Lesson Overview

LESSON 5

Divide Multi-Digit Numbers

Lesson Objectives

Content Objectives

- Divide three- and four-digit dividends by two-digit divisors.
- Use the relationship between multiplication and division to estimate quotients.
- Divide multi-digit whole numbers using area models and strategies such as place-value understanding, properties of operations, estimating quotients, and finding partial quotients.

Language Objectives

- Explain the inverse relationship between multiplication and division.
- Define *partial quotients* and use the term in a discussion with a partner.
- Draw an area model to represent a multi-digit division problem and discuss the model's relationship to the partial quotients and quotient.
- Construct arguments using objects, diagrams, and models.

Prerequisite Skills

- Understand place value.
- Recall basic multiplication and division facts.
- Divide four-digit dividends by one-digit divisors.
- Multiply multi-digit whole numbers.
- Write related multiplication and division equations.

Standards for Mathematical Practice (SMP)

SMPs 1, 2, 3, 4, 5, and 6 are integrated in every lesson through the *Try-Discuss-Connect* routine.*

In addition, this lesson particularly emphasizes the following SMPs:

1 Make sense of problems and persevere in solving them.

5 Use appropriate tools strategically.

7 Look for and make use of structure.

8 Look for and express regularity in repeated reasoning.

*See page 1i to see how every lesson includes these SMPs.

Lesson Vocabulary

- **inverse operations** operations that undo each other. For example, addition and subtraction are inverse operations, and multiplication and division are inverse operations.

Review the following key terms.

- **dividend** the number that is divided by another number.
- **division** an operation used to separate a number of items into equal-sized groups.
- **divisor** the number by which another number is divided.
- **partial quotients** the quotients you get in each step of the partial-quotient strategy. You use place value to find partial quotients. For example, the partial quotients for 2,124 ÷ 4 could be 2,000 ÷ 4 or 500, 100 ÷ 4 or 25, and 24 ÷ 4 or 6.
- **quotient** the result of division.

Learning Progression

In Grade 4 students divided three- and four-digit dividends by one-digit divisors. They used area models, applied the idea of subtracting partial products, and learned how to find partial quotients to divide. Students solved division problems with remainders and interpreted the remainder in the context of a problem.

In this lesson students divide dividends of up to four digits by two-digit divisors. They see division problems as missing factor problems in which the quotient is the unknown factor. They use estimation as a strategy to begin finding a quotient when dividing. Students apply place-value understanding to find partial quotients and record the quotient as the sum of the partial quotients.

Later in this grade students will divide decimals using the same strategies that they use with whole-number division.

Lesson Pacing Guide

Whole Class Instruction

SESSION 1 Explore *45–60 min*	**Dividing Multi-Digit Numbers** • Start *5 min* • Discuss It *10 min* • Connect It *15 min* • Close: Exit Ticket *5 min*	**Additional Practice** Lesson pages 79–80
SESSION 2 Develop *45–60 min*	**Estimating Quotients** • Start *5 min* • Try It *10 min* • Discuss It *10 min* • Model Its *5 min* • Connect It *10 min* • Close: Exit Ticket *5 min*	**Additional Practice** Lesson pages 85–86 **Fluency** Estimating Quotients
SESSION 3 Develop *45–60 min*	**Using Estimation and Area Models to Divide** • Start *5 min* • Try It *10 min* • Discuss It *10 min* • Model Its *5 min* • Connect It *10 min* • Close: Exit Ticket *5 min*	**Additional Practice** Lesson pages 91–92 **Fluency** Using Estimation and Area Models to Divide
SESSION 4 Develop *45–60 min*	**Using Area Models and Partial Quotients to Divide** • Start *5 min* • Try It *10 min* • Discuss It *10 min* • Model Its *5 min* • Connect It *10 min* • Close: Exit Ticket *5 min*	**Additional Practice** Lesson pages 97–98 **Fluency** Using Area Models and Partial Quotients to Divide
SESSION 5 Refine *45–60 min*	**Dividing Multi-Digit Numbers** • Start *5 min* • Example & Problems 1–3 *15 min* • Practice & Small Group Differentiation *20 min* • Close: Exit Ticket *5 min*	**Lesson Quiz** or **Digital Comprehension Check**

Lesson Materials

Lesson *(Required)*	*Per student:* base-ten blocks (2 hundreds flats, 30 tens rods, 10 ones units) *Per pair:* 10 hundreds flats, 25 tens rods, 10 ones units
Activities	*Per pair:* base-ten blocks (5 hundreds flats, 20 tens rods, 32 ones units), 78 counters, 17 paper cups *For display:* prepared area model for 192 ÷ 16 = 32 *Activity Sheet:* Base-Ten Grid Paper
Math Toolkit	base-ten blocks, base-ten grid paper, grid paper, index cards
Digital Math Tool	Multiplication Models

Teacher Toolbox

Small Group Differentiation

PREPARE

Ready Prerequisite Lessons

Grade 4
- Lesson 11 Multiply by One-Digit Numbers
- Lesson 14 Divide Three-Digit Numbers
- Lesson 15 Divide Four-Digit Numbers

RETEACH

Tools for Instruction

Grade 4
- Lesson 11 Multiply by One-Digit Numbers
- Lesson 14 Divide Three-Digit by One-Digit Numbers
- Lesson 15 Divide Four-Digit by One-Digit Numbers

Grade 5
- Lesson 5 Divide Multi-Digit Numbers

REINFORCE

Math Center Activities

Grade 5
- Lesson 5 Division with Area Models
- Lesson 5 Solve Area Problems with Division

EXTEND

Enrichment Activity

Grade 5
- Lesson 5 Planning an Event

i-Ready

Independent Learning

PERSONALIZE

i-Ready Lessons*

Grade 5
- Division of Whole Numbers
- Practice: Divide Whole Numbers

*We continually update the Interactive Tutorials. Check the Teacher Toolbox for the most up-to-date offerings for this lesson.

LESSON 5

Connect to Family, Community, and Language Development

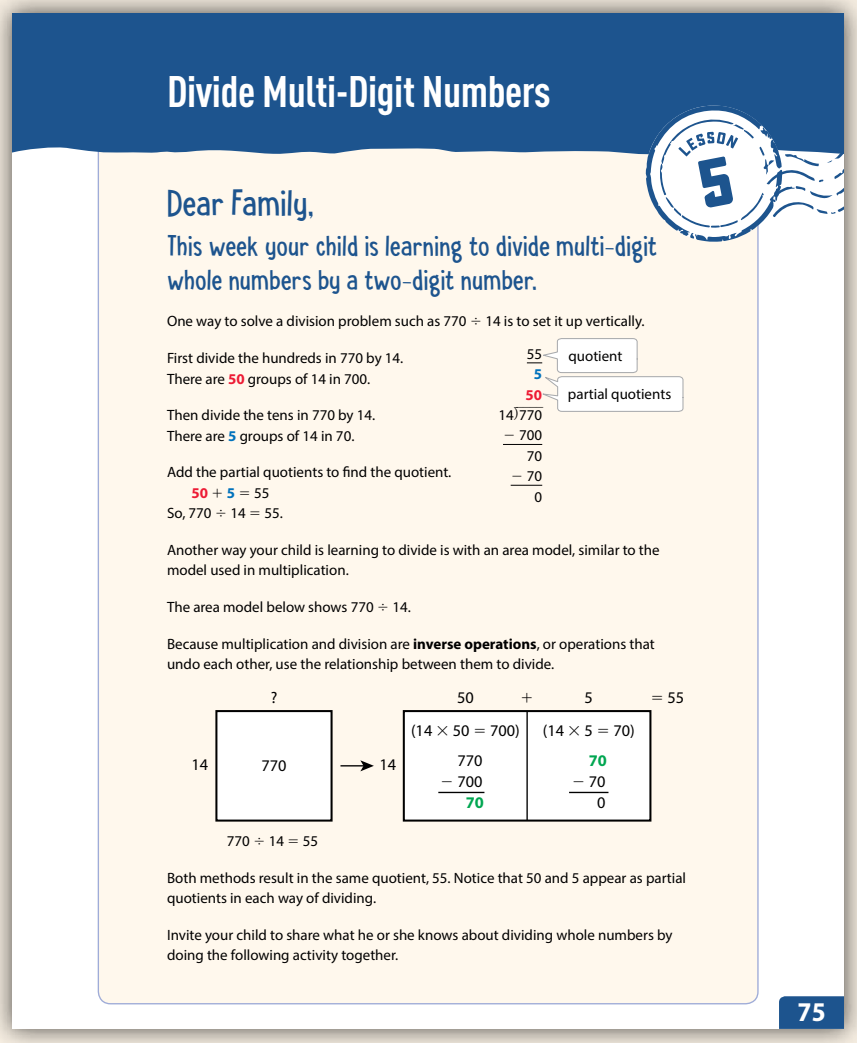
The following activities and instructional supports provide opportunities to foster school, family, and community involvement and partnerships.

Connect to Family

Use the **Family Letter**—which provides background information, math vocabulary, and an activity—to keep families apprised of what their child is learning and to encourage family involvement.

Available in Spanish

Teacher Toolbox



Divide Multi-Digit Numbers

LESSON 5

Dear Family,

This week your child is learning to divide multi-digit whole numbers by a two-digit number.

One way to solve a division problem such as 770 ÷ 14 is to set it up vertically.

First divide the hundreds in 770 by 14.
There are **50** groups of 14 in 700.

Then divide the tens in 770 by 14.
There are **5** groups of 14 in 70.

Add the partial quotients to find the quotient.
50 + **5** = 55
So, 770 ÷ 14 = 55.

55 ← quotient
5
50 ← partial quotients
14)770
− 700
70
− 70
0

Another way your child is learning to divide is with an area model, similar to the model used in multiplication.

The area model below shows 770 ÷ 14.

Because multiplication and division are **inverse operations**, or operations that undo each other, use the relationship between them to divide.

? × 14 = 770 → 50 + 5 = 55

(14 × 50 = 700)	(14 × 5 = 70)
770	70
− 700	− 70
70	0

770 ÷ 14 = 55

Both methods result in the same quotient, 55. Notice that 50 and 5 appear as partial quotients in each way of dividing.

Invite your child to share what he or she knows about dividing whole numbers by doing the following activity together.

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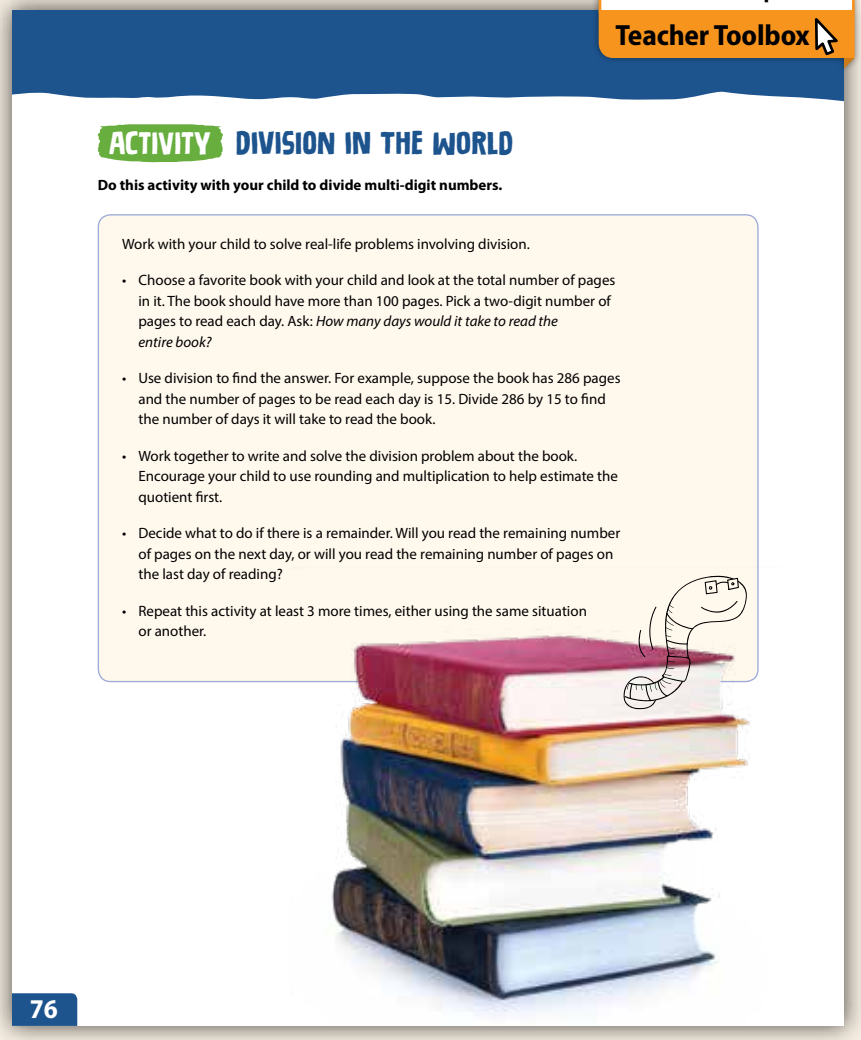

ACTIVITY DIVISION IN THE WORLD

Do this activity with your child to divide multi-digit numbers.

Work with your child to solve real-life problems involving division.

- Choose a favorite book with your child and look at the total number of pages in it. The book should have more than 100 pages. Pick a two-digit number of pages to read each day. Ask: *How many days would it take to read the entire book?*
- Use division to find the answer. For example, suppose the book has 286 pages and the number of pages to be read each day is 15. Divide 286 by 15 to find the number of days it will take to read the book.
- Work together to write and solve the division problem about the book. Encourage your child to use rounding and multiplication to help estimate the quotient first.
- Decide what to do if there is a remainder. Will you read the remaining number of pages on the next day, or will you read the remaining number of pages on the last day of reading?
- Repeat this activity at least 3 more times, either using the same situation or another.

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Goal

The goal of the Family Letter is to share with parents various methods that students will be exploring to learn how to divide multi-digit whole numbers by a two-digit number.

Activity

Students will explore daily activities in which dividing multi-digit whole numbers by a two-digit number is useful. Look at the *Division in the World* activity and adjust it if necessary to connect with your students.

Math Talk at Home

Encourage students to speak with their family members about instances when they need to divide by a two-digit number.

Conversation Starters Below are additional conversation starters students can write in their Family Letter or math journal to engage family members:

- *What are some things that you do at work or in your daily activities that require you to divide by a two-digit number?*
- *When you need to divide by a two-digit number and you don't have a calculator or phone, what is your strategy?*

Connect to Community and Cultural Responsiveness

Use these activities to connect with and leverage the diverse backgrounds and experiences of all students.

Session 1 **Use with *Try It*.**

- Ask students to discuss how the number of students in the school in the ***Try It*** problem is different from their current or previous school. If all students have been in the same school since their primary grades, ask them to think of a different school setting they may be familiar with, such as within their community or in a family member's experience. Ask students to think about why it's important to try to divide the total number of students in a grade so that each class has roughly the same number of students.

Session 2 **Use anytime during the session.**

- Point out that estimating is a skill most people use to quickly get to an answer when exact numbers are not needed. Many people have budgets when shopping for groceries or figuring out how much food will be needed to feed all the students in school. Have students work with a partner to discuss when they have used estimation and how it can be useful.

Sessions 3 and 4 **Use anytime during the sessions.**

- One way to display a division problem is to set it up vertically. Point out to students that people may have different methods of arranging the dividend, divisor, and quotient or partial quotients in a division problem. Ask students to think about why a person might write the partial quotients vertically above the dividend rather than in another position. Have students ask a family member and a friend to solve the same division problem and share the different strategies with the class.

Connect to Language Development

For ELLs, use the Differentiated Instruction chart to plan and prepare for specific activities in every session.

ELL English Language Learners: Differentiated Instruction

Prepare for Session 1
Use with *Try It*.

Levels 1–3	Levels 2–4	Levels 3–5
Reading/Speaking Choral read the ***Try It*** problem with students. Ask them to identify and underline important information from the problem. Provide base-ten blocks or other manipulatives to represent the 92 fifth graders. Prompt students with simple directions to act out the problem by asking different students to take 23 base-ten blocks until there are none left. Count the number of students with 23 base-ten blocks. [4] Call on students to retell the steps that were modeled to solve the problem. Restate student answers using sequencing words. Organize students into pairs to represent the problem in a different way. Ask: *What did you do first? Next? Then?*	**Reading/Speaking** Read the ***Try It*** problem with students. Ask them to underline or circle key information given in the problem. Organize students into pairs to restate the problem in their own words, choose items from the Math Toolkit to represent the problem, and implement a plan to solve the problem. After students solve the problem, have them work together to summarize the steps in their solution strategy using sequencing words such as *first, next,* and *then.* It may be helpful to provide sticky notes that students can label with the words and place directly onto their work to organize their thoughts before speaking.	**Reading/Speaking** Have students read the ***Try It*** problem and underline important information. Ask them to review the Math Toolkit and decide how they will represent the problem. Give students time to solve the problem individually, then pair them to share solution strategies. If possible, try to pair students who used different tools or represented the problem in different ways. Remind students to use sequencing words to explain, in order, the steps they took to solve the problem. Prompt students to notice the relationship between the numbers in the problem and the numbers in each model. Ask: *How are the models alike and how are they different?*

LESSON 5

SESSION 1 Explore

Purpose In this session students draw on prior knowledge of how to divide a multi-digit number by a one-digit divisor to divide by a two-digit divisor. They share models to explore various solution methods. They will look ahead to think about how estimation and multiplication can help them divide with two-digit divisors. They use a table of products and an area model to explore how multiplication and division are related.

Start

Connect to Prior Knowledge

Why Support students' facility with dividing whole numbers using what they know about the relationship between division and multiplication.

How Have students use multiplication facts that they know to solve division problems with two-digit dividends and divisors.

How can you use multiplication to solve each division equation?

$30 \div 10 = ?$

$24 \div 12 = ?$

Possible Solutions

$10 \times ? = 30$
$10 \times 3 = 30$
$30 \div 10 = 3$

$12 \times ? = 24$
$12 \times 2 = 24$
$24 \div 12 = 2$

TRY IT

Make Sense of the Problem

To support students in making sense of the problem, have them identify the number of fifth graders in the school as well as the number of students in each fifth-grade classroom.

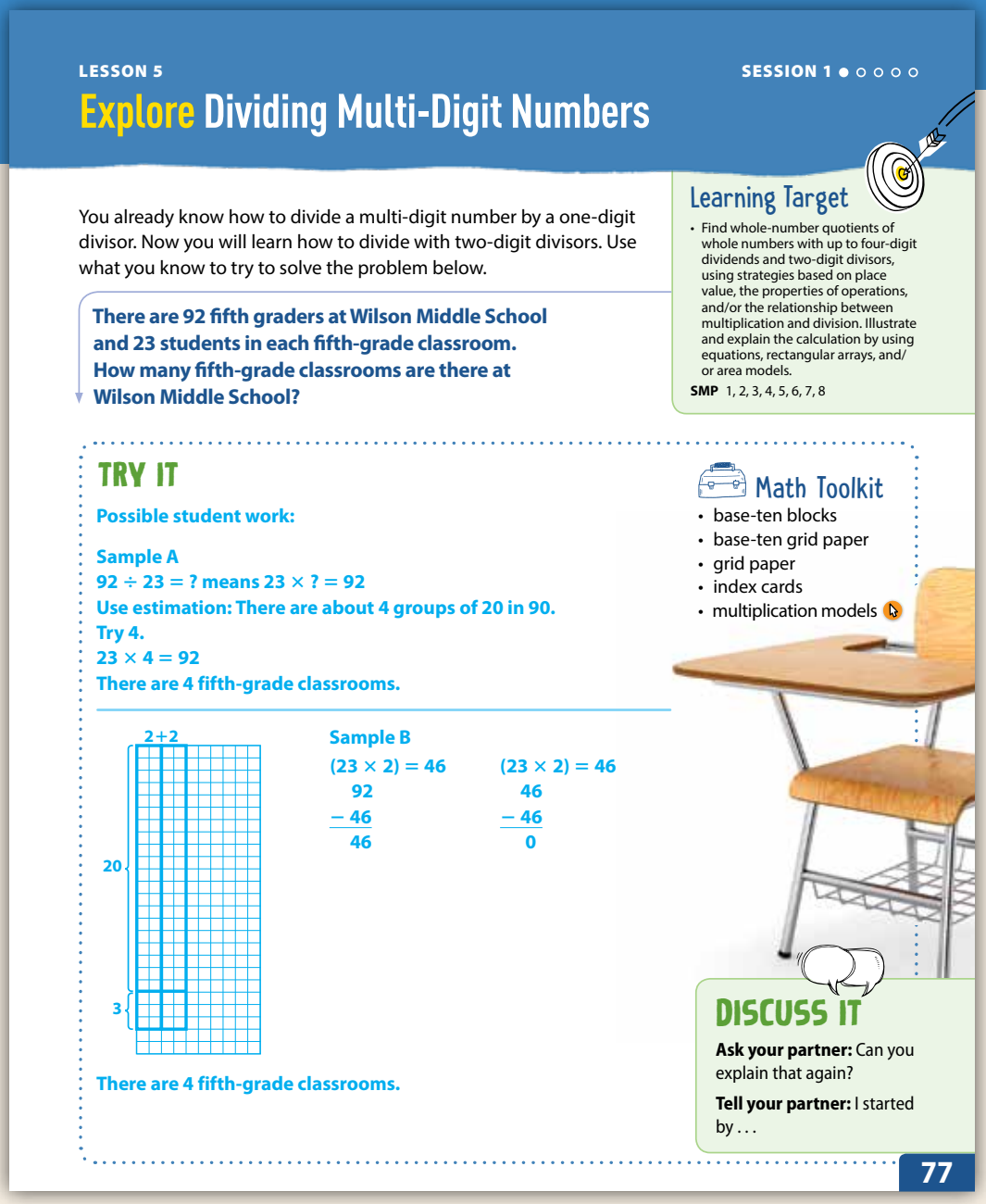
DISCUSS IT

Support Partner Discussion

Encourage students to use the *Discuss It* question and sentence starter on the Student Worktext page as part of their discussion.

Look for, and prompt as necessary for, understanding of:

- 92 as the whole
- 23 as the number in each group
- the number of fifth-grade classrooms as the unknown number of equal groups



LESSON 5 SESSION 1 ● ○ ○ ○ ○

Explore Dividing Multi-Digit Numbers

You already know how to divide a multi-digit number by a one-digit divisor. Now you will learn how to divide with two-digit divisors. Use what you know to try to solve the problem below.

There are 92 fifth graders at Wilson Middle School and 23 students in each fifth-grade classroom. How many fifth-grade classrooms are there at Wilson Middle School?

Learning Target

- Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

SMP 1, 2, 3, 4, 5, 6, 7, 8

TRY IT

Possible student work:

Sample A
92 ÷ 23 = ? means 23 × ? = 92
Use estimation: There are about 4 groups of 20 in 90.
Try 4.
23 × 4 = 92
There are 4 fifth-grade classrooms.

Sample B

$(23 \times 2) = 46$
92
$-\ 46$
46

$(23 \times 2) = 46$
46
$-\ 46$
0

There are 4 fifth-grade classrooms.

Math Toolkit

- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: I started by . . .

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Common Misconception Look for students who are not comfortable with the idea of dividing by a two-digit number. As students present solutions, be sure to have them specify how they thought about finding the number of groups of 23.

Select and Sequence Student Solutions

One possible order for whole class discussion:

- concrete models that show 92 ÷ 23
- drawings that show 92 divided into equal groups
- estimates as part of the solution process or as a way to check an answer
- strategies that break apart the problem into parts or use multiplication

Support Whole Class Discussion

Prompt students to note the relationship between the numbers in each model and the numbers in the problem.

Ask *How do [student name]'s and [student name]'s models show the total number of fifth-grade students divided into groups of 23?*

Listen for Some models may use blocks or drawings to show distributing the total number of students, 92, into groups of 23 to show 4 groups. Other models may show 92 ÷ 23 symbolically using partial quotients or repeated subtraction.

CONNECT IT

1 LOOK BACK

Look for understanding that strategies that work for dividing by a one-digit divisor can be used to divide by a two-digit divisor.

Hands-On Activity

Use counters to divide.

If . . . *students are having difficulty dividing a two-digit number by a two-digit number,*

Then . . . *use this activity to have them divide using counters.*

Materials For each pair: 78 counters, 17 paper cups

- Display the problem 51 ÷ 17.
- Distribute 51 counters to each pair of students. Tell students they are going to model the division problem by dividing their 51 counters into groups of 17 counters each.
- Have students count out 17 counters in a paper cup. Have them continue to put groups of 17 counters in paper cups until they have used all the counters. Ask: *How many counters are there in all?* [51] *How many counters are in each group?* [17] *How many groups are there?* [3] Have students record the division equation 51 ÷ 17 = 3.
- Have partners combine all 51 counters together. Tell students that now they are going to model the division problem by dividing their 51 counters into 17 groups. Have partners set out 17 paper cups and evenly distribute the counters into the cups, one counter at a time in each cup until they have used all the counters. Ask: *How many counters are there in all?* [51] *How many groups are there?* [17] *How many counters are in each group?* [3]
- Repeat the activity for other division problems, such as 78 ÷ 13.

2 LOOK AHEAD

Point out that students can use strategies they may have used when dividing by one-digit numbers to estimate and divide with two-digit divisors.

Ask a volunteer to restate the definition of *inverse operations* given on the Student Worktext page.

Students should be able to use the terms *dividend*, *divisor*, and *quotient* correctly to discuss the process of estimating and finding the quotient 264 ÷ 12 with an area model.

CONNECT IT

1 LOOK BACK

What is 92 ÷ 23? Explain your reasoning.

4; Possible answer: 23 × 4 = 92, so 92 ÷ 23 = 4.

2 LOOK AHEAD

Multiplication and division are called **inverse operations** because they "undo" each other. For example, the related multiplication and division equations 5 × 7 = 35 and 35 ÷ 5 = 7 show that if you multiply a number by 5 and then divide the result by 5, you end up with the number you started with.

Think about the related equations 264 ÷ 12 = **?** and 12 × **?** = 264.

You can use the related multiplication equation to help you divide.

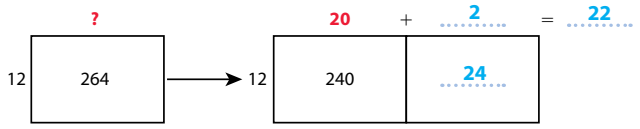
a. Start by listing products of the divisor, 12, and **multiples of 10**.

Multiple of 10	10	20	30	40	50
12 × Multiple of 10	120	240	360	480	600

b. Which row of the table above is related to the dividend in 264 ÷ 12? How could you use the table above to estimate the quotient 264 ÷ 12?

the second row; Possible answer: You can see that 264 is between 240 and 360, so you know the quotient should be between 20 and 30.

c. Start with 12 × **a multiple of 10** to divide 264 by 12 using an area model. Complete the missing numbers.



3 REFLECT

How can you use the inverse relationship between multiplication and division to check your answer to 264 ÷ 12?

Possible answer: You can multiply 12 and 22. 12 × 22 = 264, so 264 ÷ 12 = 22.

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Ask students to explain how the left side of the area model represents the related multiplication and division equations as well as how the right side of the area model breaks apart the problem.

Close: Exit Ticket

3 REFLECT

Look for understanding of multiplication and division as inverse operations, allowing multiplication to be used to check division.

Common Misconception **If** students cannot write a related multiplication equation for 264 ÷ 12, **then** use basic multiplication and division facts to remind them how multiplication and division are related. Ask students to solve the problem 50 ÷ 5 = ? using the multiplication equation 5 × ? = 50. If necessary, use a drawing to show how 50 ÷ 5 = 10 and 5 × 10 = 50 relate. Then use equations to show how 264 ÷ 12 = 22 and 12 × 22 = 264 similarly relate.

Real-World Connection

Point out that division is important in everyday life. Have students think of times when people might need to use division. Examples might include splitting up into even kickball teams, sharing jointly earned money equally, or dividing pages in a book to read over several days.

Solutions

Support Vocabulary Development

1 Say each term in the first column of the graphic organizer and have students repeat after you. Have them look at the words *dividend* and *divisor* and underline *divi-*. Have students discuss how *dividend* and *divisor* are the same and different.

Have students work with a partner to define each term in their own words. As you walk around the room, select a few groups to share their definitions and examples. Engage other students to add to the conversation with the goal of addressing any uncertainties over the use of the words.

2 Have students look at the area model and label it using the words *quotient*, *dividend*, and *divisor*. Have students form pairs, write the equation, and compare their answers.

Supplemental Math Vocabulary

- *division*
- *equal parts*

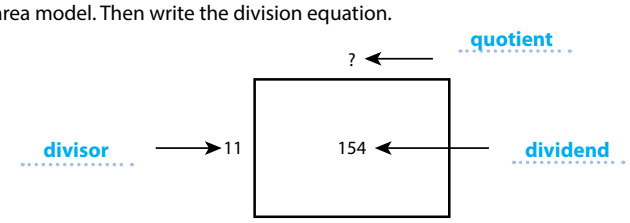
Name: _____ LESSON 5 SESSION 1

Prepare for Dividing Multi-Digit Numbers

1 Think about what you know about division. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can. **Possible answers:**

Word	In My Own Words	Example
dividend	**the number that is divided by another number**	**(56) ÷ 7 = 8**
divisor	**the number by which another number is divided**	**200 ÷ (10) = 20**
quotient	**the result of division**	**150 ÷ 25 = (6)**

2 Label the *dividend*, *divisor*, and *quotient* of the division equation shown by the area model. Then write the division equation.



154 ÷ 11 = ?

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3 Assign problem 3 to provide another look at solving a division problem with two-digit divisors.

This problem is very similar to the problem about finding the number of fifth-grade classrooms. In both problems, students divide a two-digit number by a two-digit number to find the solution. The question asks how many buses of students there are on the field trip.

Students may want to use base-ten blocks or draw a model, such as an array or an area model.

Suggest that students read the problem three times, asking themselves one of the following questions each time:

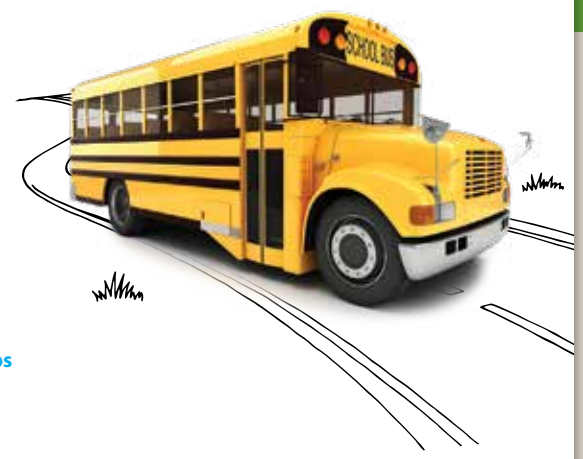
- *What is this problem about?*
- *What question am I trying to answer?*
- *What information is important?*

Solution:

95 ÷ 19 = 5. There are 5 buses of students.

Medium

4 Have students solve the problem a different way to check their answer.



3 Solve the problem. Show your work.

There are 95 students on a field trip and 19 students on each bus. How many buses of students are there on the field trip?

Possible student work:
95 ÷ 19 = ? means 19 × ? = 95.
Use estimation: 95 is close to 100 and 19 is close to 20. There are 5 groups of 20 in 100. Try 5. 19 × 5 = 95

Solution **There are 5 buses of students.**

4 Check your answer. Show your work.

Possible student work:
If 95 ÷ 19 = 5, then 95 ÷ 5 should be equal to 19.

```
  19
5 )95
 − 50
  45
 − 45
   0
```

There are 5 buses of students on the field trip.

ELL English Language Learners: Differentiated Instruction

Prepare for Session 2
Use with *Model It*.

Levels 1–3

Listening/Speaking Read the first ***Model It***. Ask students to restate the definition of *compatible numbers* using the sentence frames:

- *Compatible numbers are* ___close to___ *the actual numbers in a problem.*
- *They help you* ___estimate___ *to solve a problem.*

Ask students to listen as you call out pairs of numbers and to signal thumbs up if the numbers are compatible and thumbs down if they are not compatible. Call on students to explain their thinking. Restate answers as needed to model fluent speaking.

Levels 2–4

Speaking/Writing Read the first ***Model It***. Ask students to underline information and clues that help them understand what *compatible numbers* are. Have them form pairs and use the information they underlined to explain *compatible numbers* in their own words. It may be helpful to provide sentence starters:

- *Compatible numbers are* _____.
- *They help you solve problems because* _____.

Ask partners to write two sentences: one that explains why 500 is a compatible number for 504 and one that explains why 20 is a compatible number for 21. Guide them to use complete sentences. Call on pairs to read their sentences and explain their reasoning to the class.

Levels 3–5

Speaking/Writing Have students read the problem, form pairs, and look at the first ***Model It***. Ask them to explain in their own words to their partner what compatible numbers are and how compatible numbers help you use estimation to solve problems.

If students need additional support, provide the sentence frame:

- *The* ___closer___ *the compatible numbers are to the* ___dividend___ *and* ___divisor___*, the closer the estimated quotient will be to the actual quotient.*

Have pairs determine the dividend and divisor and compatible numbers for them. Ask students to write sentences that explain why these numbers are compatible.

LESSON 5

SESSION 2 Develop

Purpose In this session students estimate the quotient of the division problem 504 ÷ 21. Students model the numbers in the word problem either on paper or with manipulatives. The purpose of this problem is to have students develop strategies for estimating quotients when working with two-digit divisors.

Start

Connect to Prior Knowledge

Materials For each student: 1 hundreds flat, 15 tens rods, 10 ones units

Why Support students' facility with estimating in different ways.

How Have students use base-ten blocks and equations to show one way to estimate the quotient 126 ÷ 6. Compare different ways students estimate.

Estimate the quotient.

Use base-ten blocks and write an equation to show your estimate.

126 ÷ 6 = ?

Possible Solutions

120 ÷ 6 = 20,
130 ÷ 10 = 13,
125 ÷ 5 = 25,
100 ÷ 5 = 20;
Check that students' models match their equations.

Develop Language

Why Develop understanding of the meaning of *estimate* by exploring synonyms.

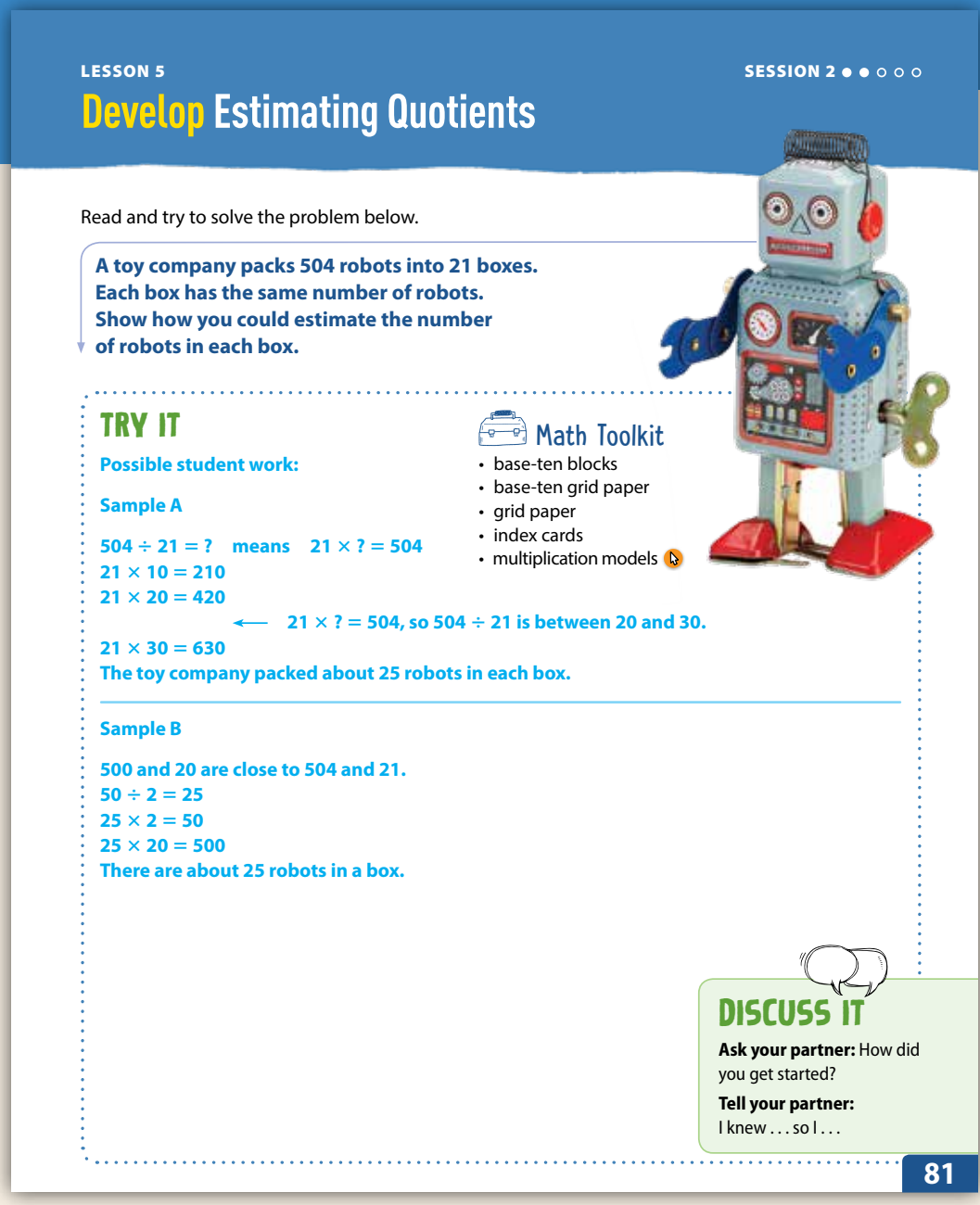
How Ask students to circle the term *estimating* in the title at the top of the Student Worktext page. Define the term and ask them to suggest other words that have the same or similar meanings as *estimate*. Possible related words include *approximate*, *close*, *ballpark*, and *rough guess*.

TRY IT

Make Sense of the Problem

To support students in making sense of the problem, have them identify what the problem is asking them to find.

Ask *How many robots are there in all? How many boxes are they packed into? What does it mean to estimate the number of robots in each box?*



LESSON 5 SESSION 2 ● ● ○ ○ ○

Develop Estimating Quotients

Read and try to solve the problem below.

A toy company packs 504 robots into 21 boxes. Each box has the same number of robots. Show how you could estimate the number of robots in each box.

TRY IT

Possible student work:

Sample A

504 ÷ 21 = ? means 21 × ? = 504
21 × 10 = 210
21 × 20 = 420
← 21 × ? = 504, so 504 ÷ 21 is between 20 and 30.
21 × 30 = 630
The toy company packed about 25 robots in each box.

Sample B

500 and 20 are close to 504 and 21.
50 ÷ 2 = 25
25 × 2 = 50
25 × 20 = 500
There are about 25 robots in a box.

Math Toolkit
- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: I knew . . . so I . . .

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DISCUSS IT

Support Partner Discussion

To reinforce using estimation, encourage students to use the word *about* as they discuss their solutions and state their answers.

Support as needed with questions such as:

- *Is that a reasonable result?*
- *How could you help your partner without saying the answer?*

Common Misconception: Look for students who find an exact answer and then round the quotient to estimate. Encourage students to estimate before they divide.

Select and Sequence Student Solutions

One possible order for whole class discussion:

- base-ten models showing an estimate, such as 500 ÷ 20 or 500 ÷ 25
- equations using rounded values for the dividend and divisor, such as 500 ÷ 20 or 500 ÷ 25
- equations using multiples of 10 or other methods of estimating numbers the quotient lies between

Support Whole Class Discussion

Compare and connect the different representations and have students identify how they are related.

Ask *How does your model show how to estimate the number of robots in each box?*

Listen for Students should recognize that you can estimate in different ways including identifying two numbers the quotient is between or providing a single estimated quotient. Accurate responses may include showing that the number of robots is between 20 and 30 or using an estimated number of robots close to 504, such as 500, and an estimated number of boxes close to 21, such as 20 or 25.

MODEL ITS

If no student presented these models, connect them to the student models by pointing out the ways they each represent:

- the dividend (the total number of robots)
- the divisor (the number of boxes)

Ask *What number in each* Model It *shows the divisor? Are they the same or different?*

Listen for The *Model Its* use different numbers for the divisor. In the first *Model It*, the divisor (the number of boxes, 21) is rounded to 20. The second *Model It* uses the actual number of boxes, 21, as the divisor.

For estimating with compatible numbers, prompt students to understand what compatible numbers are.

- *What makes 500 and 20 compatible numbers?*
- *Is there another pair of numbers you could use as compatible numbers for this problem?*

For estimating with multiples of 10, prompt students to compare the strategies in the *Model Its*.

- *Does the blue 20 in the first* Model It *represent the same quantity as the red 20 in the second* Model It*?*
- *Which strategy uses an estimate for the divisor?*
- *Which strategy is similar to a "guess and check" strategy?*

Explore different ways to understand how to estimate quotients when dividing whole numbers.

A toy company packs 504 robots into 21 boxes. Each box has the same number of robots. Show how you could estimate the number of robots in each box.

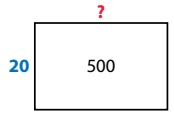
MODEL IT

You can use compatible numbers to estimate a quotient.

Compatible numbers are numbers close to the values of the actual dividend and divisor that allow you to multiply or divide using basic facts.

500 and 20 are compatible numbers that are close to 504 and 21.

You can use them to estimate by thinking 500 ÷ **20** = **?** means **20** × **?** = 500.



MODEL IT

You can use the inverse relationship between multiplication and division to estimate a quotient.

504 ÷ **21** = **?** or **21** × **?** = 504

Multiply **21** by **multiples of 10**. Make a table.

Number of Robots per Box	Total Number of Robots
10	**21** × **10** = 210
20	**21** × **20** = 420
30	**21** × **30** = 630

Deepen Understanding

Estimating with Multiples of 10

SMP 8 Use repeated reasoning.

When discussing using multiples of 10 to estimate, prompt students to look for relationships they can use to extend tables for estimating quotients.

Ask *Think about the next row of the table. How could you use the relationship between the total number of robots with 20 robots per box and 10 robots per box to find the total number of robots with 40 robots per box?*

Listen for The total number of robots with 20 robots per box, 420, is double the total number of robots with 10 robots per box, 210. To find the total number of robots with 40 robots per box, you could double the total number of robots with 20 robots per box, 420, to get 840.

Generalize *Could you use similar shortcuts to find other products when using multiples of 10 to estimate quotients?* Have students explain their reasoning. Look for understanding of using relationships between multiples of 10 to find other products. For example, 20 is two times 10, so the product of 20 and a number will be double the product of 10 and that same number.

CONNECT IT

- Remind students that one thing that is alike about all the representations is that they show a strategy for estimating the number of robots in each box.
- Explain that on this page, students will explain and compare the estimation strategies.

Monitor and Confirm

1 – 3 Check for understanding that:

- the closer the compatible numbers are to the dividend and divisor, the closer the estimated quotient will be to the actual quotient
- you can use mental math to divide the compatible numbers, giving an estimate of 25 robots per box
- useful estimation strategies lead to easy computations

Support Whole Class Discussion

4 Tell students that this problem will help them better understand the multiples of 10 estimation strategy.

Ask *How is saying that the number of robots in each box is between two numbers a way to estimate a solution? Does it give you a single estimate?*

Listen for Saying that the number of robots in each box is between 20 and 30 narrows the possible numbers of robots per box to a range of numbers. It does not give you a single estimate, but it tells you that the actual number of robots per box is greater than 20 and less than 30.

Ask *What does the range of possible quotients tell you about the first digit of the actual quotient?*

Listen for The first digit will be 2.

Ask *How can you tell which number, 20 or 30, the actual quotient is closer to?*

Listen for Think about whether the actual total number of robots, 504, is closer to 420 or 630.

5 Look for the idea that both estimation strategies provide numbers that are easier to work with, which helps you find an approximate answer quickly.

6 REFLECT Have all students focus on the strategies used to solve this problem. If time allows, have students share their preferences with a partner.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to estimate quotients with two-digit divisors.

1 Look at the first **Model It**. Why are 500 and 20 good choices to use for compatible numbers? Why not round to the nearest thousand and use 1,000 and 20 as compatible numbers?

Possible answer: You want to choose numbers close to the dividend and divisor so that the estimated quotient is close to the actual quotient.

2 How can you find the quotient 500 ÷ 20? What estimate does this give for the number of robots in each box?

Possible answer: I know 50 ÷ 2 = 25 and 2 × 25 = 50, so I can use that to see that 20 × 25 = 500, or 500 ÷ 20 = 25. There are about 25 robots in each box.

3 Look at the second **Model It**. Why do you multiply 21 by multiples of 10? Could you multiply 21 by multiples of 5 instead of by multiples of 10?

Possible answer: Multiples of 10 have only one nonzero digit to think about. You could use multiples of 5, but it's not easy to multiply 21 by 15 in your head.

4 Look at the table. Between which two numbers is a good estimate for the number of robots packed in each box? Explain how you know.

Possible answer: The number of robots packed in each box is between 20 and 30. 21 × 20 = 420, so 420 ÷ 21 = 20. 21 × 30 = 630, so 630 ÷ 21 = 30. 504 is between 420 and 630, so 504 ÷ 21 is between 20 and 30.

5 What do the methods of estimating quotients in the **Model Its** have in common?

Possible answer: Both methods use easier numbers to help you estimate.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for estimating quotients? Explain.

Possible answer: Some students may prefer estimating with compatible numbers because it requires only one calculation to find the estimate. Others may prefer using multiples of 10 because they are easy to multiply by.

Visual Model

Use hundreds grids to help find estimated quotients.

If . . . *students have difficulty dividing with a two-digit divisor even when using easier numbers,*

Then . . . *use this activity to model estimated quotients with compatible numbers.*

Materials For each student: Activity Sheet *Base-Ten Grid Paper*

- Write 322 ÷ 14 on the board. Ask: *What compatible numbers for 322 and 14 could you use to estimate the quotient? What basic multiplication or division fact did you use in choosing your numbers?* [For example, 300 and 15; 2 × 15 = 30]
- Have students model their compatible number for 322 on base-ten grid paper. [For example, show 300 by shading three hundreds grids.]
- Have students use their compatible divisor to show how to complete an estimated quotient for the division problem. [For example, outline groups of 15 in 300 to find the estimated quotient as 300 ÷ 15 = 20.]
- Discuss how student models show an estimated quotient.
- If time allows, repeat the activity for other division problems using a two-digit divisor.

APPLY IT

For all problems, encourage students to use some kind of model to support their thinking. Allow different approaches to estimation as long as the method produces a reasonable estimate and the model used supports the estimate.

7 About 10; Students may use compatible numbers. Students may also use a multiples of 10 strategy to estimate that the quotient is between 0 and 10.

8 Between 40 and 50; See possible work on the Student Worktext page. Students may also use compatible numbers to divide 1,000 ÷ 25 for an estimated quotient of 40.

Close: Exit Ticket

9 **B**; Students may use 200 ÷ 10 = 20 or 280 ÷ 14 = 20 as compatible numbers to estimate a solution of about 20.

Error Alert **If** students choose A, C, or D, **then** have them use a multiples of 10 strategy to eliminate answer choices A and C. Then have them think about which number, 140 or 280, is closer to 238.

APPLY IT

Use what you just learned to solve these problems.

7 Estimate the quotient 342 ÷ 38. Show your work.

Possible student work:
342 is close to 350.
38 is close to 35.
10 × 35 = 350, so 350 ÷ 35 = 10.

Solution **342 ÷ 38 is close to 10.**

8 Estimate the quotient 1,103 ÷ 23. Show your work.

Possible student work:

Multiple of 10	10	20	30	40	50
23 × Multiple of 10	230	460	690	920	1,150

Solution **between 40 and 50**

9 Camille arranged 238 chairs into equal rows of 14 chairs. Which of the following is the best estimate for the number of rows she made?

Ⓐ a number close to 30
Ⓑ about 20
Ⓒ a number between 30 and 40
Ⓓ about 10

Solutions

1 **a.** 1,320; 1,540; 1,760

b. Between 1,320 and 1,540

c. Between 60 and 70; The multiples of 10 table shows the quotient is between 60 and 70. 1,474 is closer to 1,540 than to 1,320, so students may indicate the quotient is closer to 70 than to 60.

Basic

Name: _____ LESSON 5 SESSION 2

Practice Estimating Quotients

Study the Example showing how to estimate a quotient with a two-digit divisor. Then solve problems 1–4.

EXAMPLE

Estimate the quotient 1,474 ÷ 22.

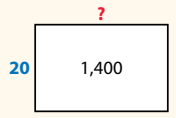
Choose compatible numbers that are close to the actual dividend and divisor and easy to multiply and divide using a basic fact.

1,400 and 20 are close to 1,474 and 22.

$2 \times 7 = 14$, $2 \times 70 = 140$, and $20 \times 70 = 1{,}400$.

$20 \times 70 = 1{,}400$ is the same as $1{,}400 \div 20 = 70$.

So, 70 is the estimated quotient for 1,474 ÷ 22.



1 Look at the Example. You can also multiply 22 by **multiples of 10** to estimate the quotient 1,474 ÷ 22.

a. Complete the table.

Multiple of 10	10	20	30	40	50	60	70	80
22 × Multiple of 10	220	440	660	880	1,100	1,320	1,540	1,760

b. Complete the statement below with two numbers from the table.

The dividend 1,474 is between 1,320 and 1,540.

c. What is a good estimate for the quotient 1,474 ÷ 22?

Possible answer: A number between 60 and 70; 1,474 is between 1,320 and 1,540; so, the quotient will be between 60 and 70; because 1,474 is closer to 1,540 than to 1,320, the quotient is closer to 70 than 60.

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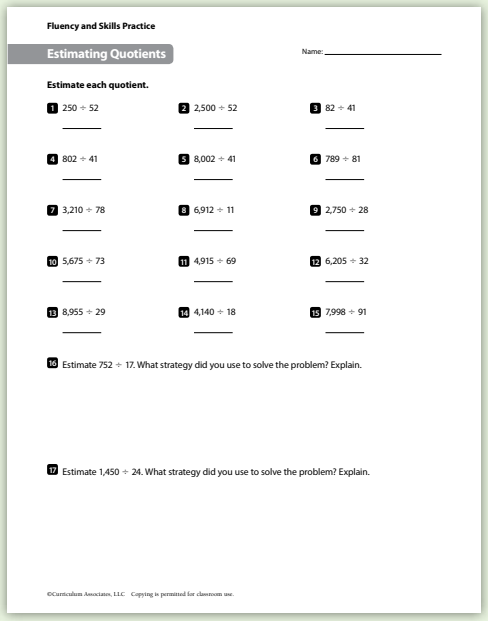
Fluency & Skills Practice

Teacher Toolbox

Assign *Estimating Quotients*

In this activity students estimate the quotient of dividing two multi-digit numbers. Estimation is helpful because it is used in real-world situations in which an exact answer is not needed. Estimation is also a way to check whether an answer is reasonable. Students may use a variety of strategies to estimate, such as using compatible numbers or the inverse relationship between multiplication and division.


Fluency and Skills Practice

Estimating Quotients

Name: _____

Estimate each quotient.

1 250 ÷ 52 _____

2 2,500 ÷ 52 _____

3 82 ÷ 41 _____

4 802 ÷ 41 _____

5 8,002 ÷ 41 _____

6 789 ÷ 81 _____

7 3,210 ÷ 78 _____

8 6,912 ÷ 11 _____

9 2,750 ÷ 28 _____

10 5,675 ÷ 73 _____

11 4,915 ÷ 69 _____

12 6,205 ÷ 32 _____

13 8,955 ÷ 29 _____

14 4,140 ÷ 18 _____

15 7,998 ÷ 91 _____

16 Estimate 752 ÷ 17. What strategy did you use to solve the problem? Explain.

17 Estimate 1,450 ÷ 24. What strategy did you use to solve the problem? Explain.

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2 **D**; The products of 31 times multiples of 10 are $31 \times 10 = 310$, $31 \times 20 = 620$, and $31 \times 30 = 930$. The dividend 713 is between 620 and 930, so the best estimate for the quotient is a number between 20 and 30.
Medium

3 About 40 boxes of water bottles; Students may use compatible numbers: $1{,}000 \div 25 = 40$. Also accept $1{,}000 \div 20 = 50$ boxes of water or a multiples of 10 strategy that results in an estimate between 40 and 50.
Medium

4 Marcus did not stick to his plan; Students may use compatible numbers and multiples of 10 to estimate that Marcus plans to give away about 200 kites per day. Students may also use the compatible numbers quotient $500 \div 2$ to estimate that Marcus gives away about 250 kites on each of the first two days. Since Marcus gave away more than 200 kites per day, he did not stick to his plan.
Challenge

2 Which of the following is the best estimate for the quotient $713 \div 31$?

Ⓐ a number between 10 and 20

Ⓑ a number close to 40

Ⓒ a number close to 35

Ⓓ a number between 20 and 30

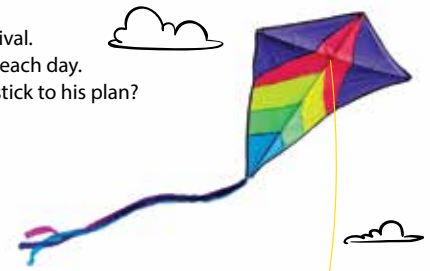
3 A beverage company makes 1,008 bottles of water and packs them into boxes. The company packs 24 bottles in each box. Estimate how many boxes of water bottles the company packs. Show your work.

Possible student work:
1,008 is about 1,000. 24 is about 25.

$25 \times 4 = 100$ and $25 \times 40 = 1{,}000$.

Solution **Possible answer: about 40 boxes of water bottles**

4 Marcus builds 2,744 kites for a 14-day summer kite festival. He plans to give away about the same number of kites each day. He gives away 492 kites the first two days. Did Marcus stick to his plan? Use estimation to explain. Show your work.



2,744 is about 2,800.
$14 \times 2 = 28$, $14 \times 20 = 280$, and $14 \times 200 = 2{,}800$.

492 is about 500. $500 \div 2 = 250$

Solution **Marcus did not stick to his plan. Possible explanation: Marcus should have given away about 200 kites a day. On the first two days, he gave away about 250 kites a day.**

ELL English Language Learners: Differentiated Instruction

Prepare for Session 3
Use with *Connect It*.

Levels 1–3

Listening/Speaking Read ***Connect It*** problem 2. Tell students to draw a number line and label it with 720 on the left end and 960 on the right end. Ask students to point to where 768 would approximately fall on the number line. Display, model, and demonstrate the meanings of the terms *less than* and *greater than*. Using the sentence frames below, ask students to say why 30 was used in the area model and not 40 to multiply by 24.

- *24 × 30 is* ___720___ *. 30 was used because* ___720___ *is* ___less than___ *768.*
- *24 × 40 is* ___960___ *. 40 was not used because* ___960___ *is* ___greater than___ *768.*

Levels 2–4

Speaking Have students form pairs and read ***Connect It*** problem 2. Ask them to discuss the information the problem provides and the questions they are asked. To facilitate student discussion, provide the following sentence frames:

- *The second* **Model It** *shows that 24 is multiplied by* ___30___ *.*
- *The second* **Model It** *uses 30 and not 40 because* _____ *.*

Levels 3–5

Speaking/Writing Have students form pairs and read ***Connect It*** problem 2. Ask students to look at the second ***Model It*** and discuss the information the problem provides and the questions they are asked. Have them write their observations. Provide the following sentence frames for students to complete.

- *The area model shows that 24 × 30 is* _____ *.*
- *Once we subtract* _____ *from* _____ *, the difference is* _____ *.*
- *Multiplying 24 by the estimate of* _____ *results in the product* _____ *, which is* _____ *the dividend. .*
- *Multiplying 24 by the estimate of* _____ *is more effective because* _____ *.*

LESSON 5

SESSION 3 Develop

Purpose In this session students solve a problem that requires estimating—and then finding—the quotient 768 ÷ 24. Students model the numbers in the word problem either on paper or with manipulatives in order to develop division strategies that use estimation to find the first digit of the quotient.

Start

Connect to Prior Knowledge

Materials For each student: base-ten blocks (2 hundreds flats, 30 tens rods, 10 ones units)

Why Review and support students' skills in estimating quotients.

How Have students estimate the quotient 273 ÷ 13, modeling their estimates using base-ten blocks and recording their work symbolically with equations on paper. Compare estimation methods and estimated quotients.

Estimate 273 ÷ 13.

Use base-ten blocks and equations to show your work.

Possible Solutions

260 ÷ 13 = 20,
300 ÷ 15 = 20,
300 ÷ 10 = 30,
between 20 and 30;
Check that students' models match their equations.

Develop Language

Why Distinguish the difference in pronunciation and meaning between the words *produced* and *product*.

How Write the words *produced* and *product* on the board. Underline the endings of each word. Carefully enunciate each word and have students repeat after you. Define each word and remind students that in mathematics, a *product* is the result of multiplication.

TRY IT

Make Sense of the Problem

To support students in making sense of the problem, have them identify the number of buses and the number of buildings.

Ask *How many buses are there all together? How many buildings are they stored in?*

Develop Using Estimation and Area Models to Divide

Read and try to solve the problem below.

A factory produces 768 buses and puts them in 24 buildings. Each building has the same number of buses. How many buses are in each building? Estimate and then solve.

TRY IT

Possible student work:

Sample A

24 × 10 = 240
24 × 20 = 480
24 × 30 = 720
24 × 40 = 960
The quotient is between 30 and 40.
24 × 30 = 720, 768 − 720 = 48
24 × 2 = 48
30 + 2 = 32
32 buses are in each building.

Sample B

750 and 25 are close to 768 and 24.
25 × 30 = 750, so 768 ÷ 24 is about 30.

```
  768
− 720   (24 × 30)
   48
−  48   (24 × 2)
    0
```

24 × 32 = 768, so 768 ÷ 24 = 32.
Each building has 32 buses.

Math Toolkit

- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I agree with you about . . . because . . .

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DISCUSS IT

Support Partner Discussion

Encourage students to share what did not work for them as well as what did as they talk to each other.

Support as needed with questions such as:

- *How did your partner explain the strategies he or she used?*
- *Did the strategy make sense to you?*

Common Misconception Look for students who have difficulty estimating 768 ÷ 24. Encourage them to identify compatible numbers, such as 750 and 25, that they can use to estimate the quotient.

Select and Sequence Student Solutions

One possible order for whole class discussion:

- solutions that use base-ten blocks or grid paper
- estimation with compatible numbers compared to estimation with multiples of 10
- solutions that use area models
- solutions that use vertical division house formats

Support Whole Class Discussion

Compare and connect the different representations and have students identify how they are related.

Ask *How does your model show the use of estimation?*

Listen for Students should recognize that different estimation strategies can be used, including the multiples of 10 strategy or compatible numbers. Closer estimates using compatible numbers will involve numbers closer to 768 and 24.

Ask *How does your model find the actual number of buses in each building?*

Listen for Students should recognize that all models involve dividing 768 by 24 but that different methods can be used to complete the division. Students may connect models that divide the total, 768, into groups and those that incorporate other operations such as addition, multiplication, and subtraction.

MODEL ITS

If no student presented these models, connect them to the student models by pointing out the ways they each show:

- the dividend and the divisor
- the use of multiplication to find the quotient

Ask *How do these models use the inverse relationship between multiplication and division as part of a strategy to solve a division problem?*

Listen for The table is made by using the related multiplication equation

$$24 \times ? \text{ buses} = \text{total number of buses}$$

and replacing "? buses" with multiples of 10. The rectangle on the left side of the area model represents the related multiplication and division equations $768 \div 24 = ?$ and $24 \times ? = 768$.

For the estimate of the quotient, prompt students to interpret the multiples of 10 table.

- *Which numbers are a product of the divisor, 24, and multiples of 10?*
- *Which numbers can be used to estimate the quotient?*

For the area model, prompt students to explain how the parts of the area model reflect the problem.

- *What happens to the dividend, 768, in the area model?*
- *How is the divisor, 24, used throughout the area model?*

Explore different ways to understand how to divide multi-digit numbers using estimation and area models.

A factory produces 768 buses and puts them in 24 buildings. Each building has the same number of buses. How many buses are in each building? Estimate and then solve.

MODEL IT

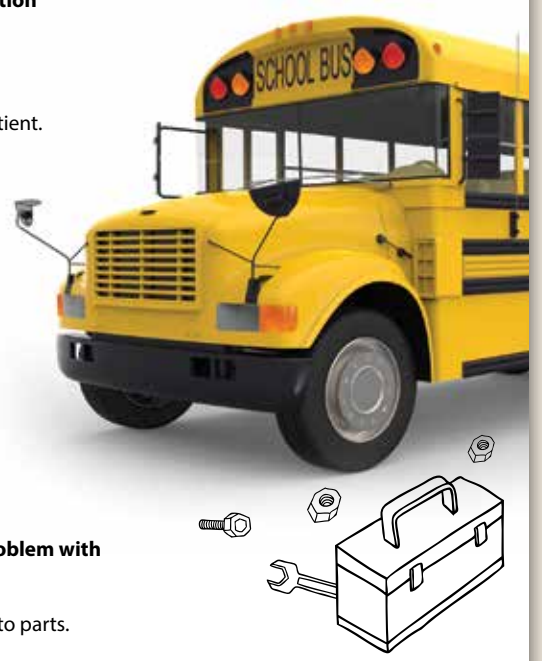
You can use the relationship between multiplication and division to estimate the quotient.

$768 \div 24 = ?$ and $24 \times ? = 768$

Multiply 24 by **multiples of 10** to estimate the quotient. You can organize your work in a table.

Number of Buses in Each Building	Total Number of Buses
10	240
20	480
30	720
40	960

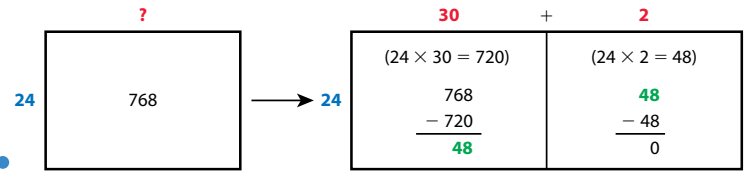
The quotient is between **30** and **40**.



MODEL IT

You can use an area model to solve a division problem with a two-digit divisor.

The area model breaks up the problem $768 \div 24$ into parts.



Deepen Understanding

Area Model

SMP 7 Look for structure.

When discussing the area model, prompt students to consider the reasoning used to build the model. Make sure students understand that the right side of the model shows the area of the original rectangle broken into parts.

Ask *Why do you start breaking the area into parts by multiplying 24 by 30?*

Listen for The estimate shows that the quotient is between 30 and 40, so you multiply the divisor (24) by 30 to get a product less than the dividend.

Ask *Why is the area model broken into two parts? Could you build an area model for 768 ÷ 24 with a different number of parts? Explain.*

Listen for By starting with 30, the first part includes the greatest number of tens in the quotient. Then you find the number of ones in the quotient. To build an area model with more parts, start by multiplying fewer tens by 24.

Work with students to make an area model for $768 \div 24$ that has three or four parts. For example, for three parts, break the quotient into $20 + 10 + 2$.

CONNECT IT

- Remind students that these two models show strategies for estimating quotients and finding exact quotients.
- Tell students that on this page they will explain these models and connect finding an estimated quotient to finding an exact quotient.

Monitor and Confirm

1 – 3 Check for understanding that:

- the total number of buses, 768, falls between 720 and 960, so the multiples of 10 related to these numbers, 30 and 40, are the tens that the quotient is between
- using 40 would lead to subtracting 960 from the total number of buses (768), so 40 is greater than the quotient
- 30 + 2, or 32, is the number of buses in each building

Support Whole Class Discussion

4 Tell students that this problem will prepare them to provide the explanation required in problem 5.

Ask *The word* partial *has the word* part *in it. What does the word* partial *mean when you talk about partial quotients?*

Listen for A partial quotient is a part of the quotient and not the whole quotient.

5 Look for the idea that the area model shows how to break apart the problem into easier problems that incorporate multiplication, subtraction, and addition to find the quotient.

6 REFLECT Have all students focus on the strategies used to solve this problem. If time allows, have students share their preferences with a partner.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to divide multi-digit numbers using estimation and area models.

1 In the first **Model It**, how do you know the quotient is between 30 and 40?

768 is between 720 and 960.

2 Look at the second **Model It**. The number 24 is multiplied by which estimate, 30 or 40, to start the area model work? Why do you think the other number was not used?

30; Possible explanation: The quotient is between 30 and 40. If you multiply 24 by 40, you get 960. 960 is greater than the dividend, 768, so 40 is too big to be part of the quotient.

3 What does the expression 30 + 2 above the area model represent?

Possible answer: 30 and 2 are numbers of buses in each of the 24 buildings. 30 + 2 is the quotient, 32, the total number of buses in each building.

4 Explain why the numbers 30 and 2 can be called *partial quotients*.

Possible answer: Each one is a quotient of a division problem related to 768 ÷ 24 and is a part of the whole quotient.

5 Explain how an area model can help you break apart a division problem to make it easier to solve.

Possible answer: The first rectangle shows the number you are dividing into equal groups as the product of the divisor and the unknown quotient. You can split the problem into easier multiplication problems, with the divisor as one factor. In each section, you subtract the product you found in that section from what remains. You keep going until you reach a number less than the divisor.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for dividing whole numbers? Explain.

Student responses may mention that the area model strategy helps you visualize the division, and it shows how multiplication can be used to help you divide. The area model also breaks down the problem into smaller parts.

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Hands-On Activity

Build an area model with base-ten blocks.

If . . . *students are unsure about how an area model represents division,*

Then . . . *use base-ten blocks to build an area model as a rectangular array.*

Materials For each pair: base-ten blocks (19 tens rods, 32 ones units); For display: prepared area model for 192 ÷ 16 = 12

- Display the area model for 192 ÷ 16 = 12. Have students model 192.
- Remind students you can use repeated subtraction to show division. Tell them to subtract 10 groups of 16 from their 192 blocks. Ask: *Why can you subtract 10 groups of 16 by removing 16 tens rods?* [10 groups of 16 is the same as 16 groups of 10 because multiplication is commutative.]
- Have students arrange the 16 tens rods horizontally, as a 16 × 10 rectangular array. Relate the array to the rectangle for 16 × 10 = 160 in the area model.
- Ask: *How many blocks remain? How many more groups of 16 can you subtract?* [32; 2] Have students exchange the remaining 3 tens rods for 30 ones units and place 2 units to the right of each tens rod in their rectangular array. Relate the 16 × 2 rectangular array to the rectangle for 16 × 2 = 32 in the area model.

APPLY IT

For all problems, encourage students to use some kind of model to support their thinking. Also encourage them to think about the ways they use the relationship between multiplication and division as they solve the problems.

7 Student responses should reflect an understanding of using the inverse relationship between multiplication and division: showing that the product of 32 and 24 is 768 confirms that the quotient, 32, is correct. Students may apply the distributive property to check the quotient as shown on the Student Worktext page; students may also use the standard algorithm to multiply 32 by 24.

8 Between 30 and 40 packages; See the completed table on the Student Worktext page. Students may find the numbers in the second row of the table by multiplying 12 by each multiple of 10 in the first row.

Close: Exit Ticket

9 39 packages; See the completed area model on the Student Worktext page. Students complete an area model in which the first partial quotient is based on the multiple of 10 estimate in problem 8. The two partial quotients are added together to find the total quotient: 30 + 9.

Students' solutions should indicate understanding of:

- the area model
- applying the multiples of 10 strategy to estimate the first partial quotient
- using the relationship between multiplication and division while solving a division problem
- combining partial quotients to find the quotient

Error Alert **If** students use a greater multiple of 10, such as 40, for the first partial quotient, **then** discuss how the product of 12 and 40, 480, is greater than the dividend, 468.

APPLY IT

Use what you just learned to solve these problems.

7 In the problem on the previous page, 768 ÷ 24, you first estimated and then used an area model to find the quotient. Describe how can you use multiplication to check that you have the correct quotient.

You multiply 32 by 24 to see if it equals 768. If it does, then the quotient is correct.

Show your work for the check.

Possible student work:

$24 \times 32 = (24 \times 30) + (24 \times 2)$
$= 720 + 48$
$= 768$

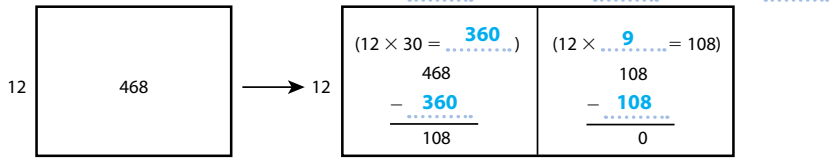
The answer checks. The quotient is correct.

8 Dante has 468 cards in his sports card collection. He buys cards in packages of 12. Complete the table and give an estimate for how many packages of cards Dante has bought.

Number of packages	10	20	30	40	50
Number of sports cards	120	240	360	480	500

Solution between 30 and 40 packages

9 Refer to the situation in problem 8. Complete the area model to find the quotient 468 ÷ 12. How many packages of sports cards did Dante buy?



Solution 468 ÷ 12 = 39; He bought 39 packages.

Solutions

1 **a.** 50; 13 was first multiplied by the lesser estimate because the quotient is between 50 and 60.

b. $13 \times 50 = 650$; the equation appears in the first part of the area model showing the first partial quotient as 50.

c. Answers may vary; Student responses may include relating division to repeated subtraction. The result of the subtraction tells you how many donuts are left to be divided into groups of 13—it becomes the dividend for the next part of the quotient ($78 \div 13$).

d. 6; Students may recognize the second partial quotient as the number above the rightmost rectangle or from the equation $13 \times 6 = 78$.

Basic

Name: _____ LESSON 5 SESSION 3

Practice Using Estimation and Area Models to Divide

Study the Example showing how to estimate and use area models to divide. Then solve problems 1–4.

EXAMPLE

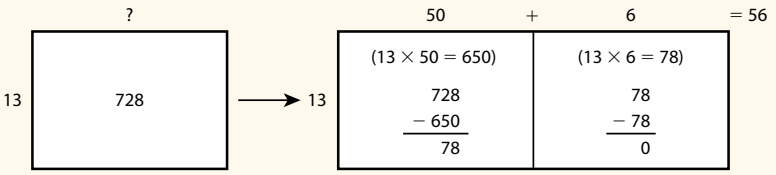
A donut shop sells donuts in boxes that each contain 13 donuts.
If 728 donuts were sold in one day, how many boxes of donuts were sold?

Multiply 13 by multiples of 10 to help you estimate the quotient. Make a table.

Number of boxes	10	20	30	40	50	60
Number of donuts	130	260	390	520	650	780

Because 728 is between 650 and 780, the quotient is between 50 and 60.

Use 50 as the first partial quotient in an area model for $728 \div 13$.



$728 \div 13 = 56$. The donut shop sold 56 boxes of donuts.

1 The area model in the Example shows how to break apart the problem $728 \div 13$ into parts.

a. What was 13 multiplied by first? 50

b. What equation in the area model shows this? $13 \times 50 = 650$

c. Why do you subtract 650 from 728?
Possible answer: to find the number left to be sorted into groups of 13

d. What is the second partial quotient? 6

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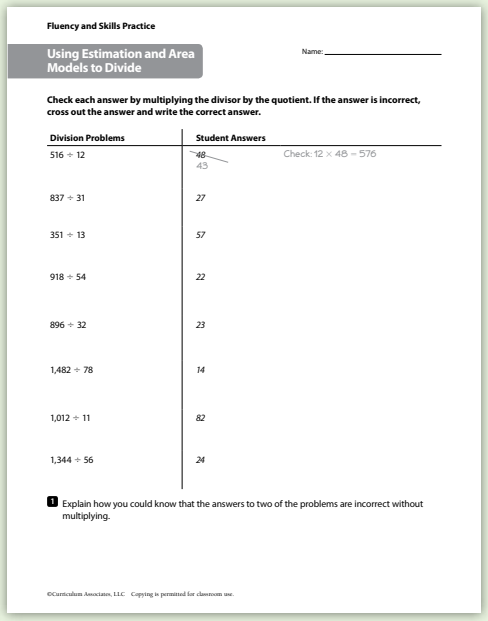
Fluency & Skills Practice

Teacher Toolbox

Assign *Using Estimation and Area Models to Divide*

In this activity students check whether a given quotient is correct by multiplying that quotient by the divisor. If the answer is incorrect, students then find the correct answer. This activity reinforces a method students may use to check their work. Students may need to verify the answer to a division problem in real-world situations. For example, if 720 mini-muffins are needed for a bake sale, and each bin can hold 48 mini-muffins, how many bins are needed?



Fluency and Skills Practice

Using Estimation and Area Models to Divide

Name: _____

Check each answer by multiplying the divisor by the quotient. If the answer is incorrect, cross out the answer and write the correct answer.

Division Problems	Student Answers
516 ÷ 12	48 (43) Check: 12 × 48 = 576
837 ÷ 31	27
351 ÷ 13	57
918 ÷ 54	22
896 ÷ 32	23
1,482 ÷ 78	14
1,012 ÷ 11	82
1,344 ÷ 56	24

1 Explain how you could know that the answers to two of the problems are incorrect without multiplying.

2 **C**; The dividend 851 is between 740 and 1,110, so the quotient is between 20 and 30, the multiples of 10 related to 740 and 1,110.
Medium

3 37 × ? = 851; See the completed area model on the student page; 851 ÷ 37 = 23. The problem starts with the students relating the division problem to multiplication. Students then build the area model by starting with multiplying 37 by 20, the lower number from the estimate in problem 2. The two partial quotients are added together to find the quotient, 23.
Medium

4 **B**; 42 is the divisor in the area model, but the equation in B represents it as an addend.
Challenge

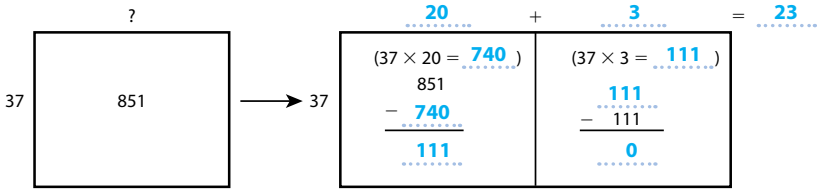
2 The table can be used to estimate the quotient 851 ÷ 37. Which of the following is the best estimate of the quotient?

Multiple of 10	10	20	30	40
37 × Multiple of 10	370	740	1,110	1,480

Ⓐ a number between 30 and 40
Ⓑ about 15
Ⓒ a number between 20 and 30
Ⓓ about 42

3 Complete the steps for using an area model to find the quotient 851 ÷ 37.

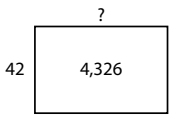
851 ÷ 37 is the same as 37 × ? = 851.



851 ÷ 37 = 23

4 Which of the following equations cannot be used to represent the area model?

Ⓐ 42 × ? = 4,326
Ⓑ 42 + 4,326 = ?
Ⓒ 4,326 ÷ ? = 42
Ⓓ 4,326 ÷ 42 = ?



ELL English Language Learners: Differentiated Instruction

Prepare for Session 4
Use with *Connect It*.

Levels 1–3

Speaking/Listening Read ***Connect It*** problem 6 with students. Have students circle the word *describe*. Share that when we *describe* something, we tell what it is like. Return to the second ***Model It*** and ask students to point to the dividend, divisor, and quotient. Have them label each number. Then provide the following sentence frames for students to describe how to divide using partial quotients:

- *First, I find a number that can be* ___multiplied___ *by the divisor to give a product that is* ___less___ *than the dividend.*
- *Then I* ___subtract___ *my answer from the dividend.*
- *Lastly, I* ___repeat___ *the steps until there is nothing left.*

Levels 2–4

Writing/Speaking Read ***Connect It*** problem 6. Write the following terms on the board: *divisor, dividend, quotient*, and *product*. Have students form pairs and write sentences that define these terms. Walk around the room and provide guidance as needed. Ask students to use the terms to label the numbers in the second ***Model It***.

Ask partners explain how to divide using partial quotients. Encourage them to use the words they defined in their explanations and to include sequencing words such as *first, next,* and *then*. Call on students to share their explanations with the class.

Levels 3–5

Reading/Writing Have students form pairs and read ***Connect It*** problem 6. Write the following terms on the board: *divisor*, *dividend*, *quotient*, *product*, and *subtract*. Have students work with a partner to write a sentence that explains what partial quotients are. Then have them write an explanation for how to divide using partial quotients.

Ask partners to exchange their sentences with other students to review and provide feedback.

LESSON 5

SESSION 4 Develop

Purpose In this session, students solve a problem that requires dividing a four-digit number by a two-digit number. Students model the division either on paper or with manipulatives to find the quotient. The purpose of this problem is to have students apply previously learned strategies and to begin using a vertical format to record partial quotients.

Start

Connect to Prior Knowledge

Materials For each pair: 10 hundreds flats, 25 tens rods, 10 ones units

Why Review the term *partial quotients* and working with four-digit dividends.

How Remind students that a partial quotient only shows part of the answer to a division problem. Given 100 as one partial quotient for 1,048, students use base-ten blocks to find additional partial quotients and then the quotient.

100 is one partial quotient for 1,048 ÷ 8.

Use base-ten blocks to find other partial quotients and the quotient.

Possible Solutions

Possible groups of partial quotients:

100, 30, 1;

100, 20, 10, 1;

100, 10, 10, 10, 1;

The quotient is 131.

Develop Language

Why Facilitate a deeper understanding of how to use the term *dozen* with quantifiers.

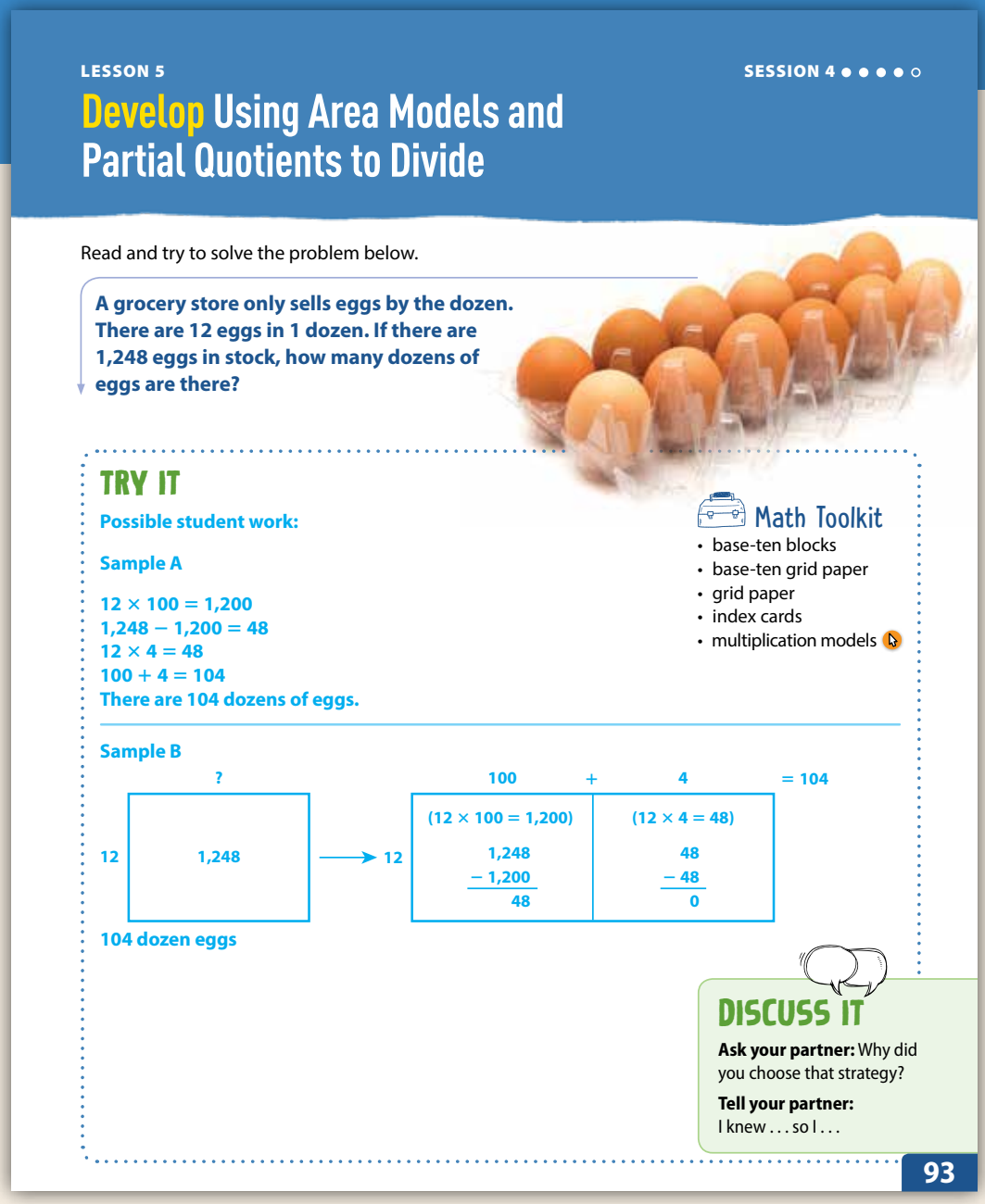
How Have students circle the word *dozen*. Say the word aloud and have students repeat after you. Say: *A dozen is a group of 12 of something. If I have 36 eggs, I have 3 dozens of eggs. It is also okay to say "3 dozen eggs." When "dozen" is used with a number and without the word "of" after it, it doesn't need the "s" to form the plural.*

TRY IT

Make Sense of the Problem

To support students in making sense of the problem, have them discuss the meaning of *in stock*.

Ask *How many eggs are in stock at the store? How many eggs are in a dozen? What is the problem asking you to find?*



LESSON 5 SESSION 4 ● ● ● ● ○

Develop Using Area Models and Partial Quotients to Divide

Read and try to solve the problem below.

A grocery store only sells eggs by the dozen. There are 12 eggs in 1 dozen. If there are 1,248 eggs in stock, how many dozens of eggs are there?

TRY IT

Possible student work:

Sample A

$12 \times 100 = 1{,}200$
$1{,}248 - 1{,}200 = 48$
$12 \times 4 = 48$
$100 + 4 = 104$
There are 104 dozens of eggs.

Sample B

	?		100	+	4	= 104
12	1,248	→ 12	(12 × 100 = 1,200)		(12 × 4 = 48)	
			1,248 − 1,200 = 48		48 − 48 = 0	

104 dozen eggs

Math Toolkit
- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: Why did you choose that strategy?

Tell your partner: I knew . . . so I . . .

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DISCUSS IT

Support Partner Discussion

Encourage students to name the model or strategy they used as they discuss their solutions.

Support as needed with questions such as:

- *How is this problem different from problems in previous sessions?*
- *How did you choose a strategy for this problem?*

Common Misconception Look for students who confuse place values while building partial products and say the quotient is 140 not 104. Have these students check their quotient by using multiplication.

Select and Sequence Student Solutions

One possible order for whole class discussion:

- base-ten blocks or grid paper used to show 1,248 divided into equal groups
- area models
- equations
- methods using two partial quotients compared to methods using three or more partial quotients

Support Whole Class Discussion

Compare and connect the different representations and have students identify how they are related.

Ask *How does your model show the total number of eggs? the number of eggs in one dozen?*

Listen for Students should recognize that accurate representations show 1,248 eggs as the total or dividend in the problem and use the number of eggs in 1 dozen, 12, as the divisor. For example, 1,248 may appear as the area of the first rectangle of an area model with 12 written as the length of one side, 1,248 may be shown as the number that multiples of 12 are subtracted from, or 1,248 may be shown divided into groups of 12 with base-ten models.

MODEL ITS

If no student presented these models, connect them to the student models by pointing out the ways they each represent:

- the dividend and the divisor
- differences after subtracting partial quotients

Ask *Where do you see the total number of eggs and the number of eggs in a dozen in each model?*

Listen for The total number of eggs, 1,248, is found as the starting point for subtraction in the area model and in the vertical format. The number of eggs in a dozen, 12, is at the left side of the area model and the left side of the division house in the vertical format.

For the area model, prompt students to think about subtraction and partial products in the model.

- *How is subtraction shown in the area model?*
- *Where are the partial quotients located?*

For the vertical format, prompt students to think about subtraction and partial products in the model.

- *How is subtraction shown in the vertical format?*
- *Where are the partial quotients located?*
- *How are the ways the two models record subtraction and partial products similar? How are they different?*

Explore different ways to record partial products when dividing multi-digit whole numbers.

A grocery store only sells eggs by the dozen. There are 12 eggs in 1 dozen. If there are 1,248 eggs in stock, how many dozens of eggs are there?

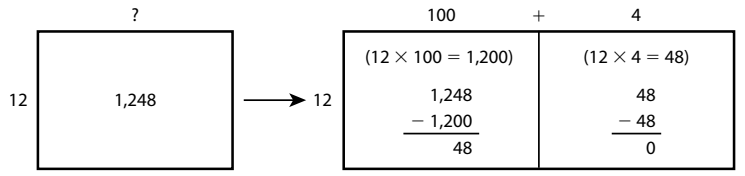
MODEL IT

You can use an area model to record partial quotients.

Estimate to determine the first partial quotient for 1,248 ÷ 12.

1,200 and 12 are compatible numbers close to the dividend and divisor.

12 × 100 = 1,200, so you can use 100 as the first partial quotient in an area model.



MODEL IT

You can use a vertical format to record partial quotients.

```
      4   ← second partial quotient
    100   ← first partial quotient
12)1,248  ← How many groups of 12 in 1,200?
- 1,200
     48   ← How many groups of 12 in 48?
-   48
      0
```

Deepen Understanding

Partial Quotient Strategy

SMP 1 Make sense of problems.

When discussing the vertical partial quotient strategy, prompt students to consider how place-value concepts are used to compute the partial quotients.

Ask *Why do you think the number of groups of 12 in 1,200 is used to find the first partial quotient? How was the second partial quotient, 4, determined?*

Listen for 1,200 can be read as twelve hundred. There are 12 hundreds in 1,200. The second partial quotient was found by finding the number of groups of 12 in the part remaining, 48.

Ask *Could you start with a different first partial quotient, such as 50? Explain.*

Listen for Yes, you could start with 50 because 12 × 50 = 600, which is still less than 1,248.

Work with students to write out the vertical format for 1,248 ÷ 12 using different sets of partial quotients, such as 50, 50, 4 or 10, 10, 50, 30, 4. Discuss how each would correspond to a different area model and how using more than one approach is a good way to check your answer.

CONNECT IT

- Remind students that one thing that is alike about the two division models is that they both use partial quotients to solve the problem.
- Explain that on this page, students will compare and connect these two division models.

Monitor and Confirm

1–4 Check for understanding that:

- the divisor, 12, multiplied by the first partial quotient, 100, equals 1,200, or the first number being subtracted from the dividend
- each partial quotient is multiplied by the divisor and the product is subtracted from the dividend, or what is left of the dividend

Support Whole Class Discussion

5 Tell students that this problem will help them better understand using partial quotients to solve the specific problem about eggs to prepare them for problem 6.

Ask *What do you need to do with the two partial quotients to tell how many dozens of eggs the store has?*

Listen for The partial quotients need to be added: 100 + 4 = 104. There are 104 dozen eggs.

6 Look for understanding that division is a process of estimating a partial quotient and multiplying it by the divisor, subtracting that product from the dividend, and repeating these steps until what is left is either less than the divisor or is zero. Then the partial quotients are added to find the quotient.

7 REFLECT Have all students focus on the strategies used to solve this problem. If time allows, have students share their preferences with a partner.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to record partial products in a vertical format.

1 Look at the second **Model It**. How many hundreds are in the dividend? 12

How many groups of 12 are in 1,200? 100

Notice that this first partial quotient is written above the bar.

2 After writing the first partial quotient above the bar, you write the number 1,200 under the dividend. What equation in the area model shows where the number 1,200 comes from? 12 × 100 = 1,200

3 Why is 1,200 subtracted from 1,248?

Possible answer: to find what is left over after finding the first partial quotient

4 How does the area model relate to finding the second partial quotient?

Possible answer: The area model shows 12 × 4 = 48. The product, 48, is recorded under 48 in the area model. The factor 4 is recorded as a partial quotient.

5 Explain how to use the partial quotients to find 1,248 ÷ 12. How many dozens of eggs does the grocery store have?

Add the partial quotients. 100 + 4 = 104, so there are 104 dozen eggs.

6 Describe how to divide using partial quotients.

Possible answer: Find a number that can be multiplied by the divisor to get a product less than or equal to the dividend. Subtract that product from the dividend. Repeat these steps until the amount remaining is less than the divisor. Add the partial quotients to find the quotient.

7 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for recording partial products? Explain.

Possible answer: I like the vertical format because it is more compact and helps me see how the partial quotients are split up by place value.

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Hands-On Activity

Use base-ten blocks to model division with partial quotients.

If . . . *students are unsure about using the vertical partial quotient format,*

Then . . . *use this activity to connect the numbers to concrete models.*

Materials For each pair: base-ten blocks (20 tens rods and 30 ones units)

- Write 168 ÷ 12 on the board, using a division house format. Have students model the dividend using tens and ones blocks. [16 tens rods, 8 ones units]
- Ask: *Which number—5, 10, or 20—do you want to use as your first estimate of how many groups of 12 you can take away from 168?* Once students decide on a number, have them remove that many groups of 12 from their model. [For example, remove 10 groups of 12, trading 2 tens for 20 ones units.]
- Ask a volunteer to come to the board to record the partial quotient and the subtraction. Have students compare the number of blocks they removed and the number of blocks remaining to the numbers in the vertical division display.
- Have students repeat these steps to divide the remaining blocks into groups of 12 and find the quotient. [14]
- If time allows, repeat activity for other division problems, such as 209 ÷ 11. [19]

APPLY IT

For all problems, encourage students to try both strategies for recording partial quotients to see which one works better for them.

8 53; See possible area model on the Student Worktext page. Students may also solve the problem using a vertical format to record partial quotients.

9 42 pennies; Students may use a vertical format to record partial quotients. Students may also solve the problem using an area model.

Close: Exit Ticket

10 **C**; Students may estimate 600 ÷ 20 = 30 as the first partial quotient.

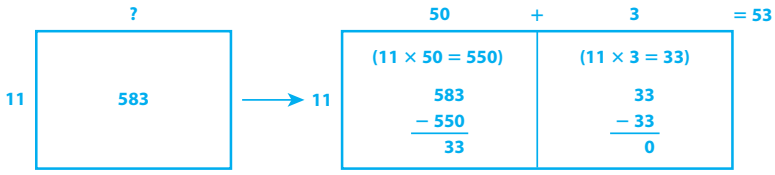
Error Alert: **If** students choose A or B, **then** review how to use multiples of 10 times the divisor to estimate the first partial quotient. Remind students that the resulting partial product must be less than or equal to the dividend, but it cannot be greater than the dividend.

APPLY IT

Use what you just learned to solve these problems.

8 What is the quotient 583 ÷ 11? Show your work.

Possible student work:



Solution 53

9 Carlos has 1,134 pennies. He puts an equal number of pennies into 27 different glass jars. How many pennies are in each jar? Show your work.

Possible student work:

```
    42
   2
  40
27)1,134
 − 1,080
    54
 −   54
     0
```

Solution 42 pennies

10 Which of the following pairs of numbers are partial quotients for 594 ÷ 18?

Ⓐ 50 and 5

Ⓑ 40 and 4

Ⓒ 30 and 3

Ⓓ 20 and 15

Solutions

1. Answers may vary; Student responses should show understanding that when Jaime multiplies to find $22 \times 70 = 1{,}540$, he will see that this product is greater than the dividend from which he would need to subtract 1,540.
Medium

2. See completed table on the student page.
   a. 30
   b. 20
   c. 50
   d. 40
Basic

Name: _____ LESSON 5 SESSION 4

Practice Using Area Models and Partial Quotients to Divide

Study the Example showing division with a two-digit divisor using partial quotients. Then solve problems 1–5.

EXAMPLE

Find 1,386 ÷ 22.

To divide using partial quotients, estimate a number that can be multiplied by the divisor to get a product less than or equal to the dividend. Then subtract the product from the dividend. Repeat these steps until you reach a number less than the divisor.

```
    3
   60
22)1,386  → How many groups of 20 in 1,200? 60
- 1,320   → 22 × 60
   66     → How many groups of 22 in 66? 3
-  66     → 22 × 3
    0
```

1,386 ÷ 22 = 63

1. Look at the Example. For the first step, Jaime thought: *How many groups of 20 in 1,400? There are 70.* If he continues with the division steps, when will he know that his first estimate of 70 is too high?

   Answers will vary. Possible answer: When he multiplies 22 × 70 in the next step, he will get a product of 1,540. That is greater than the dividend, 1,386, so he will know 70 is too high.

2. Multiply 14 by multiples of 10 to complete the table.

Multiple of 10	10	20	30	40	50	60
14 × Multiple of 10	140	280	**420**	**560**	700	**840**

Write a multiple of 10 from the table to show the greatest partial quotient to start with for each division problem below.

a. 30 / 14)462 **b.** 20 / 14)350 **c.** 50 / 14)798 **d.** 40 / 14)588

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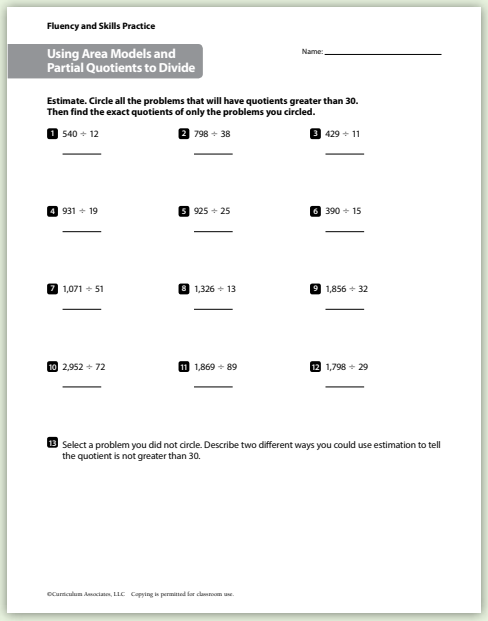
Fluency & Skills Practice

Teacher Toolbox

Assign *Using Area Models and Partial Quotients to Divide*

In this activity students estimate the quotient of dividing two multi-digit numbers and then find the exact quotients for some of the problems. Estimating quotients is a helpful skill for analyzing real-world situations in which an exact answer is not needed. For example, a student may want to know about many hours it will take a car moving at a certain speed to travel across a state. Estimation is also a way to check whether an answer is reasonable.



Fluency and Skills Practice

Using Area Models and Partial Quotients to Divide

Name: _____

Estimate. Circle all the problems that will have quotients greater than 30. Then find the exact quotients of only the problems you circled.

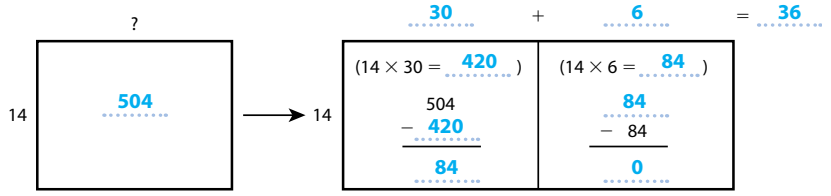
1. 540 ÷ 12 _____
2. 798 ÷ 38 _____
3. 429 ÷ 11 _____
4. 931 ÷ 19 _____
5. 925 ÷ 25 _____
6. 390 ÷ 15 _____
7. 1,071 ÷ 51 _____
8. 1,326 ÷ 13 _____
9. 1,856 ÷ 32 _____
10. 2,952 ÷ 72 _____
11. 1,869 ÷ 89 _____
12. 1,798 ÷ 29 _____
13. Select a problem you did not circle. Describe two different ways you could use estimation to tell the quotient is not greater than 30.

3 36; See completed area model on the student page.
Medium

4 12 inches; Divide the volume, 504, by the product of width and height, 42, to find the length of the box. See the student page for possible student work. Students may use an initial partial quotient less than 10 with more partial quotients and subtractions than shown on the student page.
Medium

5 94 boxes; Divide the number of pounds of food, 2,350, by the number of pounds that go into each box (25). Possible partial quotients and partial products for 2,350 ÷ 25 are $25 \times 90 = 2{,}250$ and $25 \times 4 = 100$.
Medium

3 Use an area model to find the quotient 504 ÷ 14.



504 ÷ 14 = 36

4 A rectangular box has a volume of 504 cubic inches. The width of the box is 7 inches, and the height of the box is 6 inches. Use the partial quotient method shown in the example to find the length of the box. Show your work.

Possible student work:

$7 \times 6 = 42$

```
   12
    2
   10
42)504
 − 420
   84
 −  84
    0
```

Solution 12 inches

5 A hunger relief program ships boxes that hold 25 pounds of food. How many boxes will 2,350 pounds of food fill? Show your work.

Students might use partial quotients, an area model, or some other method to solve the problem.

Solution 94 boxes

ELL English Language Learners: Differentiated Instruction

Prepare for Session 5
Use with *Apply It*.

Levels 1–3	Levels 2–4	Levels 3–5
Speaking/Listening Read ***Apply It*** problem 6 and then go back and reread the first sentence. Ask students to share what information in the first sentence is necessary to solve the problem. Then reread the second sentence. Ask: *What amount has already been used?* Reread the third sentence and have students explain what information in the third sentence is necessary to solve the problem. Have students form pairs and work together to solve the problem.	**Speaking/Listening** Read ***Apply It*** problem 6 with students. Have students form pairs, underline the second sentence and discuss the important information it contains. Using the sentence frames below, ask students to restate the problem. • *Lisa has _____ megabytes.* • *_____ of _____ has been used.* • *She has _____ available space.* • *Each picture uses _____ megabytes.* • *I need to find out _____ pictures Lisa can take.*	**Speaking/Writing** Read ***Apply It*** problem 6. Ask student to work together to restate the problem in their own words and write the steps they would use to solve the problem. Guide students as needed to write an expression that represents the problem.

LESSON 5

SESSION 5 Refine

Purpose In this session students solve word problems involving division of whole numbers and then discuss and confirm their answers with a partner.

Before students begin to work, use their responses to the *Check for Understanding* to determine those who will benefit from additional support.

As students complete the Example and problems 1–3, observe and monitor their reasoning to identify groupings for differentiated instruction.

Start

Check for Understanding

Why Confirm understanding of dividing whole numbers.

How Have students find the quotient for 4,536 divided by 42 using any strategy they want.

Find the quotient.

4,536 ÷ 42 = ?

Solution

108; Possible partial quotients and products:
42 × 100 = 4,200 and
42 × 8 = 336

Refine Dividing Multi-Digit Numbers

Complete the Example below. Then solve problems 1–8.

EXAMPLE

Each package has 21 pieces of chalk. How many packages can be made with 1,701 pieces of chalk?

Look at how you could show your work using partial quotients.

```
      1
     80
21)1,701
 −1,680   ← 21 × 80
     21
    −21   ← 21 × 1
      0
```

Solution 81 packages

Why is 80 a good number to use as a first partial quotient?

PAIR/SHARE
How can you use multiplication to check that the quotient is correct?

APPLY IT

1 A water cooler holds 1,284 ounces of water. How many more 6-ounce glasses than 12-ounce glasses can be filled from a full cooler? Show your work. **Possible student work:**

12-ounce glasses:

```
      107
        7
      100
12)1,284
 − 1,200
       84
     − 84
        0
```

6-ounce glasses:

```
      214
       14
      200
6)1,284
 − 1,200
       84
     − 84
        0
```

214 − 107 = 107

Solution 107 more 6-ounce glasses than 12-ounce glasses

You can first estimate how many glasses of each size can be filled.

PAIR/SHARE
Explain how you found your estimate.

Error Alert

If the error is . . .	*Students may . . .*	*To support understanding . . .*
180 or 18	not understand how place value relates to partial quotients.	Have students draw an area model showing two partial quotients, 4,200 ÷ 42 = 100 and 336 ÷ 42 = 8. Have students compare the area model to their written work. Discuss the place value of the partial quotients.
1,008	have written the two partial quotients next to each other instead of adding them.	Have students draw an area model showing two partial quotients, 4,200 ÷ 42 = 100 and 336 ÷ 42 = 8. Use the distributive property to remind students that partial quotients must be added.
student cannot begin the division	lack estimation skills or may not know how to combine estimation with other division strategies.	Ask students to explain why the numbers 4,200 and 42 are compatible and how they could use these compatible numbers to choose a first partial quotient.

EXAMPLE

81 packages; The vertical format to record partial quotients shown is one way to solve the problem. Students could also solve the problem by drawing an area model to find and record the partial quotients.

Look for 1,600 and 20 are compatible numbers to use to estimate that the quotient is about 80.

APPLY IT

1. 107 more 6-ounce glasses than 12-ounce glasses; See the Student Worktext page for one way to solve the problem. Students could also solve the problem by drawing two area models and subtracting their quotients to find the difference.
   DOK 2

   Look for The number of 12-ounce glasses is about 100, and the number of 6-ounce glasses is about 200.

2. 204 students; See possible work on the Student Worktext page.
   DOK 2

   Look for $35 \times 200 = 7{,}000$ and $35 \times 300 = 10{,}500$

3. **C**; Students could solve the problem by estimating that $30 \times 200 = 6{,}000$ and use 200 as the first partial quotient.

   Explain why the other two answer choices are not correct:

   B is not correct because the digits 0 and 3 are transposed; the partial quotients are 200 and 30, not 200 and 3.

   D is not correct because an extra 0 has been inserted in the first partial quotient; the partial quotients are 200 and 30, not 2,000 and 30.
   DOK 3

Error Alert Students may be confused when a zero is needed in the quotient. Remind them to record each partial quotient with all of its 0s to show its value. Stress the place value of the digits in the quotient and the role zero plays as a placeholder.

2. Each student needs 35 craft sticks for an art project. The art teacher has 7,140 craft sticks. The art teacher starts a division problem to determine how many students can get craft sticks from him. He was interrupted before he could complete the problem.

   His partial work is shown below. Fill in the blanks to complete his work. Write your answers in the blanks.

```
   204   ← quotient
     4   ← partial quotient
   200   ← partial quotient
35)7,140
 − 7,000
     140
 −   140
       0
```

What numbers can I use to estimate the quotient?

PAIR/SHARE
Explain how to check the answer to a division problem.

3. Harrison creates balloon animals for different events. He has 6,440 balloons. He wants to use the same number of balloons for each of 28 events. How many balloons can Harrison use at each event?

   Ⓐ 23

   Ⓑ 203

   Ⓒ 230

   Ⓓ 2,030

What will be the greatest place in the quotient?

Tina chose Ⓐ as the correct answer. How did she get that answer?

Possible answer: She made a mistake with place value. She divided 644 by 28 instead of 6,440 by 28.

PAIR/SHARE
Does Tina's answer make sense?

4 1,696 ÷ 32 = 53; Students may break 1,696 apart into 1,600 and 96. Divide 1,600 by 32 to get 50. Divide 96 by 32 to get 3. Add the partial quotients.
DOK 2

5 **C (40)**; **C (50)**; Divide the volume by the height to find the area of the base: 672 ÷ 16. 672 is between 640 and 800. So the area of the base is between 40 and 50 square inches.
DOK 2

6 64; Divide 2,048 by 2 to get 1,024. Then divide 1,024 by 16.
DOK 2

4 Mr. Kovich writes the problem 32 × △ = 1,696 on the board. Write a division equation that can be used to find the value of the triangle. Then find the value of the triangle. Show your work.

Possible student work:
1,696 ÷ 32 = △
How many 32s in 1,600?
32 × 50 = 1,600
1,696 − 1,600 = 96
How many 32s in 96?
32 × 3 = 96
96 − 96 = 0

Solution **1,696 ÷ 32 = 53**

5 Vera makes a table to help her find the area of the base of a rectangular box with a volume of 672 cubic inches and a height of 16 inches.

10	20	30	40	50	60
160	320	480	640	800	960

Choose the correct option to fill in each blank below.

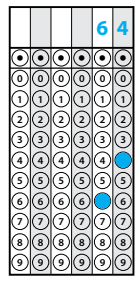
The area of the base is between _____

Ⓐ 20 Ⓑ 30 Ⓒ 40 Ⓓ 60

and _____ square inches.

Ⓐ 30 Ⓑ 40 Ⓒ 50 Ⓓ 60

6 Lisa's camera has 2,048 megabytes of memory for storing pictures. She has already used half this amount. A high-quality picture uses 16 megabytes of memory. How many high-quality pictures can Lisa store with the remaining memory?



Differentiated Instruction

RETEACH

Hands-On Activity
Use base-ten blocks with two-digit divisors.

Students struggling with division by two-digit divisors

Will benefit from additional work with estimation and division strategies.

Materials For each pair: base-ten blocks (5 hundreds flats, 10 tens rods, 10 ones units)

- Write 483 ÷ 21 on the board. Have students model 483 with their blocks.
- Ask: *How many 20s are in 100?* [5] Discuss how each hundreds flat shows 5 groups of 2 tens and why this means that the number of groups of 21 in 400 is close to 4 × 5, or 20.
- Have students explain why there are close to 4 groups of 21 in 8 tens and why there are no groups of 21 in 3 ones. Ask: *How can you use these results to estimate the quotient?* [4 groups + 20 groups = 24 groups, so the quotient is close to 24.]
- Have students show 483 divided into groups of 21. Help them see 2 hundreds flats and 1 tens rod placed side-by-side as 10 groups of 21 rather than trading hundreds flats for tens rods. [The blocks should form a 21 × 23 array, with 2 rows of 2 flats and 1 rod, and 3 rows of 2 rods and 1 unit.] Ask: *What is the quotient 483 ÷ 21?* [23].

EXTEND

Challenge Activity
Write division word problems.

Students who have achieved proficiency

Will benefit from deepening understanding of division of multi-digit whole numbers.

- Have students write division word problems using a three- or four-digit number for the dividend and a two-digit number for the divisor.
- Problems may involve separating a total into equal-sized groups or separating a total into a given number of groups.
- Have students exchange problems with a partner to solve.

7 Part A

168 students; Multiply the number of students in each class by the number of classes: $21 \times 8 = 168$.

Part B

14 teams; Divide the total number of students by the number of students on each team: $168 \div 12 = 14$.

Part C

5 fewer students; See possible explanation on the Student Worktext page. Solve the new division problem and find the difference in the two quotients.

DOK 2

7 Mr. Sullivan is organizing teams for the middle school's annual field day. There are 8 classes at the school and 21 students in each class.

Part A What is the total number of students at the school?

168 students

Part B Mr. Sullivan wants to have 12 students on each team. How many teams will there be?

14 teams

Part C How many fewer students will be on each team if he decides to have 24 teams? Explain your answer using diagrams, pictures, mathematical expressions, and/or words.

Possible student work:
168 students ÷ 24 teams = 7 students per team

12 students per team (original plan)
− 7 students per team (new plan)
5 fewer students per team

5 fewer students

8 MATH JOURNAL

Explain what you would do first to divide 1,260 by 28. Tell why it would be your first step.

Accept any reasonable answer. Possible answer: I would estimate how many times 28 divides into 1,260 by multiplying. 50 × 28 = 1,400 is too high. 40 × 28 = 1,120 is too low. I would start by dividing by 40.

SELF CHECK Go back to the Unit 1 Opener and see what you can check off.

REINFORCE

Problems 4–8

Divide multi-digit whole numbers.

All students will benefit from additional work with dividing multi-digit whole numbers by solving problems in a variety of formats.

- Have students work on their own or with a partner to solve the problems.
- Encourage students to show their work.

PERSONALIZE

i-Ready

Provide students with opportunities to work on their personalized instruction path with *i-Ready* online instruction to:

- fill prerequisite gaps
- build up grade-level skills

Close: Exit Ticket

8 MATH JOURNAL

Student responses should indicate understanding of how to estimate a first partial quotient in multi-digit whole number division.

Error Alert If students cannot describe a first step, then have them make a multiples of 10 table with the divisor 28 to estimate a first partial quotient for 1,260 ÷ 28. Discuss how an initial low estimate of the quotient can be used with either an area model or with the vertical format for recording division.

SELF CHECK Have students consider whether they feel they are ready to check off any new skills on the Unit 1 Opener.

Lesson Overview

LESSON 7

Understand Powers of 10

Lesson Objectives

Content Objectives

- Explain the relationship between the values of numbers when multiplying or dividing by powers of 10.
- Explore the placement of the decimal point when multiplying or dividing a decimal by a power of 10.
- Use exponents to denote powers of 10.

Language Objectives

- Record and extend place-value patterns using models and equations.
- Use language of equivalent fractions to describe equivalent decimals.
- Record decimals in place-value charts to show the effect of multiplying or dividing by a power of 10.
- Read powers of 10 written with exponents.
- Write powers of 10 using exponents.

Prerequisite Skills

- Understand place value in whole numbers and decimals.
- Multiply multi-digit numbers.
- Multiply and divide by 10.

Standards for Mathematical Practice (SMP)

SMPs 1, 2, 3, 4, 5, and 6 are integrated in every lesson through the *Try-Discuss-Connect* routine.*

In addition, this lesson particularly emphasizes the following SMPs:

6 Attend to precision.

7 Look for and make use of structure.

8 Look for and express regularity in repeated reasoning.

*See page 1i to see how every lesson includes these SMPs.

Lesson Vocabulary

- **base (of a power)** in a power, the number that is used as a repeated factor.
- **exponent** the number in a power that tells how many times to use the base as a factor in repeated multiplication.
- **power of 10** a number that can be written as a product of tens. For example, 100 and 1,000 are powers of 10 because $100 = 10 \times 10$ and $1{,}000 = 10 \times 10 \times 10$.

Review the following key term.

- **decimal** a number containing a decimal point that separates a whole from fractional place values (tenths, hundredths, thousandths, and so on).

Learning Progression

In the previous lesson students explored place value in decimals through the thousandths place. They recognized that decimals use the same base-ten concepts as whole numbers and learned that a digit in one place not only has ten times the value it would have in the place to its right but also has one tenth of the value it would have in the place to its left. Students used visual models and equations to explore patterns in place-value relationships between numbers, based on multiplying or dividing by 10.

In this lesson students explore the concept of powers of 10. They learn to recognize patterns in the number of zeros and in the placement of the decimal point when a number is multiplied or divided by a power of 10, understanding that the position of the decimal point is always between the ones place and the tenths place. Students are introduced to exponents as a way to write powers of 10. They relate an exponent to the number of zeros in a product or quotient when a number is multiplied or divided by a power of 10 as well as to the placement of the decimal point in the product or quotient and the place value of each digit.

Later in Grade 5 students will use these understandings when they multiply and divide decimals and reason about the placement of the decimal point in products and quotients. Understanding powers of 10 prepares students for work in later grades with scientific notation and exponential expressions and equations.

Lesson Pacing Guide

Whole Class Instruction

SESSION 1
Explore
45–60 min

Interactive Tutorial* *(Optional)*
Prerequisite Review:
Understand Place Value

Explore Powers of 10
- Start *5 min*
- Model It *10 min*
- Discuss It *5 min*
- Model It *10 min*
- Discuss It *10 min*
- Close: Exit Ticket *5 min*

Additional Practice
Lesson pages 135–136

SESSION 2
Develop
45–60 min

Understanding of Powers of 10
- Start *5 min*
- Model It: Decimal Point Patterns *5 min*
- Discuss It *5 min*
- Model It: Place-Value Charts *5 min*
- Discuss It *5 min*
- Connect It *15 min*
- Close: Exit Ticket *5 min*

Additional Practice
Lesson pages 139–140

Fluency
Understanding of Powers of 10

SESSION 3
Refine
45–60 min

Ideas About Powers of 10
- Start *5 min*
- Apply It *35 min*
- Close: Exit Ticket *5 min*

Lesson Quiz or **Digital Comprehension Check**

Lesson Materials

Lesson *(Required)*	*Activity Sheet:* Digit Cards
Activities	*Per pair:* base-ten blocks (10 hundreds flats, 11 tens rods); 4 strips of paper, each showing one row of the completed place-value chart in Session 2, problem 3
Digital Math Tool	Base-Ten Blocks

*We continually update the Interactive Tutorials. Check the Teacher Toolbox for the most up-to-date offerings for this lesson.

Teacher Toolbox

Small Group Differentiation

PREPARE

Ready Prerequisite Lessons

Grade 4
- Lesson 1 Understand Place Value
- Lesson 26 Relate Decimals and Fractions

RETEACH

Tools for Instruction

Grade 4
- Lesson 1 Place Value in Multi-Digit Whole Numbers
- Lesson 26 Write Fractions as Decimals

Grade 5
- Lesson 7 Powers of Ten

REINFORCE

Math Center Activities

Grade 5
- Lesson 7 Powers of Ten Vocabulary Match
- Lesson 7 Patterns of Zeros

EXTEND

Enrichment Activity

Grade 5
- Lesson 7 Broken Calculator

i-Ready

Independent Learning

PERSONALIZE

i-Ready Lessons*

Grade 5
- Multiplication and Division of Decimals by Positive Powers of Ten
- Practice: Decimals and Powers of Ten
- Practice: Whole Numbers and Powers of Ten

Learning Games
- Prerequisite: *Zoom*
- Prerequisite: *Bounce*

LESSON 7

Connect to Family, Community, and Language Development

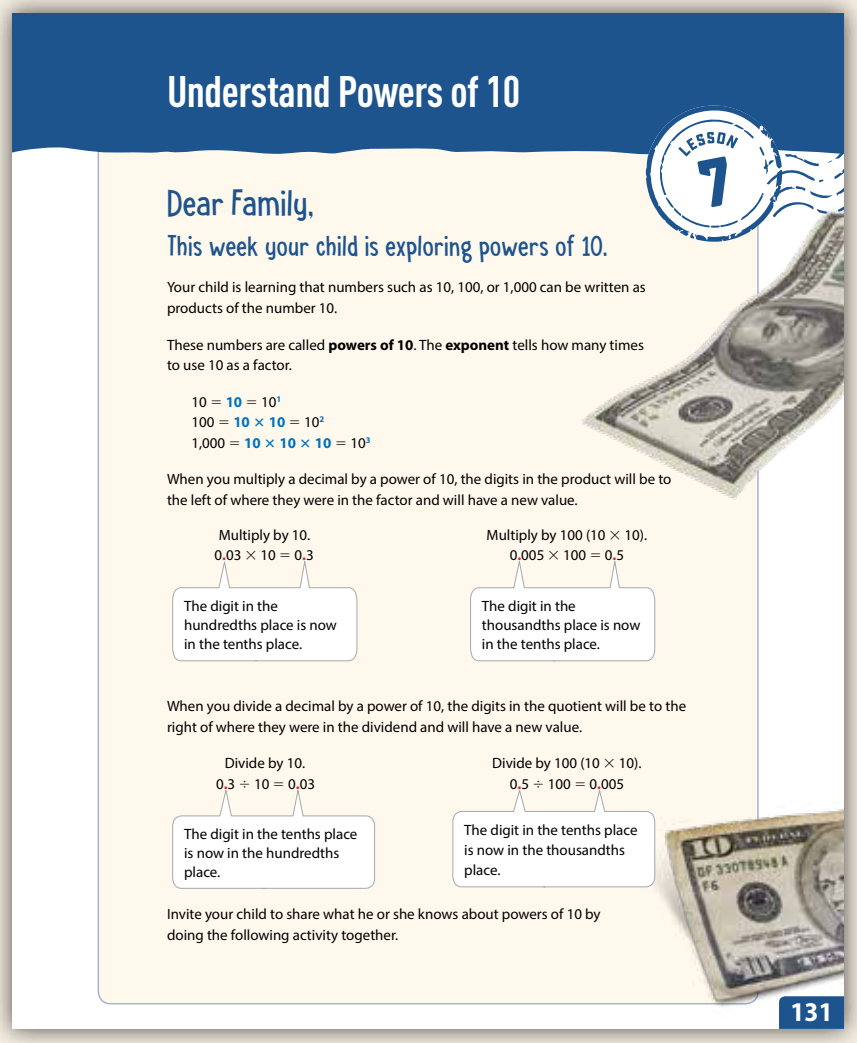
The following activities and instructional supports provide opportunities to foster school, family, and community involvement and partnerships.

Connect to Family

Use the **Family Letter**—which provides background information, math vocabulary, and an activity—to keep families apprised of what their child is learning and to encourage family involvement.

Available in Spanish

Teacher Toolbox



Understand Powers of 10

LESSON 7

Dear Family,

This week your child is exploring powers of 10.

Your child is learning that numbers such as 10, 100, or 1,000 can be written as products of the number 10.

These numbers are called **powers of 10**. The **exponent** tells how many times to use 10 as a factor.

$10 = \mathbf{10} = 10^1$
$100 = \mathbf{10 \times 10} = 10^2$
$1{,}000 = \mathbf{10 \times 10 \times 10} = 10^3$

When you multiply a decimal by a power of 10, the digits in the product will be to the left of where they were in the factor and will have a new value.

Multiply by 10.
$0.03 \times 10 = 0.3$
The digit in the hundredths place is now in the tenths place.

Multiply by 100 (10×10).
$0.005 \times 100 = 0.5$
The digit in the thousandths place is now in the tenths place.

When you divide a decimal by a power of 10, the digits in the quotient will be to the right of where they were in the dividend and will have a new value.

Divide by 10.
$0.3 \div 10 = 0.03$
The digit in the tenths place is now in the hundredths place.

Divide by 100 (10×10).
$0.5 \div 100 = 0.005$
The digit in the tenths place is now in the thousandths place.

Invite your child to share what he or she knows about powers of 10 by doing the following activity together.

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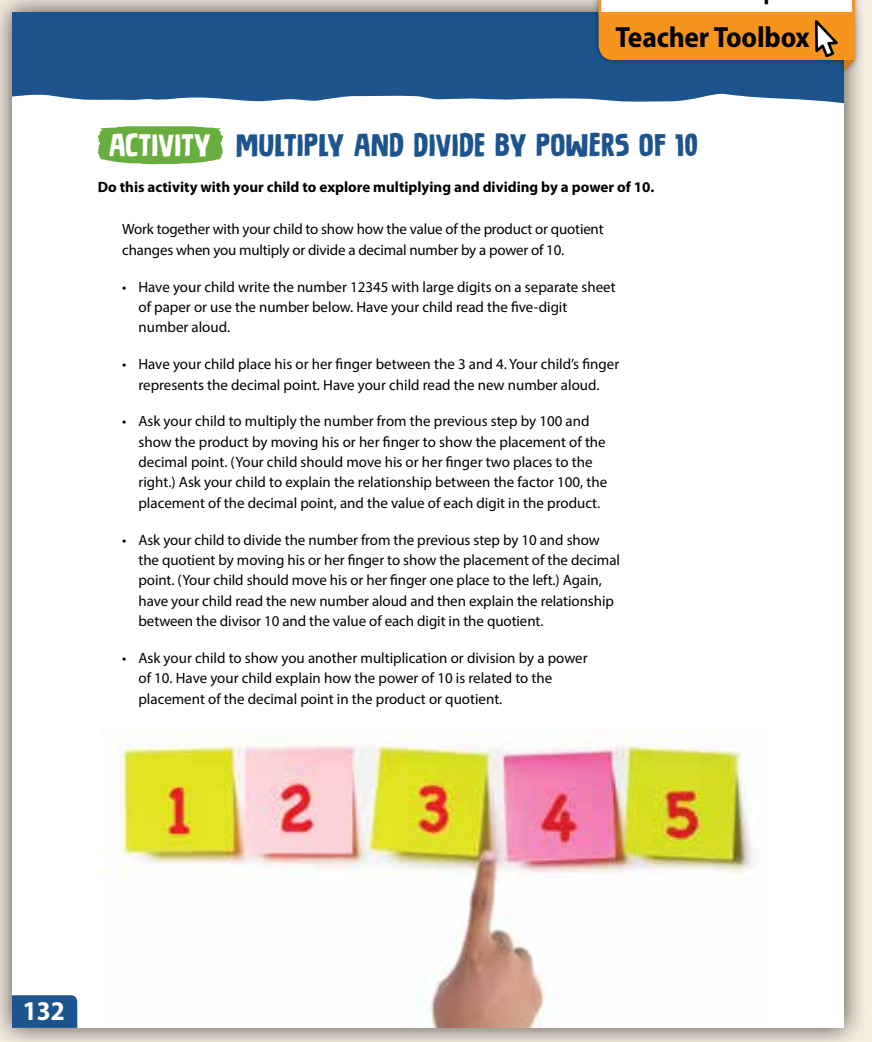

ACTIVITY MULTIPLY AND DIVIDE BY POWERS OF 10

Do this activity with your child to explore multiplying and dividing by a power of 10.

Work together with your child to show how the value of the product or quotient changes when you multiply or divide a decimal number by a power of 10.

- Have your child write the number 12345 with large digits on a separate sheet of paper or use the number below. Have your child read the five-digit number aloud.
- Have your child place his or her finger between the 3 and 4. Your child's finger represents the decimal point. Have your child read the new number aloud.
- Ask your child to multiply the number from the previous step by 100 and show the product by moving his or her finger to show the placement of the decimal point. (Your child should move his or her finger two places to the right.) Ask your child to explain the relationship between the factor 100, the placement of the decimal point, and the value of each digit in the product.
- Ask your child to divide the number from the previous step by 10 and show the quotient by moving his or her finger to show the placement of the decimal point. (Your child should move his or her finger one place to the left.) Again, have your child read the new number aloud and then explain the relationship between the divisor 10 and the value of each digit in the quotient.
- Ask your child to show you another multiplication or division by a power of 10. Have your child explain how the power of 10 is related to the placement of the decimal point in the product or quotient.

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Goal

The goal of the Family Letter is to reinforce the concept that powers of ten are numbers such as 10, 100, or 1,000 that can be written as products of the number 10.

- Multiplying and dividing a decimal by a power of 10 affects the placement of the decimal point and the value of each digit.

Activity

Work with students to explore how multiplying and dividing by a power of 10 is related to the placement of the decimal point in the product or quotient. Use the *Multiply and Divide by Powers of 10* activity and adjust if needed to connect with your students.

Math Talk at Home

Encourage students to talk with their family members about situations in which decimals are necessary.

Conversation Starters Below are additional conversation starters students can write in their Family Letter or math journal to engage family members:

- *What happens when you divide a dollar by 10? If you write the result as dollars and cents, where is the decimal point placed?*
- *What happens when you multiply a dollar by 100? If you write the result as dollars and cents, where is the decimal point placed?*

Connect to Community and Cultural Responsiveness

Use these activities to connect with and leverage the diverse backgrounds and experiences of all students.

Session 1 **Use anytime during the session.**

- Have a conversation with students about currency from different countries. Point out that in many countries it is common to have bills of 1, 10, 100, or 1,000. Powers of 10 and exponents are useful when thinking about U.S. dollars and many other types of currency. Discuss with students how an equation such as $100 = 10 \times 10$ could be represented using a hundred-dollar bill and ten-dollar bills. The equation $500 = 5 \times 10 \times 10$ can be represented using 5 stacks of 10 ten-dollar bills. Have students think about how they would represent other equations using bills.

Session 2 **Use with *Model It*.**

- Point out the photo of the ten-dollar bill below problem 2. Have a conversation with students about different containers used to save money. Point out that in the United States, many children put the coins and bills they save in piggy banks, containers in the shape of pigs. In other countries, such as Nepal, ceramic pots with slits are used. Ask students if they have ever saved money in a piggy bank or in another type of container. Ask them if they ever broke open the piggy bank and, if so, how they counted the money that was in it. Help students think about how they can write $10 as a power of 10. Repeat for $100. Encourage them to show the power of 10 in exponent form in each case.

Connect to Language Development

For ELLs, use the Differentiated Instruction chart to plan and prepare for specific activities in every session.

English Language Learners: Differentiated Instruction

Prepare for Session 1
Use with *Model It*.

Levels 1–3	Levels 2–4	Levels 3–5
Reading/Speaking Read ***Model It*** problem 1 aloud. Have students underline the phrase *product of tens* and confirm that understanding that this refers to the result of multiplying factors of 10. Have students point to the factors of 10 on the diagram. Ask: *What patterns do you see? How many factors of 10 are there? How many zeroes are there?* Organize students into small groups to solve the equations. Encourage them to use words, gestures, or arrows to identify the patterns. After students have written their answers, have them circle and state the products that are powers of 10. (100; 1,000; 10,000)	**Reading/Speaking** Read ***Model It*** problem 1 with students. Organize students into small groups to discuss the diagram and solve the equations. Then give each group index cards one of the following terms on each: *factor, product, multiply, tens, pattern*. Ask them to take turns selecting an index card, read the word, and use it to describe powers of 10. After students have discussed each term, provide the sentence starter: • *Powers of ten are* _____. Have students define the term in a complete sentence using their own words. Ask volunteers to share ideas with the class.	**Reading/Writing** Have students read ***Model It*** problem 1 with a partner. Ask them to think aloud together to interpret the diagram, make sense of the problem, and solve the equations. Have partners make a list of math terms they use as they think aloud, such as: *factor, times 10, number of zeroes, patterns, number of tens, product*. Ask students to reflect on the bold term, powers of 10. Have each student write a definition for the term using important terms and ideas from their partner discussion. Ask volunteers to share their sentences with the class.

LESSON 7

SESSION 1 Explore

Purpose In this session students explore the idea that there are patterns in the number of zeros found in products or quotients when multiplying or dividing by powers of 10. They represent powers of 10 with exponents.

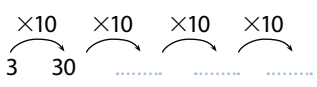
Start

Connect to Prior Knowledge

Why Prepare students for multiplying with powers of 10 and reinforce their knowledge of relationships between adjacent place values.

How Have students complete the × 10 pattern that starts with 3. Students will look for relationships between numbers in this diagram in problem 1.

Complete the × 10 pattern.



Solution
300, 3,000, 30,000

MODEL IT

Read the question at the top of the Student Worktext page. Remind students that they know how each place value is related to the place value to its right and to its left.

1 – 2 Tell students that they are going to use what they know about relationships between adjacent place values to show how numbers relate across several place values, as shown by the arrows below the diagrams. Then clarify the task and have students complete the problems.

Common Misconception **If** students are unsure about the quotients in problem 2, **then** have them write each divisor as a product of 10s.

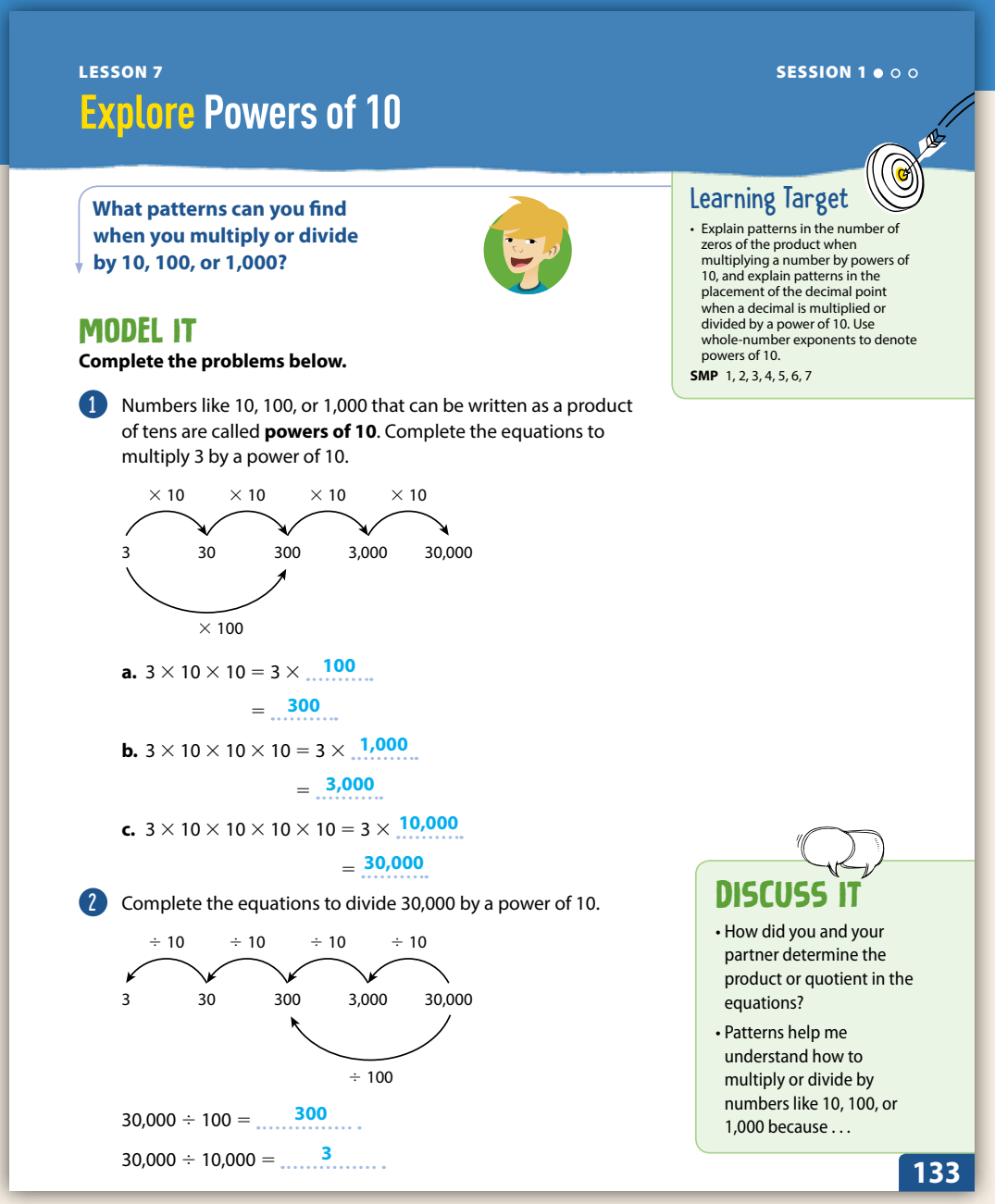
DISCUSS IT

Support Partner Discussion

Encourage students to look for patterns in the diagrams and equations.

Listen for recognition of:

- the relationship between the number of zeros in the product and the number of factors of 10
- the relationship between the numbers of zeros in the quotient and in the dividend and divisor



LESSON 7 SESSION 1 ● ○ ○

Explore Powers of 10

What patterns can you find when you multiply or divide by 10, 100, or 1,000?

Learning Target

- Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

SMP 1, 2, 3, 4, 5, 6, 7

MODEL IT

Complete the problems below.

1 Numbers like 10, 100, or 1,000 that can be written as a product of tens are called **powers of 10**. Complete the equations to multiply 3 by a power of 10.

a. 3 × 10 × 10 = 3 × 100
= 300

b. 3 × 10 × 10 × 10 = 3 × 1,000
= 3,000

c. 3 × 10 × 10 × 10 × 10 = 3 × 10,000
= 30,000

2 Complete the equations to divide 30,000 by a power of 10.

30,000 ÷ 100 = 300

30,000 ÷ 10,000 = 3

DISCUSS IT

- How did you and your partner determine the product or quotient in the equations?
- Patterns help me understand how to multiply or divide by numbers like 10, 100, or 1,000 because . . .

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Support Whole Class Discussion

Prompt students to use the two diagrams and equations to compare multiplying and dividing by 10, 100, and 1,000.

Ask *What do you notice about the number of zeros in each product and the numbers of factors of 10?*

Listen for The number of zeros in the product is the same as the number of factors of 10.

Ask *How does the value of the digit 3 in 3,000 compare to the value of the digit 3 in 30? How can you use the diagram to answer the question?*

Listen for The value of the 3 in 3,000 is 100 times as great as the value of the 3 in 30. The diagram shows that to go from 30 to 3,000, you multiply by 10 × 10, or 100.

Ask *What do you notice about the number of zeros in each quotient and the number of zeros in the dividend and divisor?*

Listen for Each factor of 10 in the divisor reduces the number of zeros in the dividend by one. The numbers of zeros in the quotient is the difference between the number of zeros in the dividend and divisor.

MODEL IT

Complete the problems below.

3 You can write a power of 10 using an **exponent**.

The exponent **4** means to use the **base 10** as a factor 4 times.

$$10^4 = 10 \times 10 \times 10 \times 10$$

Complete the table to show different ways to write the first three powers of 10.

Standard Form	Product of Tens	Exponent Form
10	10	10^1
100	10 × 10	10^2
1,000	10 × 10 × 10	10^3

DISCUSS IT

- What patterns do you notice in multiplying by powers of 10?
- Using exponent form helps me understand place-value relationships because . . .

4 Complete the table to show different ways to write 300, 3,000, and 30,000.

Standard Form	Using a Power of 10	Using Factors of 10	Exponent Form
300	3 × 100	3 × 10 × 10	3×10^2
3,000	3 × 1,000	3 × 10 × 10 × 10	3×10^3
30,000	3 × 10,000	3 × 10 × 10 × 10 × 10	3×10^4

5 REFLECT

How do you know how many zeros are in the product 5×10^4? What is the product?

Possible answer: 10^4 means 10 × 10 × 10 × 10, which equals 10,000. There are four factors of 10 and four zeros in the product.

The product is 50,000.

MODEL IT

3 – 4 Tell students that they will now think about another way to write powers of ten. Clarify the tables as necessary and have students complete the problems.

Common Misconception **If** students misinterpret an exponent as a factor—for example, by writing 10 × 2 in the second row of the table in problem 3—**then** review the definition of an exponent shown on the Student Worktext page. Help students see that there is no *factor* of 4—instead, there are four factors of 10.

DISCUSS IT

Support Partner Discussion

Again encourage students to look for patterns as they work.

Listen for understanding that:

- the exponent is the small numeral in the upper-right position next to the 10
- the exponent shows the number of times 10 is used as factor
- the standard form has a zero for each factor of 10.

Hands-On Activity

Use base-ten blocks to model powers of 10.

If . . . *students are unsure about exponents and powers of 10,*

Then . . . *use this activity to give them practice writing powers of 10 with factors of 10 and with exponents.*

Materials For each pair: base-ten blocks (10 hundreds flats, 11 tens rods)

- Ask students to use their blocks to show 10. [1 tens rod]
- Have students multiply 10 by 10 by setting out 10 tens rods in a row. Ask: *What base-ten block is this equivalent to?* [1 hundreds flat]
- Then have students multiply by 10 again, laying out 10 flats in a row to make 1,000.
- Finally, have students write $10^1 = 10$, $10^2 = 10 \times 10$, and $10^3 = 10 \times 10 \times 10$ on index cards and match the expressions to their models.

Support Whole Class Discussion

Prompt students to compare the three forms of writing a power of 10. Encourage them to use the terms *factor, exponent,* and *base.*

Ask *Describe all the ways that* ten thousand *is shown in the table in problem 4.*

Listen for Ten thousand is shown in standard form as 10,000 in the second column, it is shown as four factors of 10 (10 × 10 × 10 × 10) in the third column, and it is shown by using the exponent 4 on the base 10 (10^4) in the fourth column.

Close: Exit Ticket

5 REFLECT

Look for understanding that the exponent indicates how many times 10 is used as a factor in the product. In this case, the exponent is 4, so the product is 5 × 10 × 10 × 10 × 10, or 50,000.

Common Misconception **If** students confuse the factor of 5 with the exponent of 4, **then** refer them back to the table in problem 4. Have them underline the factor of 3 in the exponent form and the three in the standard form. Then have them circle each exponent one at a time and its corresponding number of zeros in the standard form.

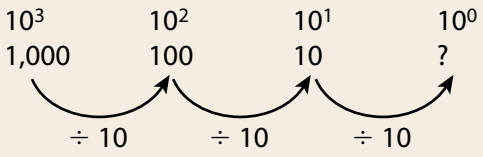
Solutions

Support Vocabulary Development

1 Have students say *power of 10*. Have students work in partners to fill in each box with different examples of powers of 10. Walk around the room and look for a written example and a numerical example of a power of 10.

Make a class anchor chart that mirrors the one on the student page. Throughout the week, call on volunteers to add examples of powers of 10 to the chart.

Help students reason to find the value of 10^0 so that they can add it to their charts. Write the following pattern on the board.



Guide them to the conclusion that $10^0 = 1$.

2 Have students circle the word *product*. Remind students that a *product* refers to the result of a multiplication operation. Ask students to use the diagram to find the two products the problem asks for.

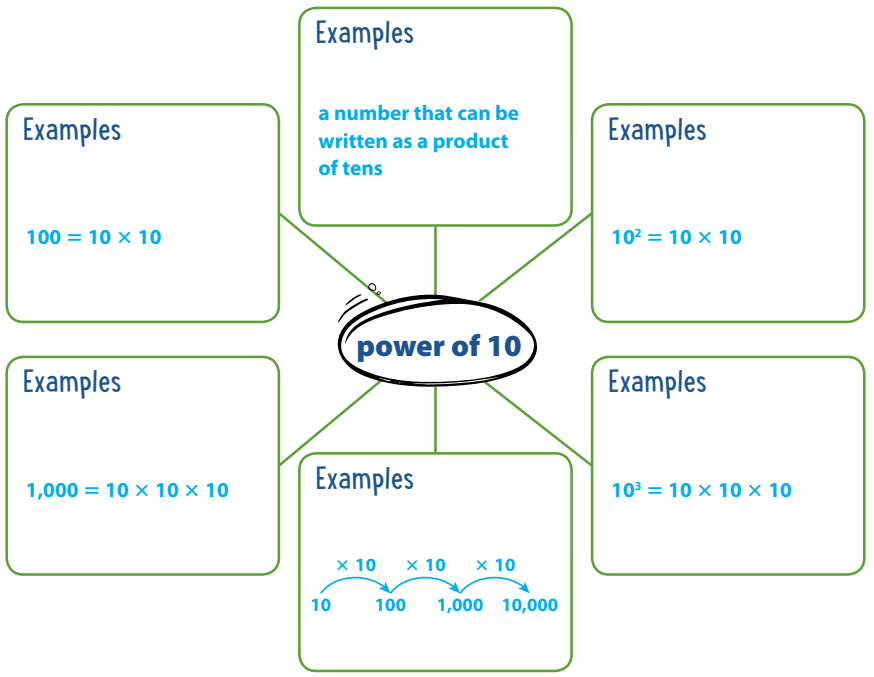
Supplemental Math Vocabulary

- *product*

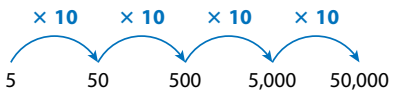
Name: _____ LESSON 7 SESSION 1

Prepare for Powers of 10

1 Think about what you know about powers of 10. Fill in each box.
Use words, numbers, and pictures. Show as many ideas as you can. **Possible answers:**



2 Use the diagram to help you find each product.



$5 \times 100 =$ 500

$5 \times 10{,}000 =$ 50,000

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3 Students complete a table to show powers of 10 in standard form, as a product of tens, and in exponent form; See the completed table on the student page.

Medium

4 Students complete the multiplication equations to show each power of 10 written as a product of tens and written with an exponent; See the completed table on the student page.

Medium

5 Students rewrite two division equations to show the power of 10 in exponent form.

$5{,}000 \div 10^2 = 50$

$5{,}000 \div 10^3 = 5$

Medium

Solve.

3 Complete the table showing different ways to write powers of 10.

Standard Form	Product of Tens	Exponent Form
100	10×10	10^2
1,000	$10 \times 10 \times 10$	10^3
10,000	$10 \times 10 \times 10 \times 10$	10^4
100,000	$10 \times 10 \times 10 \times 10 \times 10$	10^5

4 Complete the table to show different ways to write 500, 5,000, and 50,000.

Standard Form	Using a Power of 10	Using Factors of 10	Exponent Form
500	5×100	$5 \times 10 \times 10$	5×10^2
5,000	$5 \times 1{,}000$	$5 \times 10 \times 10 \times 10$	5×10^3
50,000	$5 \times 10{,}000$	$5 \times 10 \times 10 \times 10 \times 10$	5×10^4

5 Rewrite each division equation to show the power of 10 in exponent form. Use the first pair of equations as an example.

$5{,}000 \div 10 = 500 \longrightarrow 5{,}000 \div 10^1 = 500$

$5{,}000 \div 100 = 50 \longrightarrow 5{,}000 \div 10^2 = 50$

$5{,}000 \div 1{,}000 = 5 \longrightarrow 5{,}000 \div 10^3 = 5$

ELL English Language Learners: Differentiated Instruction

Prepare for Session 2
Use with *Connect It*.

Levels 1–3

Listening/Writing Read ***Connect It*** problem 5 aloud. Have partners locate the decimal point pattern diagram and place-value chart, and display them side by side. Read the sentence frames below, filling in only the operation (multiply or divide) and have students gesture to indicate if the missing word is *right* or *left*.

- *When I _____ the digits move _____ into the next place-value position.*
- *When I _____ the decimal point is placed to the _____.*

Display the completed sentence frames. Suggest phrases from the sentence frames for students to use as they compose their written answers.

Levels 2–4

Reading/Writing Read ***Connect It*** problem 5 with students. Have them form pairs to talk and write about the problem. Encourage them to use the terms *multiplication, division, placement, left* and *right* in their comparisons. Allow time for exploratory talk, then provide sentence frames for partners to complete together:

- *In the decimal point pattern diagrams, the placement of the decimal point changes _____ when _____.*
- *In the place-value chart, the digits move _____ when _____.*

Have them complete the sentence frames for both multiplication and division.

Levels 3–5

Reading/Writing Have students read ***Connect It*** problem 5 and form pairs to compare the models and discuss how each one shows the same information in a different way. Provide sentence starters for describing each model:

- *The decimal point pattern diagram shows _____.*
- *The place value chart shows _____.*

Have students discuss ways to complete the sentence starters, then write their answers individually.

LESSON 7

SESSION 2 Develop

Purpose In this session students look at decimal point patterns and place-value charts to examine patterns when multiplying or dividing by powers of 10. They compare how these models show the patterns in the placement of the decimal point. Then they use their understanding to find the value of an expression involving a power of 10.

Start

Connect to Prior Knowledge

Why Support students' ability to understand and work with exponents.

How Have students rewrite products that involve a power of 10 in exponent form, using the correct number of factors of 10, and then find the product.

Write each product with factors of 10. Then find its value.

$4 \times 10^2 =$ ..... $=$ .....

$4 \times 10^3 =$ ..... $=$ .....

$4 \times 10^4 =$ ..... $=$ .....

Solutions

$4 \times 10 \times 10 = 400$;
$4 \times 10 \times 10 \times 10 = 4{,}000$;
$4 \times 10 \times 10 \times 10 \times 10 = 40{,}000$

Develop Language

Why Foster a deeper understanding of the meaning of the word *power* in mathematics.

How Ask students to circle the term *powers* in the title of the session. Ask students to share what *power* means in everyday language. [capability, authority] Explain that in mathematics, multiplying or dividing by a *power of 10* influences the magnitude [size] of a number by changing the place value of its digits. Suggest that students remember this meaning by thinking of someone who is powerful and therefore can influence change.

MODEL IT: DECIMAL POINT PATTERNS

1 – 2 Present the problems and have students complete. As students work, have them identify that they are being asked to look for and use patterns in the placement of the decimal point when multiplying and dividing by powers of 10.

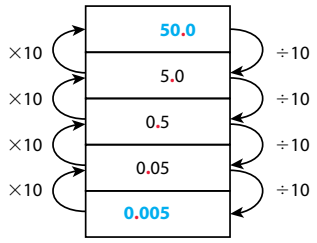
Develop Understanding of Powers of 10

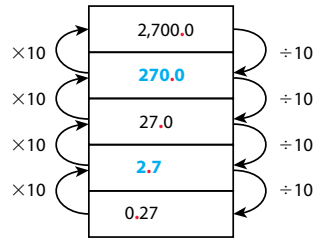
MODEL IT: DECIMAL POINT PATTERNS

Try these two problems.

1 The diagrams below show patterns in the placement of the decimal point each time you multiply or divide a decimal by 10.

Complete the missing numbers in each diagram. The decimal point for each missing number is already placed for you.





2 Use the decimal point pattern diagrams above to help you find each product or quotient.

$0.5 \times 100 =$ 50

$0.5 \times 10^2 =$ 50

$5 \div 100 =$ 0.05

$5 \div 10^2 =$ 0.05

$0.27 \times 1{,}000 =$ 270

$0.27 \times 10^3 =$ 270

$2{,}700 \div 1{,}000 =$ 2.7

$2{,}700 \div 10^3 =$ 2.7

DISCUSS IT

- What happens to the value of a number when you multiply or divide by a power of 10? Why?
- I think patterns in the placement of the decimal point help you multiply by 1,000 because . . .

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Common Misconception **If** students write $0.5 \times 100 = 0.500$ by inserting zeros without changing the placement of the decimal point, **then** have them write the original number and their answer as fractions to see that the value did not change $\left(\frac{5}{10} = \frac{500}{1{,}000}\right)$.

DISCUSS IT

Support Partner Discussion

Encourage students to look for the pattern in the placement of the decimal point.

Support as needed with questions such as:

- *Did you use the diagrams to help you find the products and quotients?*
- *How did the values of the digits 5, 2, and 7 change as you multiplied and divided?*

Support Whole Class Discussion

For each problem, have volunteers share complete tables and equations.

Ask *How is multiplying by a power of 10 similar to dividing by that same power of 10? How is it different?*

Listen for The digits move the number of places equal to the power of ten whether you multiply or divide. They move to the left when multiplying and to the right when dividing.

MODEL IT: PLACE-VALUE CHARTS

3 – 4 Present the problems and have students complete. As students work, have them identify that they are being asked to use place-value charts to show the result of multiplying and dividing decimals by powers of 10.

Point out that the number in the first row of each chart is multiplied or divided by 10^0, or 1.

DISCUSS IT

Support Partner Discussion

Encourage students to look at how the digit 5 moves when multiplying and dividing by powers of 10.

Support as needed with questions such as:

- *How did you know how many factors of 10 to multiply or divide by?*
- *How did the value of the 5 change?*

Support Whole Class Discussion

For each problem, have one student share a completed table.

Ask *Why does the digit 5 move one place to the right when you divide by a power of 10?*

Listen for Dividing a number by 10 decreases the value of each digit by one place value.

Hands-On Activity

Explore decimal point placement.

If . . . *students are unsure about describing the patterns in the placement of the decimal point,*

Then . . . *use this activity to help them relate the place-value charts to the decimal point patterns.*

Materials For each pair: 4 strips of paper, each showing 1 row of the completed place-value chart in problem 3

- Have students arrange the strips in the order of the place-value chart in problem 3, with decimal points aligned vertically. Ask: *How does the digit 5 change position each time you multiply by 10?* [It moves 1 place to the left.]
- Have students move the strips of paper so the 5s align vertically. Then have students describe how and why the placement of the decimal point changes.
- Repeat for division using the same strips to show the place-value chart in problem 4.

MODEL IT: PLACE-VALUE CHARTS

Use place-value charts to show multiplying and dividing by powers of 10.

3 Complete each row with the product shown to the right of that row.

Ones	.	Tenths	Hundredths	Thousandths	
0	.	0	0	5	
0	.	0	5	0	0.005×10^1
0	.	5	0	0	0.005×10^2
5	.	0	0	0	0.005×10^3

4 Complete each row with the quotient shown to the right of that row.

Ones	.	Tenths	Hundredths	Thousandths	
5	.	0	0	0	
0	.	5	0	0	$5 \div 10^1$
0	.	0	5	0	$5 \div 10^2$
0	.	0	0	5	$5 \div 10^3$

DISCUSS IT

- How do the values of the digits and the placement of the decimal point change when you multiply or divide any decimal by a power of 10?
- I think place-value charts show the pattern of multiplying and dividing by powers of 10 because . . .

CONNECT IT

Complete the problems below.

5 Look at the first decimal point pattern diagram and the place-value charts. How do the position and the value of the digit 5 change when multiplying and dividing by 10?

Possible answer comparing multiplication: Each time you multiply by 10, the digit 5 moves one place value to the left and its value becomes 10 times greater. When dividing by 10, the digit 5 moves one place value to the right and its value becomes $\frac{1}{10}$ of what it was in the row above.

6 Show how to find the product 0.19×10^3.

Possible student work: $0.19 \times 10 = 1.9$; $1.9 \times 10 = 19$; $19 \times 10 = 190$; $0.19 \times 10^3 = 190$

CONNECT IT

5 Student responses show understanding of patterns in the placement of the decimal when you multiply or divide by a power of 10. Students should be able to describe that noticing the placement of the decimal point relative to the digits is another way to recognize that the place value of the digits has changed.

Close: Exit Ticket

6 Look for understanding that the exponent 3 indicates to multiply by 10 three times and that this changes the position of all digits three places to the left.

Common Misconception **If** students move the digits to the right instead of to the left, **then** have them think about whether the product should be greater than 0.19 or less than 0.19.

Solutions

1 Write the missing factors as powers of ten in exponential form.

a. 10^1; 10^3

b. 10^2; 10^3

c. 10^3; 10^2

Basic

2 **a.** 800

b. 10^3; 8,000

c. 10; 20

d. 10^2; 2

Medium

3 **a.** 30

b. 18

Medium

Name: _____ LESSON 7 SESSION 2

Practice with Powers of 10

Study how the Example shows multiplying a decimal number by a power of 10. Then solve problems 1–7.

EXAMPLE

Find $10^2 \times 0.004$.

Break 10^2 into the product of tens.

$10^2 \times 0.004 = 10 \times \mathbf{10} \times \mathbf{0.004}$
$= 10 \times \mathbf{0.04}$
$= 0.4$

The value of the digit 4 increases by moving one place to the left for each factor of 10.

$10^2 \times 0.004 = 0.4$

1 Write the missing power of 10 in exponential form.

a. $0.04 \times$ ___10¹___ $= 0.4$ $\quad 0.004 \times$ ___10³___ $= 4$

b. ___10²___ $\times 0.006 = 0.6$ $\quad$ ___10³___ $\times 0.006 = 6$

c. $0.007 \times$ ___10³___ $= 7$ $\quad 0.07 \times$ ___10²___ $= 7$

2 Complete the equations to find each product.

a. $8 \times 100 = 8 \times 10^2 =$ ___800___

b. $8 \times 1{,}000 = 8 \times$ ___10³___ $=$ ___8,000___

c. $2 \times$ ___10___ $= 2 \times 10^1 =$ ___20___

d. $0.02 \times 100 = 0.02 \times$ ___10²___ $=$ ___2___

3 Complete the equations.

a. $0.03 \times 1{,}000 =$ ___30___

b. $0.18 \times 100 =$ ___18___

Vocabulary

power of 10 a number that can be written as a product of tens.
$10 = 10$
$100 = 10 \times 10$
$1{,}000 = 10 \times 10 \times 10$

exponent the number in a power that tells how many times to use the base as a factor.

10^2 ← exponent
↑ base

$10^2 = 10 \times 10$, or 100

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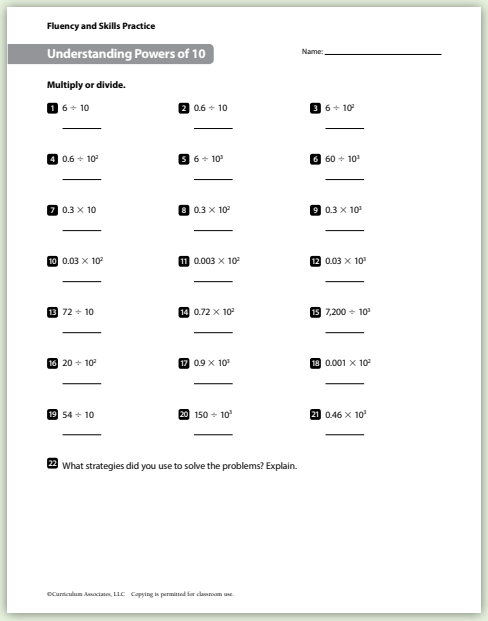
Fluency & Skills Practice Teacher Toolbox

Assign *Understanding Powers of 10*

In this activity students work with powers of 10 in multiplication and division problems. Later in school, students will use powers of 10 in scientific notation to represent numbers both large (e.g., the average distance between the sun and Earth) and small (e.g., the diameter of a human red blood cell). To solve the problems, students may use a strategy such as breaking a base and exponent into the product of tens.



Fluency and Skills Practice

Understanding Powers of 10

Name: _____

Multiply or divide.

1. 6 ÷ 10 ____
2. 0.6 ÷ 10 ____
3. 6 ÷ 10^2 ____
4. 0.6 ÷ 10^2 ____
5. 6 ÷ 10^3 ____
6. 60 ÷ 10^3 ____
7. 0.3 × 10 ____
8. 0.3 × 10^2 ____
9. 0.3 × 10^3 ____
10. 0.03 × 10^2 ____
11. 0.003 × 10^2 ____
12. 0.03 × 10^3 ____
13. 72 ÷ 10 ____
14. 0.72 × 10^2 ____
15. 7,200 ÷ 10^3 ____
16. 20 ÷ 10^2 ____
17. 0.9 × 10^3 ____
18. 0.001 × 10^2 ____
19. 54 ÷ 10 ____
20. 150 ÷ 10^3 ____
21. 0.46 × 10^3 ____
22. What strategies did you use to solve the problems? Explain.

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4 See completed table on the student page; dividing by a power of 10 changes the place value of the digits one place to the right for each factor of 10 in the divisor.
Medium

5 **a.** 0.52; Dividing by 10 results in each digit having $\frac{1}{10}$ of its previous value.

b. 5.2; $10^2 = 100$ and dividing by 100 results in each digit having $\frac{1}{100}$ of its previous value.

c. 0.052; $10^3 = 1{,}000$ and dividing by 1,000 results in each digit having $\frac{1}{1{,}000}$ of its previous value.

d. 520; $10^1 = 10$ and dividing by 10 results in each digit having $\frac{1}{10}$ of its previous value.
Medium

6 See possible student answer on the student page.
Medium

7 No; See possible student explanation on the student page. Student responses should show understanding that 10^3 represents 3 factors of 10, not 10 factors of 3.
Challenge

4 Use the place-value chart to show dividing 9 by powers of 10. Complete each row with the quotient shown to the right of the row.

Ones	.	Tenths	Hundredths	Thousandths	
9	.	0	0	0	
0	.	9	0	0	$9 \div 10$
0	.	0	9	0	$9 \div 10^2$
0	.	0	0	9	$9 \div 10^3$

5 Match each expression with its quotient.

a. $5.2 \div 10$ — 5.2
b. $520 \div 10^2$ — 5.2
c. $52 \div 10^3$ — 0.052
d. $5{,}200 \div 10^1$ — 520

6 Describe how the placement of the decimal point changes when you multiply a number by a power of ten. How is this the same and different for division?

Possible answer: The placement of the decimal point changes one place to the right each time a number is multiplied by a power of 10. Each digit in the product has a greater value because it is in a different place value. When dividing, the placement of the decimal point also changes one place each time the number is divided by a power of 10, but in the opposite direction because the value of each digit decreases.

7 Is multiplying by 10^3 the same as multiplying by 10 factors of 3? Explain.

No; Possible explanation: $10^3 = 10 \times 10 \times 10$, which is multiplying by 3 factors of 10, not by 10 factors of 3. $10 \times 10 \times 10 = 1{,}000$, which is not the same as $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 59{,}049$.

ELL English Language Learners: Differentiated Instruction

Prepare for Session 3
Use with *Apply It*.

Levels 1–3

Speaking/Writing Read ***Apply It*** problem 3 aloud to students. Ask students to circle the word *exponent*. Have them state in their own words what an exponent shows. Guide them with the phrase *how many times*. [Possible answer: how many times to multiply a number by itself] Ask students to write the number 9,700. Have them form pairs and use gestures, numbers, words, and arrows to think aloud about how to find the value of the unknown exponent. Help them write a response using the sentence frame:
When you divide 9,700 by 10 __four__ times, the quotient is 0.97.

Levels 2–4

Speaking/Writing Read ***Apply It*** problem 3 and have students read the problem with a partner. Ask them to discuss the ways that the placement of the decimal point in a number changes relative to the digits when multiplying and dividing by powers of 10. Have students use the sentence frames below to write their answer:

- *The placement of the decimal point changed __four__ places to the right.*
- *For the quotient to be 0.97, you need to divide 9,700 by 10 __four__ times.*

Levels 3–5

Reading/Writing Have students read ***Apply It*** problem 3 with a partner. Ask them to model finding the unknown exponent by drawing a place-value chart. Have them refer to the chart to write an explanation of how to use it to find the value of the missing exponent.

[Possible answer: The chart shows that there is a change of 4 place values for the digits 9 and 7. So, the value of the missing exponent is 4.]

LESSON 7

SESSION 3 Refine

Purpose In this session students demonstrate their understanding of multiplying and dividing by powers of 10 as they talk through three problems. Then they compare two points of view about how to multiply a number by a power of 10.

Start

Connect to Prior Knowledge

Materials For each pair: Activity Sheet *Digit Cards* (6 cards for 2, 20 cards for 0, 6 decimal point cards)

Why Reinforce students' understanding of how multiplying and dividing by powers of 10 affects the value of a number and see the pattern in the placement of the decimal point.

How Have students multiply and divide 2 by powers of 10, using digit cards to display the answers. You may want to have some students show the numbers with all ones places aligned (as shown below) and other students show the numbers with all digits 2 aligned.

Use digit cards to show these products and quotients.

2×10^3	$2 \div 10^1$
2×10^2	$2 \div 10^2$
2×10^1	$2 \div 10^3$

Solutions

$2 \times 10^3 = 2{,}000$
$2 \times 10^2 = 200$
$2 \times 10^1 = 20$
$2 \div 10^1= 0.2$
$2 \div 10^2 = 0.02$
$2 \div 10^3 = 0.002$

APPLY IT

Have students work independently or with a partner.

1 COMPARE

Look for understanding that since $0.8 \times 10^2 = 80$ and $0.8 \div 10^2 = 0.008$, students can compare the values of these numbers by considering how many places apart the digits 8 are in the numbers.

Prompt discussion with questions such as:

- *Do you see multiplying by 10 as changing the placement of the digit 8 to the left or as changing the placement of the decimal point to the right?*
- *How does the place value of the digit 8 change when you divide by 10? How does the placement of the decimal point change?*
- *How many decimal places apart are the digits 8 in the numbers 80 and 0.008? How many times do you multiply 0.008 by 10 to change 0.008 into 80?*

Refine Ideas About Powers of 10

APPLY IT

Complete these problems on your own.

1 COMPARE

Complete the place-value chart with the products and quotients shown to the right of the chart. Then write a sentence to compare the value of 0.8×10^2 to the value of $0.8 \div 10^2$.

Tens	Ones	.	Tenths	Hundredths	Thousandths	
8	0	.	0	0	0	0.8×10^2
	8	.	0	0	0	0.8×10^1
	0	.	8	0	0	
	0	.	0	8	0	$0.8 \div 10^1$
	0	.	0	0	8	$0.8 \div 10^2$

Possible answer: The value of 0.8×10^2 (80) is 10,000 times the value of $0.8 \div 10^2$ (0.008).

2 INSPECT

Max says that the product 30×10^4 has exactly four zeros. Is he correct? Explain.

No; Possible explanation: The first factor, 30, already has one zero. Multiplying 30 by 10^4 means you can put four more zeros after 30 because it's the same as finding the product $30 \times 10 \times 10 \times 10 \times 10$, which is 300,000.

3 EXPLAIN

How do you determine the value of the unknown exponent in the equation $9{,}700 \div 10^? = 0.97$?

Possible answer: For the quotient to be 0.97, the dividend 9,700 needs to be divided by 10 four times. So, the value of the unknown exponent is 4.

PAIR/SHARE
Discuss your solutions for these three problems with a partner.

2 INSPECT

Look for understanding that both factors can contribute zeros to the product.

Prompt discussion with questions such as:

- *How many zeros does 10^4 contribute to the product?* [four]
- *Why does the product 30×10^4 have more than four zeros?* [because 30 already has one zero]
- *What is the product 30×10^4?* [300,000]

Common Misconception **If** students show the product as 30,000, **then** have them write the original factor of 30 on a sheet of paper and use digit cards to show each zero the exponent indicates needs to be inserted [4].

3 EXPLAIN

Look for understanding that the division resulted in changing the placement of the decimal point 4 places to the left, so 9,700 was divided by 10,000, or 10^4. Have students explain the process they used for finding the missing exponent.

Have students write the completed equation $9{,}700 \div 10^4 = 0.97$ on small whiteboards. Then ask them to write related division and multiplication equations with the power of 10 written in standard form. [$9{,}700 \div 10{,}000 = 0.97$ and $9{,}700 = 0.97 \times 10{,}000$]

Use what you have learned to complete problem 4.

4 Jaime claims that when you multiply a whole number or a decimal by 10^2, the placement of the decimal point in the product is always two places to the right of where it was in the factor.

Salome argues that the placement of the decimal point changes two places to the right only when you multiply a decimal by 10^2. Salome says that when you multiply a whole number by 10^2, you can put two extra zeros after the whole number to find the product.

Part A Explain each student's point of view with examples.

Possible answer:
Jaime: Every whole number can be written using a decimal point. 3 and 3.00 name the same number. So, you can think about 3×10^2 as 3.00×10^2 and find that the product is 300 by changing the placement of the decimal point two places to the right. When you multiply 0.3 by 10^2, the placement of the decimal point in the product is also two places to the right. $0.3 \times 10^2 = 30$

Salome: Any whole number times 10^2 is that number of hundreds, so the product will have zeros in the ones and tens places. For example, $5 \times 10^2 = 500$. When you multiply a decimal number by 100, the placement of the decimal point changes 2 places to the right. For example, $0.5 \times 10^2 = 50$.

Part B Which student is correct? Justify your answer.

Possible answer: Both Jaime and Salome have correct understandings about multiplying by powers of 10, but Salome may not recognize that whole numbers can be written with decimal points. Jaime uses the same method for decimals and whole numbers to multiply by 10^2, while Salome uses different methods.

5 MATH JOURNAL

Find the value of $80 \div 10^4$. Explain the change in value between 80 and $80 \div 10^4$.

0.008; Possible explanation: When you divide a number by 10, the value of the number decreases. The value of 80 decreased from 80 to 0.008 because dividing by 10^4 is dividing 80 by 10 four times.

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4 **Before students begin,** read through problem 4 as a class. Make sure students understand their task is to analyze two points of view about multiplying by a power of 10.

As students work on their own, walk around to assess their progress and understanding, to answer their questions, and to give additional support, if needed.

Have students share and justify their thinking about Jaime's and Salome's ideas with a partner.

Scoring Rubrics

Part A

Points	Expectations
2	The "Jaime" explanation includes the idea that every whole number can be written using a decimal point. The "Salome" explanation uses the idea of writing extra zeros. Both explanations are correct and include correct examples.
1	The "Jaime" explanation includes the idea that every whole number can be written using a decimal point. One or both explanations are incomplete, but all math examples are correct.
0	The "Jaime" explanation does not include the idea that every whole number can be written using a decimal point. One or both explanations are incomplete, and math examples may or may not be correct.

Part B

Points	Expectations
2	The explanation acknowledges that both are correct and points out that because Jaime recognizes that every number can be written with a decimal point, Jaime uses the same method for both types of numbers, while Salome uses different methods for whole numbers and decimals.
1	The explanation says that only one student is correct and includes the idea that every whole number can be written with a decimal point.
0	The explanation says that both students are incorrect or that one student is correct, but fails to mention that every whole number can be written with a decimal point.

Close: Exit Ticket

5 MATH JOURNAL

Students may draw a diagram, make a place-value chart, or use reasoning and their understanding of changing the placement of the decimal point one place to the left for each power of 10 and their understanding of how dividing by a power of 10 affects the placement of the decimal point and decreases the value of the quotient. Their responses should indicate understanding that dividing by 10 four times decreases the value from 80 to 0.008.

Error Alert **If** students find a quotient that is less than or greater than 0.008, **then** ask them if dividing a number by 10 makes the number increase or decrease in value. Have them write each of the four numbers in the "$\div$ 10" pattern for 80, saying each number aloud.

$8 \leftarrow 80 \div 10$

$0.8 \leftarrow 8 \div 10$

$0.08 \leftarrow 0.8 \div 10$

$0.008 \leftarrow 0.08 \div 10$