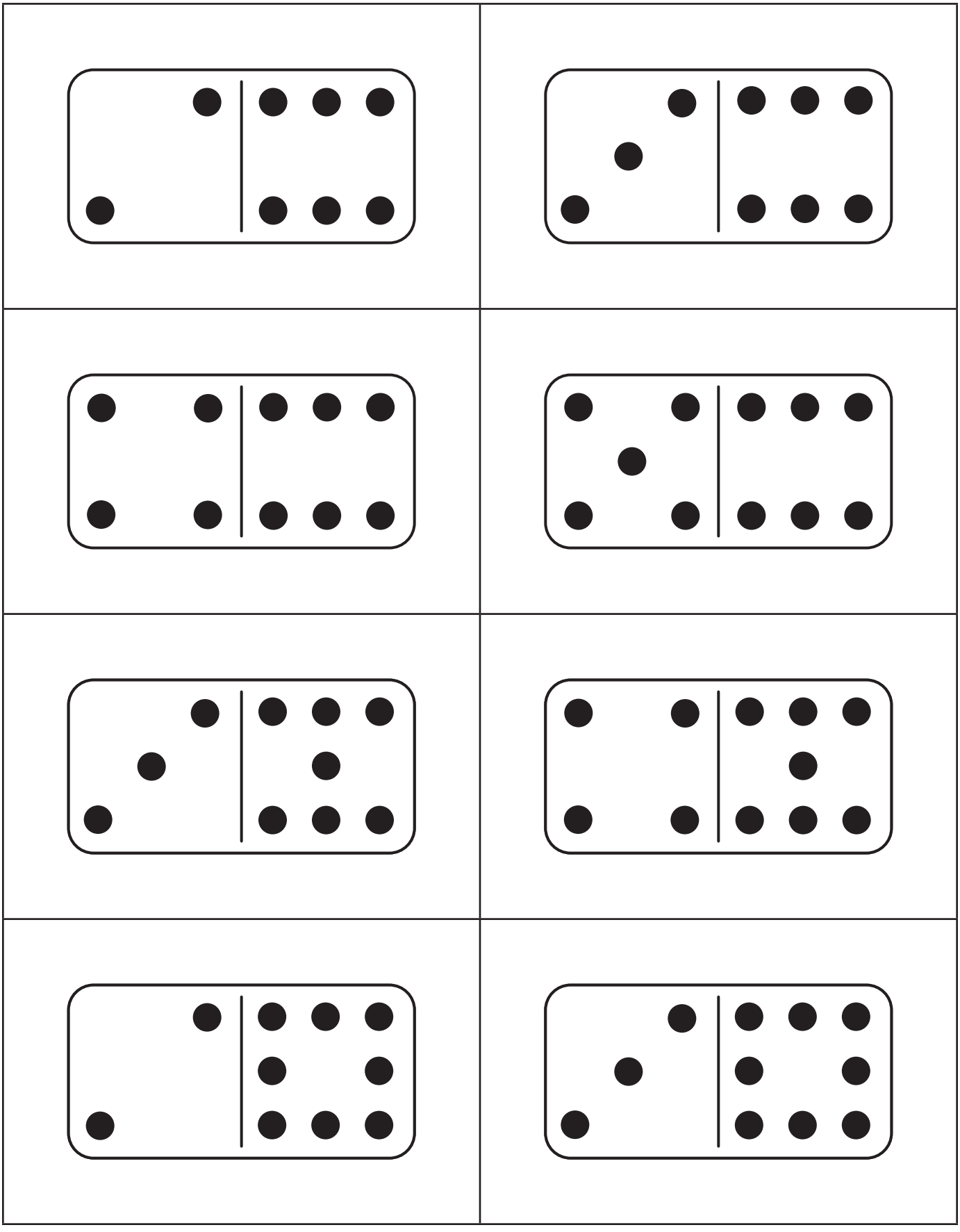
Domino Cards page 2 of 3



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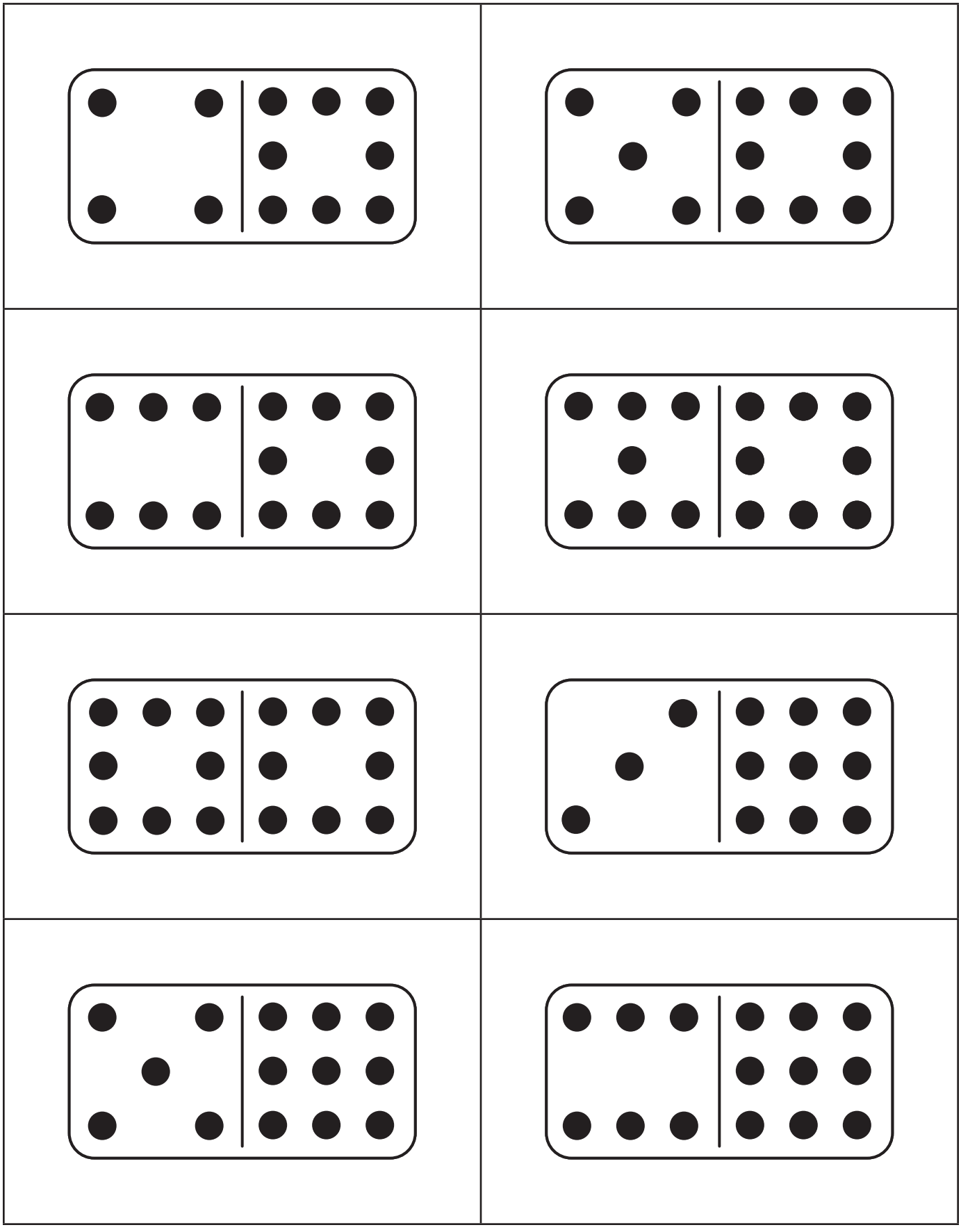
Domino Cards page 3 of 3



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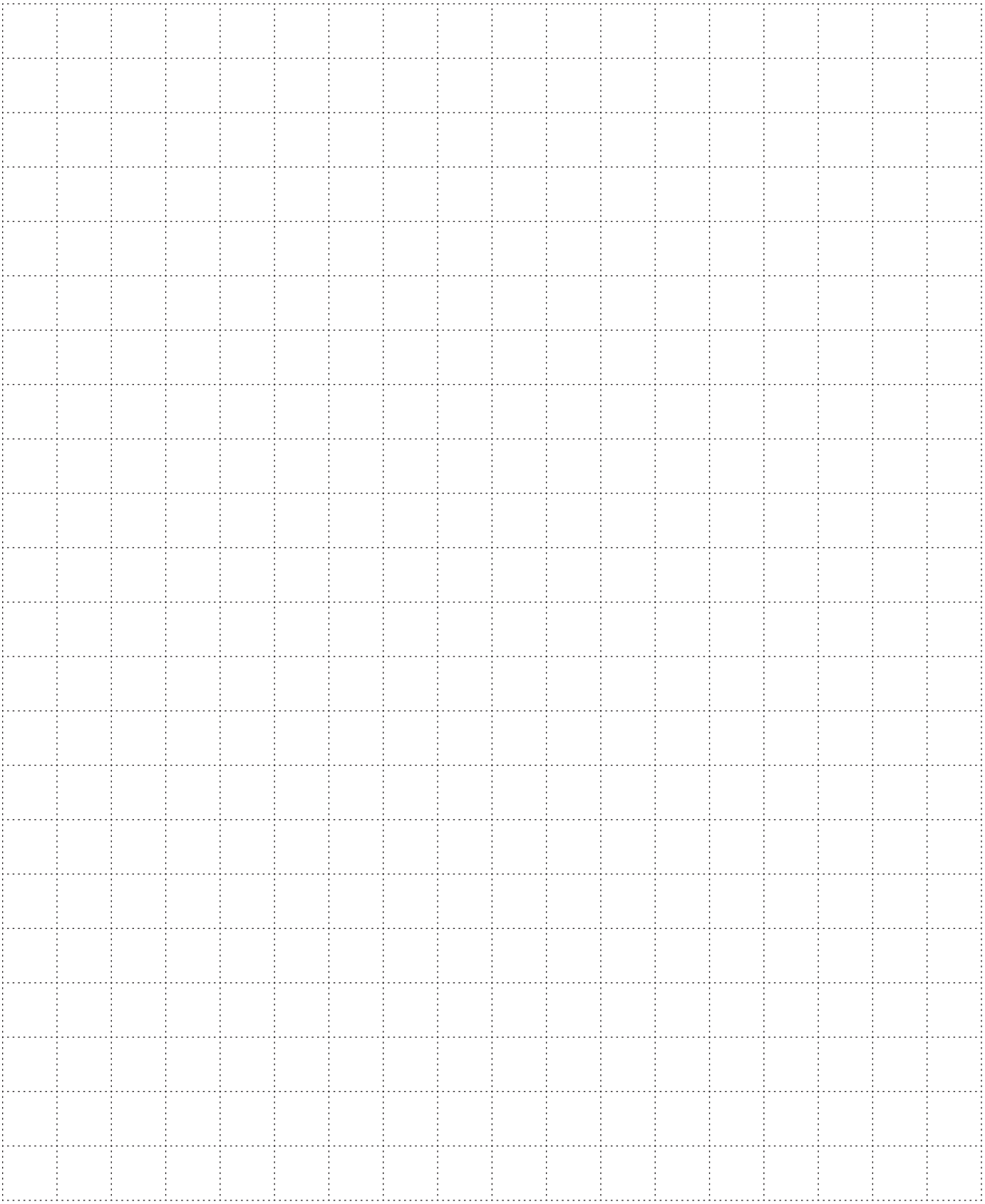
Journal Page Grid



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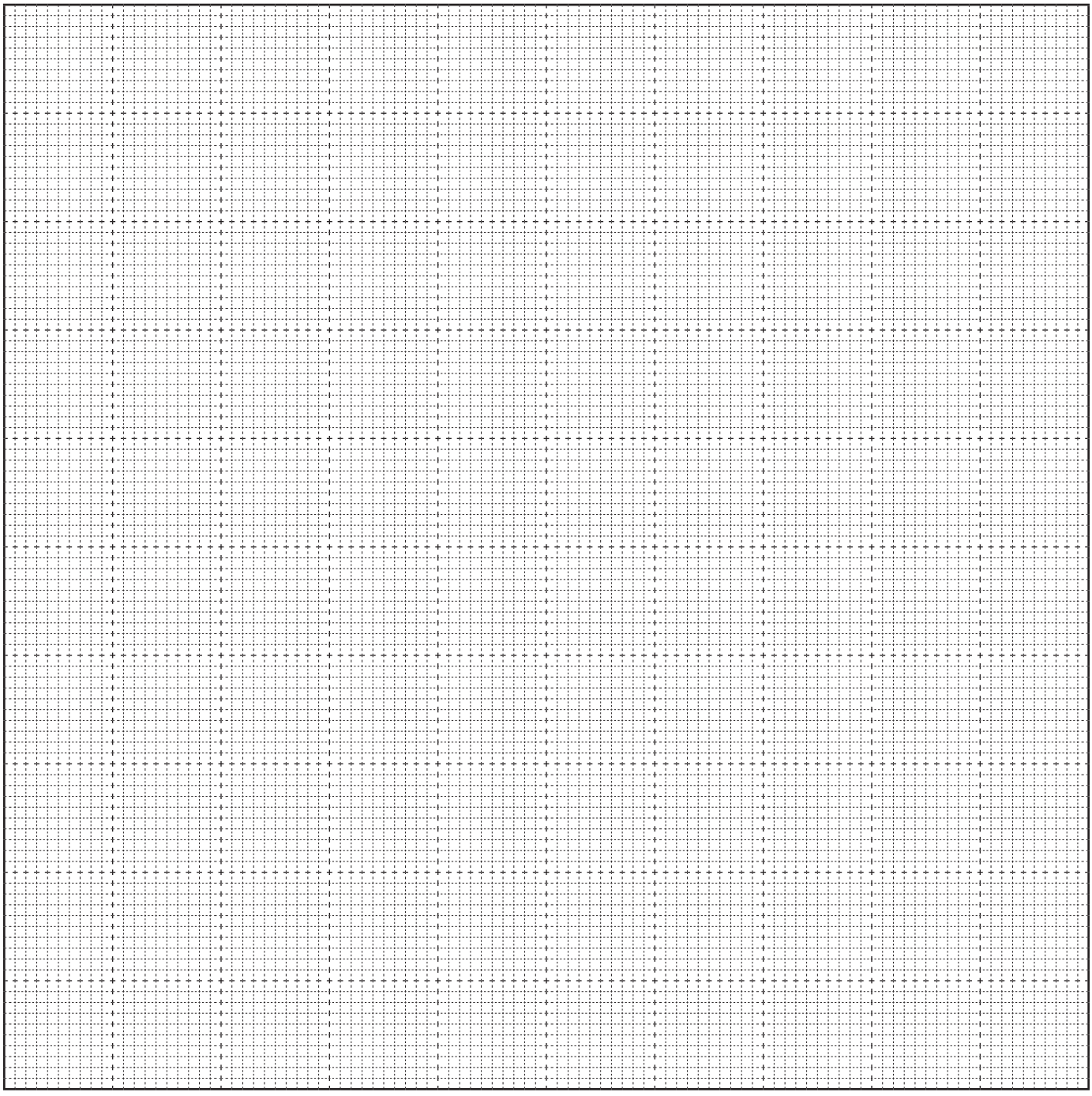
Decimal Grid



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Set A11 ★ Activity 7

ACTIVITY

Dividing Decimals with Money & Menus

Overview

Students use money value pieces and multiplication menus to solve division word problems with decimals and whole numbers. Additional exploration with the partial quotients method helps students make connections to the traditional algorithm for dividing whole numbers. These strategies develop place value understanding and reasoning about quotients with decimals.

Skills & Concepts

★ Estimate the product of multiplying decimal numbers to determine a reasonable answer.

★ Multiply and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between multiplication and division (CCSS5.NBT.7)

★ Relate the strategy to a written method and explain the reasoning used. (CCSS 5.NBT.7)

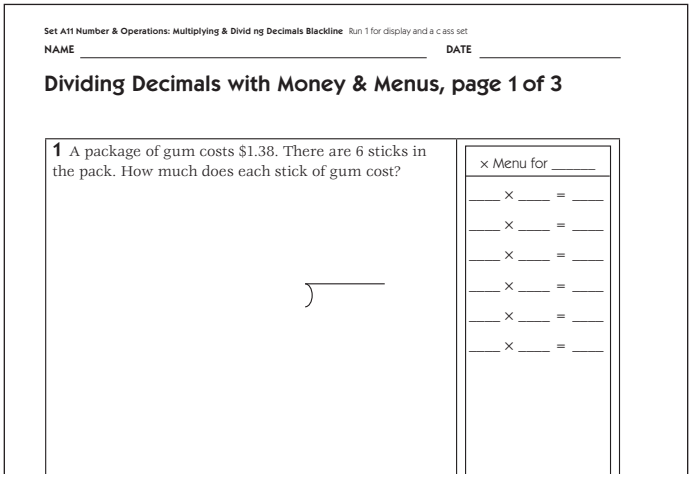
You'll Need

★ Dividing Decimals with Money & Menus (pages A11.49– A11.51, (Run 1 copy for display and a class set)

★ Money Value Pieces, half-class set

Instructions for Menus for Decimals

1. Display Dividing Decimals with Money and Menus and ask students to silently read the first problem and consider a reasonable estimate. Invite students to pair share, and then invite a few students to share their thinking with the class.



Set A11 Number & Operations: Multiplying & Divid ng Decimals Blackline Run 1 for display and a c ass set

NAME _____ DATE _____

Dividing Decimals with Money & Menus, page 1 of 3

1 A package of gum costs $1.38. There are 6 sticks in the pack. How much does each stick of gum cost?

)

× Menu for _____

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

Students *I know that 20 cents times 6 would be $1.20, and that's close. And 25 cents would be too much because 25¢ × 6 is $1.50, so it's more like 22 or 23 cents.*

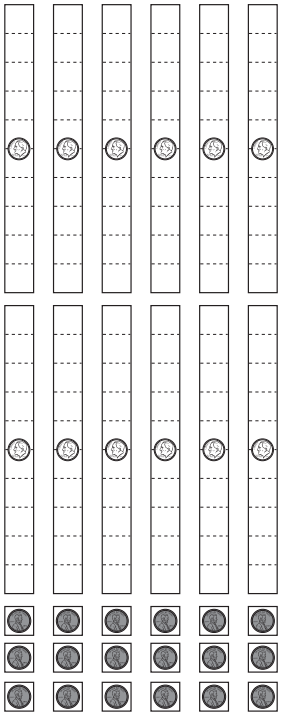
Activity 7 Dividing Decimals with Money & Menus (cont.)

2. Ask students to consider a menu of quotients that might help them solve for this division problem. At the display fill in the menu on the Dividing Decimal with Money and Menus master with the combinations that students suggest. Be sure the menu includes the multiplication facts below.

- $6 \times .10 = 0.60$
- $6 \times .20 = 1.20$
- $6 \times .01 = 0.06$
- $6 \times .05 = 0.30$

Then, give students a moment to re-think their estimates while you pass out money value pieces. Have students work out the problem with the money value pieces, and then invite students to share a few efficient strategies. During the discussion, continue to emphasize decimal place value in the context of money.

> ***Jackson*** *Since we said that 6 × 0.20 = $1.20, I started by setting out ten of the 10¢ pieces in groups of two. Then I needed 18¢ more, and 18 divided by 6 is 3¢, so I gave each of the six groups 3¢ each. Each piece cost $0.23.*



> ***Teacher*** *Did anyone think of it a different way?*
>
> ***Piper*** *I did. I tried to make an array like we did when we did division with the base ten pieces. First I set out six 10¢ strips, and that was 60¢. Then I set out six more, and that was $1.20. I didn't have enough 10¢ strips to do it again, so I used the 18 pennies, which gave each of the 6 rows 3¢ more.*

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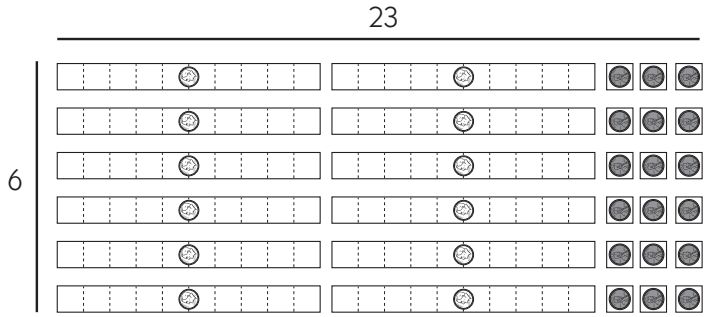
Activity 7 Dividing Decimals with Money & Menus (cont.)



3. Present Problem 2 and fill in the menu on the display master with students. Be sure the menu includes these combinations:

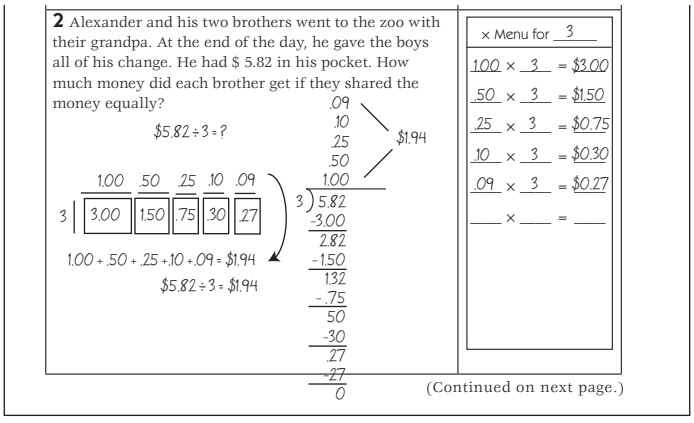
- $3 \times 0.10 = \$0.30$
- $3 \times 0.20 = \$0.60$
- $3 \times 0.50 = \$1.50$
- $3 \times 1.00 = \$3.00$
- $3 \times 2.00 = \$6.00$

4. Ask students to look at the information on the menu and consider what a reasonable estimate would be for the quotient.

> ***Students*** *If it was \$3.00, they would each get \$1, and if it was \$6.00 they'd each get \$2.00. Since it's in between, I think they'll each get around \$1.50.*
> *It's going to be less than \$2.00 but not much less—maybe like \$1.80.*

Give students time to solve the problem. After a few minutes, invite several students to share their thinking with the class. When students agree on the correct answer, record the decimal division equation $\$5.82 \div 3 = \$1.94$ where everyone can see.

> ***Ajay*** *I knew each brother would get \$1.00, and that left \$2.82 I gave each brother 50¢, and then there was still \$1.32, so I gave them each a quarter. Then I had \$0.57, so I gave them each another 10¢ and that left 27¢. 3 × 9 is 27, so altogether each brother got \$1.94.*



Activity 7 Dividing Decimals with Money & Menus (cont.)

Student *I thought of it a different way. I knew that $5.82 was really close to $6.00, so I thought about the difference between them, which is $0.18. I knew if there was $6.00, each brother would get $2.00. I divided the 18¢ by 3 and took away 6¢ from $2.00, so each brother got $1.94.*

5. Continue with Problem 3. Create a menu together and have students estimate before they solve for the quotient. Invite students to help you identify menu combinations that would be helpful for this problem, and be sure to include 6 × $1.00 and 6 × .50. Record $9.12 ÷ 6 = ____ where everyone can see.

Note *At this point, modeling with the money value pieces may not as efficient as sketching an array model and using the menus to determine the partial quotients.*

Students *I thought about this problem like $1 × 6, so a bit more than a dollar. I know that 12¢ ÷ 6 = 2¢. Maybe $1.02.*

6. Before sending students out to work independently, with a partner or in a small group with you, remind students to estimate a reasonable solution, make a menu, and then choose a division strategy that makes sense to them. It might be using the money value pieces, a quick sketch, partial quotients or the traditional algorithm. Have the students use one method to solve for the word problem and a second method to double-check their thinking.

INDEPENDENT WORKSHEET

Use Independent Worksheet 6 on pages A11.71 and A11.72 anytime after Activity 7 for more practice estimating and dividing whole numbers and decimals.

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NAME _____ **DATE** _____

Dividing Decimals with Money & Menus, page 1 of 3

1 A package of gum costs $1.38. There are 6 sticks in the pack. How much does each stick of gum cost?

)_____

× Menu for _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

2 Alexander and his two brothers went to the zoo with their grandpa. At the end of the day, he gave the boys all of his change. He had $ 5.82 in his pocket. How much money did each brother get if they shared the money equally?

)_____

× Menu for _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

(Continued on next page.)

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NAME _____ **DATE** _____

Dividing Decimals with Money & Menus, page 2 of 3

3 Kait spent $9.12 on 6 granola bars. How much did she pay for each one?

)_____

× Menu for _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

4 The cash registered recorded $3.44 for 4 packages of markers. Kale was going to pay for one of the packages. How much does he owe?

)_____

× Menu for _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

(Continued on next page.)

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NAME _____ **DATE** _____

Dividing Decimals with Money & Menus, page 3 of 3

5 A group of 12 girls went to see a new movie on its opening night. Altogether their entrance fees were $88.20. How much did each girl pay?

)_____

× Menu for _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

6 Eight families decided to chip in to buy their team's practice soccer balls. The bill was $103.92, which was half the regular price. How much should each family pay, if everyone pays a fair share?

)_____

× Menu for _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

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Set A11 ★ Activity 8

ACTIVITY

Using Models & Strategies to Divide with Decimals

Overview

Students use sketches, menus, the partial quotient and traditional algorithm to solve word problems with decimals and whole numbers. They practice recording their thinking in a variety of ways. Estimation, that requires students to consider where the decimal point goes—continues to build place value understanding in this lesson.

Skills & Concepts

★ Estimate the product of multiplying decimal numbers to determine a reasonable answer.

★ Multiply and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between multiplication and division (CCSS 5.NBT.7)

★ Relate the strategy to a written method and explain the reasoning used. (CCSS 5.NBT.7)

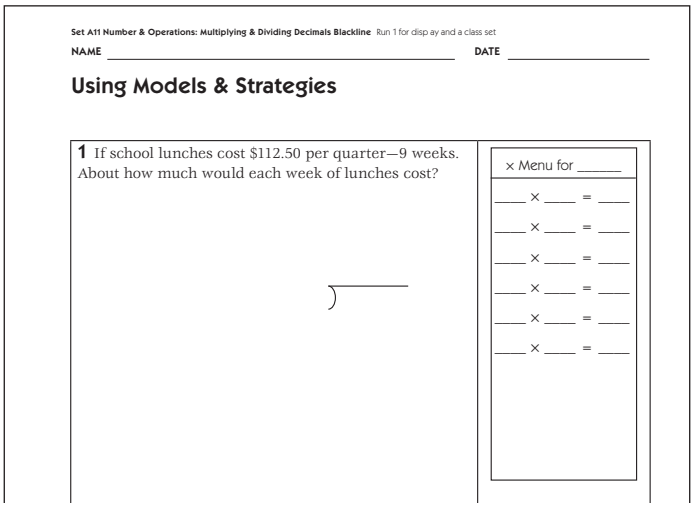
You'll Need

★ Using Models & Strategies (page A11.57, run 1 for display and a class set)

★ Student Math Journals or Journal Page Grid (page A11.58 optional, run 1 copy for display plus additional copies as needed)

Instructions for Using Models and Strategies

1. Display the first word problem and ask students to read the problem, consider a reasonable estimate and record it in their journal. Invite them to pair share and then share their thinking with the class.



Set A11 Number & Operations: Multiplying & Dividing Decimals Blackline Run 1 for disp ay and a class set

NAME _____ DATE _____

Using Models & Strategies

1 If school lunches cost $112.50 per quarter—9 weeks. About how much would each week of lunches cost?

)_____

× Menu for _____

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

___ × ___ = ___

Students *I think 112 divided by 10 would be 11.2 by its only 9 so it has to be a little less than that. I think its going to be more than 11.2… because you are only making 9 groups instead of 10. 9 × 10 is 90, and then you still have $22 left so maybe 2 more, $12?*

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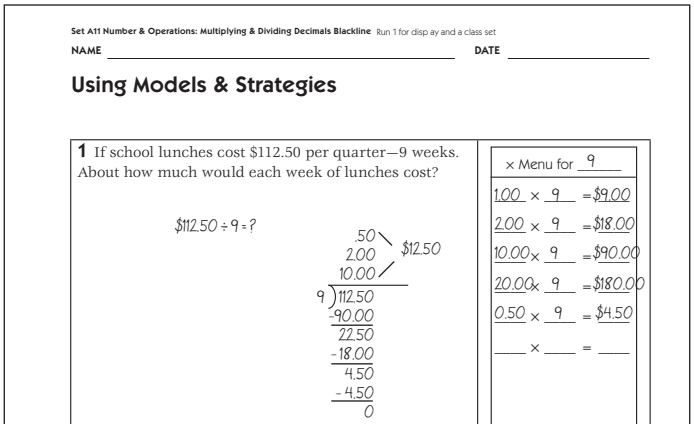
Activity 8 Using Models & Strategies to Divide with Decimals (cont.)

2. Work with your students to create a menu of quotients that will help them solve this division problem. Create a menu on a student journal page for the combinations that students suggest. Be sure the menu includes the multiplication facts below.

- $9 \times 1.00 = 9.00$
- $9 \times 2.00 = 18.00$
- $9 \times 10.00 = 90.00$
- $9 \times 20.00 = 180.00$

Then, give students a moment to re-think their estimates and share a few efficient strategies including sketches, menus and the partial quotients method. Be sure to discuss "where the decimal goes" in student strategies. Would $1.25 make sense? Or $125.00?

> ***Cedric*** *Since we said that 9 × $10.00 = $90.00, I subtracted 90 from 112.50. Then I had $22.50 left so I used the menu to help me with 9 × $2.00. I subtracted $18. From $22.50 and that only left 4.50. That's half of $9.00, so I figured .50¢ would work. Each week cost $12.50.*



Set A11 Number & Operations: Multiplying & Dividing Decimals Blackline Run 1 for disp ay and a class set

NAME _____ DATE _____

Using Models & Strategies

1 If school lunches cost $112.50 per quarter—9 weeks. About how much would each week of lunches cost?

$112.50 ÷ 9 = ?

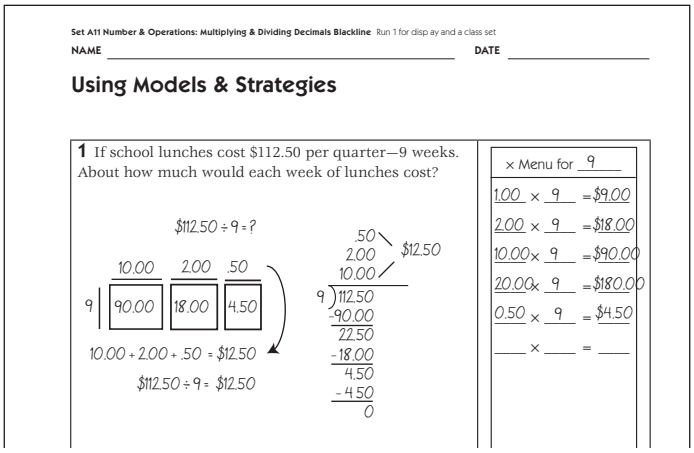
.50
2.00
10.00) $12.50
9) 112.50
-90.00
22.50
-18.00
4.50
-4.50
0

× Menu for 9

1.00 × 9 = $9.00
2.00 × 9 = $18.00
10.00 × 9 = $90.00
20.00 × 9 = $180.00
0.50 × 9 = $4.50
___ × ___ = ___

> ***Teacher*** *Did anyone think of it a different way?*

> ***Ana Lucia*** *You could make an array, with 10, then 2 more and finally half of a dollar-to show 50¢.*



Set A11 Number & Operations: Multiplying & Dividing Decimals Blackline Run 1 for disp ay and a class set

NAME _____ DATE _____

Using Models & Strategies

1 If school lunches cost $112.50 per quarter—9 weeks. About how much would each week of lunches cost?

$112.50 ÷ 9 = ?

10.00 2.00 .50
9 | 90.00 | 18.00 | 4.50 |
10.00 + 2.00 + .50 = $12.50
$112.50 ÷ 9 = $12.50

.50
2.00
10.00) $12.50
9) 112.50
-90.00
22.50
-18.00
4.50
-4.50
0

× Menu for 9

1.00 × 9 = $9.00
2.00 × 9 = $18.00
10.00 × 9 = $90.00
20.00 × 9 = $180.00
0.50 × 9 = $4.50
___ × ___ = ___

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Activity 8 Using Models & Strategies to Divide with Decimals (cont.)

3. Present Problem 2 and create a menu with students on a journal page. Be sure the menu includes these combinations:

- 8 × 0.10 = $0.80
- 8 × 1.00 = $8.00
- 8 × 2.00 = $16.00
- 8 × 10.00 = $80.00
- 8 × 0.50 = $4.00

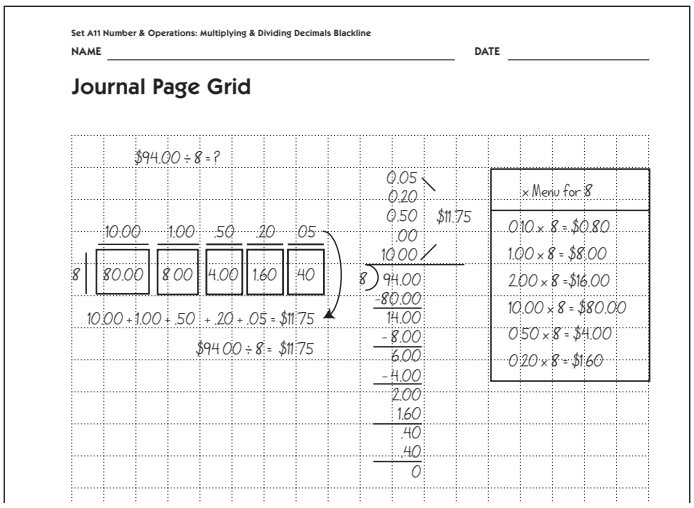
> **2** A fifth grader earned $94.00 gardening this month for a neighbor. If she worked 8 hours this month, then how much did she earn per hour?

4. Ask students to look at the information on the menu and consider what a reasonable estimate would be for the quotient.

> ***Students*** *Well, $10 an hour would be $80. That's close enough.*
> *Well, I thought that too, but then you still have almost $15 left. That's almost enough for another $2. I say close to $12 an hour.*

Give students time to solve the problem. After a few minutes, invite several students to share their thinking with the class. When students agree on the correct answer, record the decimal division equation $94.00 ÷ 8 = $11.75.

- Would an answer of $117 per hour make sense? Would $1.17 make sense?
- Give students time to think, pair and share their understanding.



5. Continue with Problem 3. Invite students to create a menu and share what particular multiplication combinations are helpful to estimate a reasonable quotient. This particular situation, like many real world scenarios, does not require an exact answer. If none of your students bring that point up, you may want to. In this real world situation, an estimate, rather than an exact answer, is more appropriate. This problem will include a remainder.

> **3** Dan can travel about 526 miles on a full tank of gas. His car has a tank that holds about 14.60 gallons of gas. About how far can Dan travel on one gallon of gas?

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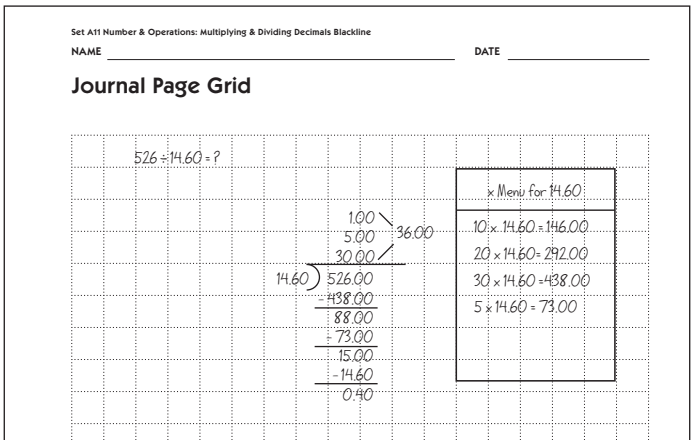
Activity 7 Using Models & Strategies to Divide with Decimals (cont.)

Students *My parents get about 30 miles to the gallon, so I think a menu for 30 would be good-that's my estimate too.*
Well I thought about it like 15 gallons × 40 miles would be 600 miles, and that's too high.
How come this problem keeps saying "about"?
Well, it's not going to be an exact number when you are driving. It depends on the traffic and how fast you are going, I think


Set A11 Number & Operations: Multiplying & Dividing Decimals Blackline
NAME _____ DATE _____
Journal Page Grid
526 ÷ 14.60 = ?
1.00
5.00
30.00
36.00
14.60) 526.00
-438.00
88.00
- 73.00
15.00
- 14.60
0.40
x Menu for 14.60
10 x 14.60 = 146.00
20 x 14.60 = 292.00
30 x 14.60 = 438.00
5 x 14.60 = 73.00

6. Before sending students out to work independently, with a partner or in a small group with you, remind students to estimate a reasonable solution, make a menu, and then choose a division strategy that makes sense to them. They may use a quick sketch, partial quotients or the traditional algorithm. Have the students use one method to solve for the word problem and a second method to double-check their thinking. While students are working, monitor their thinking and invite them to convince you of the quotient, relating to the placement of the decimal.

INDEPENDENT WORKSHEET

Use Independent Worksheet 7 on pages A11.73 and A11.74 for more practice estimating and dividing whole numbers and decimals.

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NAME _____ **DATE** _____

Using Models & Strategies

1 If school lunches cost $112.50 per quarter—9 weeks. About how much would each week of lunches cost?

)_____

× Menu for _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

_____ × _____ = _____

2 A fifth grader earned $94.00 gardening this month for a neighbor. If she worked 8 hours this month, then how much did she earn per hour?

3 Dan can travel about 511 miles on a full tank of gas. His car has a tank that holds about 14.60 gallons of gas. About how far can Dan travel on one gallon of gas?

4 Marcy joined the school track team and ran a total of 231.80 miles in practice over 61 days. About how many miles did she average per day?

5 A store owner had 7.11 lbs. of nuts left in the bin. If he put the nuts into 9 jars, how much will each jar of nuts weigh?

6 There are 2.54 centimeters in one inch. How many inches are in 38.10 centimeters?

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NAME _____ **DATE** _____

Journal Page Grid

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NAME _____ **DATE** _____

Set A11 ★ Independent Worksheet 1

INDEPENDENT WORKSHEET

Thinking about Tenths, Hundredths & Thousandths

1 Write two fractions that are equal to each decimal number.

0.1 = _____ and _____ 0.01 = _____ and _____

0.001 = _____ and _____ 0.05 = _____ and _____

2 Complete the chart below.

Number	0.1 less	0.1 greater	0.01 less	0.01 greater	0.001 less	0.001 greater
1.2	1.1	1.3	1.19	1.21	1.199	1.201
8.73						
4.06						
6.9						
2.896						
6						

3 Round each number to the place shown to complete the chart below.

Number	Nearest tenth (0.1) Look at the 0.01 place.	Nearest hundredth (0.01) Look at the 0.001 place.	Nearest thousandth (0.001) Look at the 0.0001 place.
0.1629	0.2	0.16	0.163
0.9608			
0.0274			
6.0085			

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NAME _____ **DATE** _____

Set A11 ★ Independent Worksheet 2

INDEPENDENT WORKSHEET

Very Large & Very Small Numbers in Context

1 A micrometer is one-millionth of a meter (0.000001 m): ten thousand times shorter than a centimeter (0.01 m). How many micrometers long is one edge of a centimeter cube?

2 The football team for the University of Tennessee, the Tennessee Volunteers, plays its home games in the Neyland Stadium in Knoxville, Tennessee. The stadium holds about 100,000 people. (Do an image search on the internet to see what this many people looks like.)

a How many stadiums would it take to hold one million people (a bit less than the number of people living in Dallas, Texas)?

b According to estimates, there are over 300 million people living in the United States. How many Neyland Stadiums would it take to hold 300 million people?

3 The table below shows the estimated population of different countries as of 2012. Round each number to complete the table.

Country	Population	Nearest 1,000,000	Nearest 100,000	Nearest 10,000
Philippines	103,775,000	104,000,000	103,800,000	103,780,000
Iran	78,868,710			
France	65,630,690			
South Korea	48,860,500			
Argentina	42,192,490			
Sudan	34,206,710			

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Set A11 ★ Independent Worksheet 3

INDEPENDENT WORKSHEET

Multiplying & Dividing by Powers of Ten

1 Solve the multiplication problems below.

34 × 0.01 = _____ 34 × 0.10 = _____ 34 × 1 = _____

34 × 10 = _____ 34 × 100 = _____ 34 × 1,000 = _____

2 Solve the division problems below.

34 ÷ 0.01 = _____ 34 ÷ 0.10 = _____ 34 ÷ 1 = _____

34 ÷ 10 = _____ 34 ÷ 100 = _____ 34 ÷ 1,000 = _____

3 What patterns do you notice in the equations you completed above?

4 Solve the multiplication and division problems below.

62 ÷ 100 = _____ 3.4 × 1000 = _____ 7.89 ÷ 0.10 = _____

0.43 × 100 = _____ 0.08 × 0.01 = _____ 123.05 ÷ 100 = _____

5 Ramon bought erasers shaped like animals to give away at Family Night at his school. Each eraser costs $0.10. If he spent $25.60, how many erasers did he buy?

a Write a division equation to represent this situation.

b Solve the problem using a strategy that makes sense to you. Show all your work.

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Set A11 ★ Independent Worksheet 4

INDEPENDENT WORKSHEET

Using Landmark Fractions & Percents to Multiply by Decimals

1 At morning assembly, the principal said that the number of students at the school would be increasing by 10% next year.

a If there are 260 students at the school this year, how many more students are coming to the school next year?

b How many students will be at the school altogether next year?

c If the number of students increased by 30% over the next three years, how many more students would be coming to the school?

d If the number of students increased by 25% over the next three years, how many more students would be coming to the school?

2 Look at your work above. Use it to complete the equations below.

260 × 0.10 = _____ 260 × 0.30 = _____ 260 × 0.25 = _____

3 Complete the following equations.

430 × 0.10 = _____ 430 × 0.20 = _____ 430 × 0.50 = _____

84 × 0.01 = _____ 84 × 0.02 = _____ 84 × 0.06 = _____

72 × 0.50 = _____ 72 × 0.25 = _____ 72 × 0.75 = _____

0.12 × 0.50 = _____ 0.12 × 0.25 = _____ 0.12 × 0.10 = _____

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Set A11 ★ Independent Worksheet 5

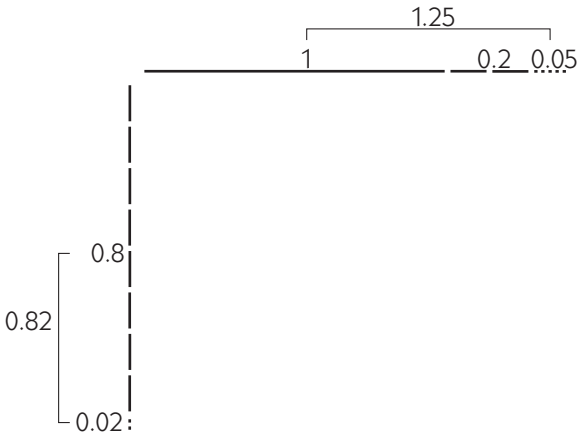
INDEPENDENT WORKSHEET

Multiplying Two Decimal Numbers

1 The memory card for Steve's camera measures 0.82 inches by 1.25 inches

a What do you estimate the total area of the memory card is?

b Find the exact area of the memory card. Show all your work. Fill in the array below if it helps you.



c What is the place value of the smallest unit of area in the array above?

2 Fill in an estimate and the exact answer for the problems below.

a Estimate _____ 0.40 × 0.56 Exact Answer _____	**b** Estimate _____ 2.06 × 1.42 Exact Answer _____	**c** Estimate _____ 3.7 × 0.28 Exact Answer _____

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Set A11 ★ Independent Worksheet 6

INDEPENDENT WORKSHEET

Comparing & Multiplying Fractions & Decimals

1 Use one of the following symbols to make each expression below true.

> (greater than) < (less than) = (equal to)

ex $\frac{2}{4}$ $\boxed{<}$ $\frac{3}{5}$	**a** $\frac{11}{16}$ $\square$ $\frac{3}{4}$	**b** $\frac{3}{4}$ $\square$ $\frac{3}{5}$
c $\frac{6}{14}$ $\square$ $\frac{1}{2}$	**d** $\frac{1}{2}$ $\square$ $\frac{8}{31}$	**e** $\frac{5}{7}$ $\square$ $\frac{4}{9}$
f $\frac{2}{3}$ $\square$ $\frac{6}{9}$	**g** 0.34 $\square$ $\frac{1}{4}$	**h** 0.58 $\square$ $\frac{4}{5}$

2 Convert the decimal to a fraction and multiply. Write the product in the simplest form.

a 0.25 × 13 = _____	**b** 57 × 0.50 = _____	**c** 23 × 0.25 = _____
d 0.25 × 27 = _____	**e** 56 × 0.25 = _____	**f** 37 × 0.75 = _____
g 3 × 0.25 = _____	**h** 0.25 × 7 = _____	**i** 8 × 0.50 = _____

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Set A11 ★ Independent Worksheet 7

INDEPENDENT WORKSHEET

Olympic Swimmers

For each problem, first estimate the answer and then solve the problem. Show your thinking using words, numbers, and/or labeled sketches.

1 In the 2012 Olympics, U.S. athlete Nathan Adrian finished the 100-meter free-style swim in 47.52 seconds. If Adrian swam in a regular 25-meter pool, what would his time have been per lap?

Estimate _____ Answer _____

2 Dana Vollmer set a world record in the 100-meter butterfly finals in London. Her time was 55.98 seconds. If she swam in a 25-meter pool, what would Dana's time be per lap?

Estimate _____ Answer _____

3 Missy Franklin competed in seven Olympic swimming events and posted five gold medals in London. Her time in the 100-meter backstroke was 58.33 seconds. If Missy were swimming in a 25-meter pool, what would her time be per lap?

Estimate _____ Answer _____

(Continued on next page.)

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Independent Worksheet 7 Olympic Swimmers (cont.)

4 Michael Phelps has 14 gold and 16 overall Olympic medals! In London, he won a gold medal for the 100-meter butterfly with a time of 51.21 seconds. If Michael were swimming in a 25-meter pool, what would his time be per lap?

Estimate _____ Answer _____

CHALLENGE

5 The men's 4 × 100 meter medley was won with a time of 3:29.35.

a If each of the four members of the team posted the same time, what would their individual times be?

Estimate _____ Answer _____

b If the men's swim team coach wanted to be sure the team was on track to win the gold medal, what times would each member have needed to post per 50 meter lap?

Estimate _____ Answer _____

Note *Did you know that Olympic length pools are actually 50 meters long?*

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Set A11 ★ Independent Worksheet 8

INDEPENDENT WORKSHEET

Olympic Track Star

Solve each problem. Show your thinking using words, numbers, and/or labeled sketches.

1 Usain Bolt won 3 gold medals in the Track and Field events in the 2012 Olympics in London. His times are posted below.

Race	Time in Seconds
Men's 100 meter	9.63
Men's 200 meter	19.32
Men's 4 x 100 meter relay	36.84

a Bolt ran the 200 meters in 19.32 seconds. If he ran 100 meters at that pace, what would his 100 meter time be?

b For 100 meters, what's the difference between Usain's 100 meter pace and his 200 meter pace?

c Four Jamaican runners ran the men's 4 × 100 meter relay with a time of 36.84. If each ran the same speed, what would one runner's time have been?

d If the relay runners could run as fast as Bolt did in his individual 100 meter race, would their relay time have been faster or slower? By how much?

(Continued on next page.)

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Independent Worksheet 8 Olympic Track Star (cont.)

2 Divide each number. Show your work.

9.6 ÷ 10 =	9.6 ÷ 100 =
16.08 ÷ 10 =	16.08 ÷ 20 =
132.22 ÷ 10 =	132.22 ÷ 100 =
78.2 ÷ 10 =	78.2 ÷ 20 =

3 Compare what happens to the quotient when you divide by 10 and by 100.

4 Compare what happens to the quotient when you divide by 10 and by 20.

5 Kary and Val were solving the following problem: $12.55 ÷ 5. Kary wrote $25.10 as her answer. Val wrote $2.51. Who is right? How do you know?

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