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.

Lesson Vocabulary

• inverse operations operations that undo each other. For example, addition and subtraction are inverse operations, and multiplication and division are inverse operations.
• dividend the number that is divided by another number.
• 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.

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 i of the teacher edition to see how every lesson includes these SMPs.

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

<table>
<thead>
<tr>
<th>SESSION 1</th>
<th>Explore</th>
<th>45–60 min</th>
<th>Dividing Multi-Digit Numbers</th>
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<th>SESSION 2</th>
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<tr>
<th>SESSION 3</th>
<th>Develop</th>
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<th>Using Estimation and Area Models to Divide</th>
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<tr>
<th>SESSION 4</th>
<th>Develop</th>
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<th>Using Area Models and Partial Quotients to Divide</th>
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<tr>
<td></td>
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<td>• Try It 10 min</td>
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<td>Differentiation 20 min</td>
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<td>• Close: Exit Ticket 5 min</td>
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</table>

## 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

### 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 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 \(192 \div 16 = 32\)
- Activity Sheet: Base-Ten Grid Paper

**Math Toolkit**
- base-ten blocks, base-ten grid paper, grid paper, index cards

**Digital Math Tool**
- Multiplication Models
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.

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**Divide Multi-Digit Numbers**

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 $770 \div 14$ 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.

There are 50 and 5 partial quotients. $50 + 5 = 55$.

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 $770 \div 14$.

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

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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**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.

Connect to Language Development

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

<table>
<thead>
<tr>
<th>Levels 1–3</th>
<th>Levels 2–4</th>
<th>Levels 3–5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading/Speaking</strong></td>
<td><strong>Reading/Speaking</strong></td>
<td><strong>Reading/Speaking</strong></td>
</tr>
<tr>
<td>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?</td>
<td>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.</td>
<td>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?</td>
</tr>
</tbody>
</table>
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.

**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.

### Possible Solutions
- How can you use multiplication to solve each division equation?
  - $10 \times ? = 30$
  - $10 \times 3 = 30$
  - $30 \div 10 = 3$
  - $12 \times ? = 24$
  - $12 \times 2 = 24$
  - $24 \div 12 = 2$

### 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

### 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 $92 \div 23$
- 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 $92 \div 23$ symbolically using partial quotients or repeated subtraction.
Connect It

Look Back

What is $264 \div 12$? Explain your reasoning.

Possible answer: $23 \times 4 = 92$, so $92 \div 23 = 4$.

Connect It

Look Ahead

Multiplication and division are called inverse operations because they “undo” each other. For example, the related multiplication and division equations $5 \times 7 = 35$ and $35 \div 7 = 5$ 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 $264 \div 12 = ?$ and $12 \times ? = 264$.

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

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

<table>
<thead>
<tr>
<th>Multiple of 10</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>$12 \times$ Multiple of 10</td>
<td>120</td>
<td>240</td>
<td>360</td>
<td>480</td>
<td>600</td>
</tr>
</tbody>
</table>

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

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 $12 \times$ a multiple of 10 to divide 264 by 12 using an area model. Complete the missing numbers.

| 12 | 264 | 20 | 2 | = 22 |

Possible answer: You can multiply $12 \times 22 = 264$, so $264 \div 12 = 22$.

Reflect

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

Possible answer: You can multiply $12 \times 22 = 264$, so $264 \div 12 = 22$.

Close: Exit Ticket

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 $264 \div 12$, then use basic multiplication and division facts to remind them how multiplication and division are related. Ask students to solve the problem $50 \div 5 = ?$ using the multiplication equation $5 \times ? = 50$. If necessary, use a drawing to show how $50 \div 5 = 10$ and $5 \times 10 = 50$ relate. Then use equations to show how $264 \div 12 = 22$ and $12 \times 22 = 264$ 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.
### 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:**

<table>
<thead>
<tr>
<th>Word</th>
<th>In My Own Words</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>dividend</td>
<td>the number that is divided by another number</td>
<td>$56 \div 7 = 8$</td>
</tr>
<tr>
<td>divisor</td>
<td>the number by which another number is divided</td>
<td>$200 \div 10 = 20$</td>
</tr>
<tr>
<td>quotient</td>
<td>the result of division</td>
<td>$150 \div 25 = 6$</td>
</tr>
</tbody>
</table>

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

```
  ?
/   \
\   /
 \ /  

154 \div 11 = ?
```

### 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*
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.

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**Prepare for Session 2**

Use with **Model It.**

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<th>Levels 1–3</th>
<th>Levels 2–4</th>
<th>Levels 3–5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Listening/Speaking</strong></td>
<td><strong>Speaking/Writing</strong></td>
<td><strong>Speaking/Writing</strong></td>
</tr>
<tr>
<td>Read the first <strong>Model It.</strong> Ask students to restate the definition of compatible numbers using the sentence frames:</td>
<td>Read the first <strong>Model It.</strong> 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:</td>
<td>Have students read the problem, form pairs, and look at the first <strong>Model It.</strong> 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:</td>
</tr>
<tr>
<td>- <strong>Compatible numbers are close to</strong> the actual numbers in a problem.</td>
<td>- <strong>Compatible numbers are</strong>.</td>
<td>- The closer the compatible numbers are to the <strong>dividend</strong> and <strong>divisor</strong>, the closer the estimated quotient will be to the actual quotient.</td>
</tr>
<tr>
<td>- <strong>They help you estimate</strong> 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.</td>
<td>- <strong>They help you solve problems because</strong>. 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.</td>
<td>Have pairs determine the dividend and divisor and compatible numbers for them. Ask students to write sentences that explain why these numbers are compatible.</td>
</tr>
</tbody>
</table>
LESSON 5
SESSION 2  Develop

**Purpose** In this session students estimate the quotient of the division problem $504 \div 21$. 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 $126 \div 6$. Compare different ways students estimate.

**Possible Solutions**

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

$126 \div 6 = ?$

**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?

**TRY IT**

Possible student work:

Sample A

$504 \div 21 = ?$ means $21 \times ? = 504$

$21 \times 10 = 210$

$21 \times 20 = 420$

$21 \times 30 = 630$

$504, so 504 \div 21$ is between 20 and 30.

The toy company packed about 25 robots in each box.

Sample B

500 and 20 are close to 504 and 21.

$50 \div 2 = 25$

$25 \times 2 = 50$

$25 \times 20 = 500$

There are about 25 robots in a box.

**DISCUSS IT**

Ask your partner: How did you get started?
Tell your partner: I knew . . . so I . . .

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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?

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 twice 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.

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 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 a number close to 30
   B about 20
   C a number between 30 and 40
   D about 10
LESSON 5
SESSION 2  Additional Practice

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.

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

20 × 70 = 1,400 is the same as 1,400 ÷ 20 = 70.

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

Look at the Example. You can also multiply 22 by multiples of 10 to estimate the quotient 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.

<table>
<thead>
<tr>
<th>Multiple of 10</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 × Multiple of 10</td>
<td>220</td>
<td>440</td>
<td>660</td>
<td>880</td>
<td>1,100</td>
<td>1,320</td>
<td>1,540</td>
<td>1,760</td>
</tr>
</tbody>
</table>

   b. Complete the statement below with two numbers from the table.
   The dividend 1,474 is between \(\underline{1,320}\) and \(\underline{1,540}\).

   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 to 60.

Fluency & Skills Practice

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.

Estimate each quotient.
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 1,080 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.
   - Possible student 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.

**Prepare for Session 3**

**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.

**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 \_\_\_\_\_.
- The second Model It uses 30 and not 40 because \_\_\_\_\_.

**Levels 2–4**

**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.

**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 \_\_\_\_.
- The second Model It uses 30 and not 40 because \_\_\_\_.

**Levels 3–5**

**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.

**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 \_\_\_.

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**Lesson 5**

**Session 3**

**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**

\[
\begin{align*}
24 \times 10 &= 240 \\
24 \times 20 &= 480 \\
24 \times 30 &= 720 \\
24 \times 40 &= 960 \\
\text{The quotient is between 30 and 40.} \\
24 \times 30 &= 720, 768 - 720 &= 48 \\
24 \times 2 &= 48 \\
30 + 2 &= 32 \\
32 \text{ buses are in each building.}
\end{align*}
\]

**Sample B**

750 and 25 are close to 768 and 24. 

\[
\begin{align*}
25 \times 30 &= 750, \text{so } 768 \div 24 = 30. \\
24 \times 30 &= 720, 768 - 720 &= 48 \\
24 \times 2 &= 48 \\
30 + 2 &= 32 \\
\text{Each building has 32 buses.}
\end{align*}
\]

**Discuss It**

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

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

**Possible Solutions**

260 \div 13 = 20, 
300 \div 15 = 20, 
300 \div 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?

**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 \div 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?

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 \(768 \div 24\) 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?

3 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.

4 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.

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

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 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 step, you subtract the product you found in that section from what remains. You keep going until you reach a number less than the divisor.

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.

<table>
<thead>
<tr>
<th>Number of packages</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sports cards</td>
<td>120</td>
<td>240</td>
<td>360</td>
<td>480</td>
<td>500</td>
</tr>
</tbody>
</table>

Solution between 30 and 40 packages

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?

\[
\begin{array}{c}
12 \\
\downarrow \\
468 \\
\downarrow \\
30 \\
\downarrow \\
9 \\
\hline
? \\
108 \\
\hline
108 \\
\hline
216 \\
\hline
108 \\
\hline
108 \\
\hline
0 \\
\end{array}
\]

Solution 468 ÷ 12 = 39; He bought 39 packages.
LESSON 5
SESSION 3  Additional Practice

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

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.

<table>
<thead>
<tr>
<th>Number of boxes</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of donuts</td>
<td>130</td>
<td>260</td>
<td>390</td>
<td>520</td>
<td>650</td>
<td>780</td>
</tr>
</tbody>
</table>

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 $728 \div 13$.

78
2
78
078

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

1. 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

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

1. a. What is 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

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

1. a. What is 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

1. a. What is 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

Answer: 56

Fluency & Skills Practice

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?
The table can be used to estimate the quotient $851 \div 37$. Which of the following is the best estimate of the quotient?

<table>
<thead>
<tr>
<th>Multiple of 10</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>$37 \times$ Multiple of 10</td>
<td>370</td>
<td>740</td>
<td>1,110</td>
<td>1,480</td>
</tr>
</tbody>
</table>

- a number between 30 and 40
- about 15
- a number between 20 and 30
- about 42

Complete the steps for using an area model to find the quotient $851 \div 37$.

$851 \div 37$ is the same as $37 \times ? = 851$.

\[
\begin{array}{c|c|c}
37 & 851 & 37 \\
\hline
? & ? & ? \\
\end{array}
\]

\[
\begin{array}{c|c|c|c}
37 & 851 & 37 & 23 \\
\hline
? & ? & 20 & 3 \\
\hline
851 & 740 & 111 & 0 \\
\end{array}
\]

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

- $42 \times ? = 4,326$
- $42 + 4,326 = ?$
- $4,326 \div ? = 42$
- $4,326 \div 42 = ?$

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

37 $\times$ ? = 851; See the completed area model on the student page; $851 \div 37 = 23$. 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

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

Challenge
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.

**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?

**Possible Solutions**

Possible groups of partial quotients:

- 100, 30, 1
- 100, 20, 10, 1
- 100, 10, 10, 10, 1

The quotient is 131.

**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
LESSON 5  DEVELOP

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 \( \div 12 \).

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

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

100 4

12 1,248

? 12

(12 \( \times 100 = 1,200 \))

1,248  1,200

48  48

0

**MODEL IT**
You can use a vertical format to record partial quotients.

Second partial quotient

First partial quotient

How many groups of 12 in 1,200?

How many groups of 12 in 48?

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 \( \times 50 = 600 \), which is still less than 1,248.

Work with students to write out the vertical format for 1,248 \( \div 12 \) 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.

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?
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.

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. What is the quotient $583 \div 11$? Show your work.

Possible student work:

```
11  | 583
-  550
  ---
   33
```

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:

```
27 | 1134
-  54
  ---
   54
```

Solution: 42 pennies

10. Which of the following pairs of numbers are partial quotients for $594 \div 18$?

- 50 and 5
- 40 and 4
- 30 and 3
- 20 and 15

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.

Close: Exit Ticket

10. C; Students may estimate $600 \div 20 = 30$ as the first partial quotient.
LESSON 5
SESSION 4 Additional Practice

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

Fluency & Skills Practice

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

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*

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 $2,350 \div 25$ are $25 \times 90 = 2,250$ and $25 \times 4 = 100$.
*Medium*

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 × 6 = 42 | 12 |
| 2 |
| 10 |
| $42 \div 504$ |
| $- 420$ |
| $- 84$ |
| $- 84$ |
| $0$ |

**Solution** 12 inches

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

**English Language Learners:** Differentiated Instruction

**Prepare for Session 5**

**Use with Apply It.**

**Levels 1–3**

**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.

**Levels 2–4**

**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.

**Levels 3–5**

**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  Refine

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.

\[
\begin{array}{c}
1 \\
\hline
80 \\
21 \\
\hline
1,680 \\
21 \\
\hline
1,680 \\
21 \\
\hline
0 \\
\end{array}
\]

Solution 81 packages

APPLY IT
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.

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

PAIR/SHARE
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?

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.
4. Mr. Kovich writes the problem $32 \times \triangle = 1,696$ 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:

Possible student work:

Possible student work:

Possible student work:

Possible student work:

Solution $1,696 \div 32 = 53$

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.

<table>
<thead>
<tr>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>320</td>
<td>480</td>
<td>640</td>
<td>800</td>
<td>960</td>
</tr>
</tbody>
</table>

Choose the correct option to fill in each blank below.

The area of the base is between

\[ \text{between } 40 \text{ and } 50 \text{ square inches}. \]

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?

\[ 64; \text{Divide } 2,048 \text{ by } 2 \text{ to get } 1,024. \text{ Then divide } 1,024 \text{ by } 16. \]

**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 $\div 21$ on the board. Have students model 483 with their blocks.
- Ask: \textit{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 $\times$ 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: \textit{How can you use these results to estimate the quotient?} [4 groups $\times$ 20 groups $\times$ 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 $21 \times 23$ array, with 2 rows of 2 flats and 1 rod, and 3 rows of 2 rods and 1 unit.]
- Ask: \textit{What is the quotient } 483 $\div 21$? [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.
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

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 \div 24 teams = 7 students per team

12 students per team (original plan)

7 students per team (new plan)

5 fewer students per team

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:
The students would estimate how many times 28 divides into 1,260 by multiplying. 50 \times 28 = 1,400 is too high, 40 \times 28 = 1,120 is too low. I would start by dividing by 40.

Close: Exit Ticket

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 \div 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.

Personalize

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.

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

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

**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
  - Connect It 15 min
  - Close: Exit Ticket 5 min

**SESSION 3**

**Refine**

45–60 min

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

**Additional Practice**

- Lesson pages 139–140

**Fluency**

Understanding of Powers of 10

**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

**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

**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

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*We continually update the Interactive Tutorials. Check the Teacher Toolbox for the most up-to-date offerings for this lesson.
**Lesson 7**

**Understand Powers of 10**

**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:

- $10 = 10^1$
- $100 = 10 \times 10 = 10^2$
- $1,000 = 10 \times 10 \times 10 = 10^3$

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.

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.

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

**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 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.

**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.

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**Connect to Language Development**

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

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**Prepare for Session 1**

Use with Model It.

<table>
<thead>
<tr>
<th>Levels 1–3</th>
<th>Levels 2–4</th>
<th>Levels 3–5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading/Speaking</strong></td>
<td><strong>Reading/Speaking</strong></td>
<td><strong>Reading/Writing</strong></td>
</tr>
<tr>
<td>Read Model It problem 1 aloud. Have students underline the phrase <em>product of tens</em> 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: <em>What patterns do you see? How many factors of 10 are there? How many zeroes are there?</em> 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)</td>
<td>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: <em>factor, product, multiply, tens, pattern</em>. 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: <em>Powers of ten are _______.</em> Have students define the term in a complete sentence using their own words. Ask volunteers to share ideas with the class.</td>
<td>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: <em>factor, times 10, number of zeroes, patterns, number of tens, product</em>. 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.</td>
</tr>
</tbody>
</table>
**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.

**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

**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?

**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**

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 $10 \times 2$ 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 ($10 \times 10 \times 10 \times 10$) 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**

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 $5 \times 10 \times 10 \times 10 \times 10$, 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.
**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:**

   \[
   \begin{array}{c|c|c|c}
   \text{Examples} & \text{Examples} & \text{Examples} \\
   100 = 10 \times 10 & 10^2 = 10 \times 10 & 10^3 = 10 \times 10 \times 10 \\
   1,000 = 10 \times 10 \times 10 & 1,000 = 10 \times 10 \times 10 & 10,000 = 10 \times 10 \times 10 \times 10 \\
   \hline
   \end{array}
   \]

   - **Examples**: a number that can be written as a product of tens

2. Use the diagram to help you find each product.

   \[
   \begin{array}{c|c|c|c|c}
   \times 10 & \times 10 & \times 10 & \times 10 \\
   5 & 50 & 500 & 5,000 \\
   \hline
   5 \times 100 = \quad & 5 \times 500 = \quad & 5 \times 5,000 = \quad \\
   500 & 2,500 & 25,000 \\
   \hline
   \end{array}
   \]

**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:

   \[
   \begin{array}{c|c|c|c|c}
   10^3 & 10^2 & 10^1 & 10^0 \\
   1,000 & 100 & 10 & ? \\
   \hline
   \end{array}
   \]

   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*
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**

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**English Language Learners: Differentiated Instruction**

**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.

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**LESSON 7 SESSION 1**  
**Connect It** problem 3:

### Solve.

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

<table>
<thead>
<tr>
<th>Standard Form</th>
<th>Product of Tens</th>
<th>Exponent Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>$10 \times 10$</td>
<td>$10^2$</td>
</tr>
<tr>
<td>1,000</td>
<td>$10 \times 10 \times 10$</td>
<td>$10^3$</td>
</tr>
<tr>
<td>10,000</td>
<td>$10 \times 10 \times 10 \times 10$</td>
<td>$10^4$</td>
</tr>
<tr>
<td>100,000</td>
<td>$10 \times 10 \times 10 \times 10 \times 10$</td>
<td>$10^5$</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Standard Form</th>
<th>Using a Power of 10</th>
<th>Using Factors of 10</th>
<th>Exponent Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>$5 \times 100$</td>
<td>$5 \times 10 \times 10$</td>
<td>$5 \times 10^2$</td>
</tr>
<tr>
<td>5,000</td>
<td>$5 \times 1,000$</td>
<td>$5 \times 10 \times 10 \times 10$</td>
<td>$5 \times 10^3$</td>
</tr>
<tr>
<td>50,000</td>
<td>$5 \times 10,000$</td>
<td>$5 \times 10 \times 10 \times 10 \times 10$</td>
<td>$5 \times 10^4$</td>
</tr>
</tbody>
</table>

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

- $5,000 \div 10^2 = 500$  
  $5,000 \div 10^3 = 50$

- $5,000 \div 100 = 5$  
  $5,000 \div 1,000 = 5$

- $5,000 \div 100 = 50$  
  $5,000 \div 1,000 = 5$
**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.

**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.** 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.

**Solutions**

<table>
<thead>
<tr>
<th>×10</th>
<th>50.0</th>
<th>×10</th>
<th>2,700.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>-10</td>
<td>27.0</td>
<td>-10</td>
</tr>
<tr>
<td>0.5</td>
<td>-10</td>
<td>2.7</td>
<td>-10</td>
</tr>
<tr>
<td>0.05</td>
<td>-10</td>
<td>0.27</td>
<td>-10</td>
</tr>
</tbody>
</table>

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

- \(0.5 \times 100 = \ ?\)
- \(0.5 \times 10^3 = \ ?\)
- \(5 \div 100 = \ ?\)
- \(5 \div 10^3 = \ ?\)
- \(0.27 \div 1,000 = \ ?\)
- \(2,700 \div 1,000 = \ ?\)

**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 . . .

**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: \(\frac{5}{10} = \frac{500}{1,000}\).

**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.
Lesson 7 Understand Powers of 10

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 10⁰, 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.

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.
Lesson 7 Understand Powers of 10

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. $10^2 \times 0.004 = 10 \times 0.004 = 0.04$

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

1. Write the missing factors as powers of ten in exponential form.
   - a. $10^3$; $10^1$
   - b. $10^2$; $10^3$
   - c. $10^5$; $10^2$
   - **Basic**

2. a. 800
   - b. $10^3$; 8,000
   - c. 10; 20
   - d. $10^2$; 2
   - **Medium**

3. a. 30
   - b. 18
   - **Medium**

Vocabulary

- **power of 10**: a number that can be written as a product of tens.
- **exponent**: the number in a power that tells how many times to use the base as a factor.

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.
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 \( 10^n \) represents 3 factors of 10, not 10 factors of 3.

**Challenge**

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**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.

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**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.

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**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.]
 Containers 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.

### 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?

   **Solutions**
   
   - \(2 \times 10^3 = 2,000\)
   - \(2 \times 10^2 = 200\)
   - \(2 \times 10^1 = 20\)
   - \(\frac{2}{10} = 0.2\)
   - \(\frac{2}{10^2} = 0.02\)
   - \(\frac{2}{10^3} = 0.002\)

2. **INSPECT**

   Max says that the product \(30 \times 10^4\) 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.

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### 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 \(0.8 \times 10^4\) to the value of \(0.8 \div 10^2\).

   **Possible answer:** The value of \(0.8 \times 10^4\) is 10,000 times the value of \(0.8 \div 10^2\).

   **Possible answer:** The value of \(0.8 \times 10^2\) is 100 times the value of \(0.8 \div 10^4\).

2. **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.
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

<table>
<thead>
<tr>
<th>Points</th>
<th>Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>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.</td>
</tr>
<tr>
<td>1</td>
<td>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.</td>
</tr>
<tr>
<td>0</td>
<td>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.</td>
</tr>
</tbody>
</table>

#### Part B

<table>
<thead>
<tr>
<th>Points</th>
<th>Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>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.</td>
</tr>
<tr>
<td>1</td>
<td>The explanation says that only one student is correct and includes the idea that every whole number can be written with a decimal point.</td>
</tr>
<tr>
<td>0</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Close: Exit Ticket

#### 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.

#### 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 “$\div 10^4$” pattern for 80, saying each number aloud.

- $8 \leftarrow 80 \div 10$
- $0.8 \leftarrow 8 \div 10$
- $0.08 \leftarrow 0.8 \div 10$
- $0.008 \leftarrow 0.08 \div 10$