TEACHER RESOURCE

Leaps and Bounds TOWARD Math Understanding

Marian Small

Teacher Resource Sampler: Number Topics 4–5, Draft Material

5/6



| Name: | Date: | Nome: | Date: | | | | |
|--|--|---|--|--|-------------------|---|---|
| Multiplying Wh | tole Numbers Diagnostic Tool | 4. Estimate. a) 5 × 34 is about . | d) 6 × 475 is about | | | | |
| 1. a) How much more is 4 | i × 6 than 3 × 6? more | b) 7 × 68 is about . | e) 32 × 56 is about | | | | |
| b) How much more is 8 c) How much more is 7 | 1 × 2 than 5 × 2? more 7 × 9 than 6 × 9? more | 5. Calculate | I) 62 × 66 is dubbir | | | | |
| d) How much more is 5 | 5 × 9 than 3 × 9? more | a) 7 × 51 = | c) 42 × 72 = | Step 1: A | Administer | the | |
| What multiplication is sh a) assess assess as | hown? 202000 002000 × | | | diagnost | tic assessn | nent | |
| b) 101 8 | IIII ^s | | | alagnoot | | | |
| c) (11) | | b) 3 × 648 = | d) 53 × 43 = | | | | |
| | × | | | | | | |
| d) | | | | | | | |
| | × | 6. Describe a situation | where you would use each | | | | |
| e) | | a) 5 × 23 | | | | | |
| | × | | | | | | |
| 3. Calculate using mental | math. | b) 7 × 14 | | | | | |
| a) 4 × 9 = | e) 8 × 40 = | | | | | | |
| b) 3 × 7 = c) 8 × 6 = | f) $9 \times 60 =$ g) $6 \times 300 =$ | c) 22 × 23 | | | | | _ |
| d) 7 × 4 = | h) 30 × 50 = | | | | | Intervention Pathways The purpose of the intervention pathways is to help students multiply. The focus | |
| 50 Multiplying Whole Numbers, Diognostic T | Tool Leope and Bounds Copyright © 2011 by Nelson Education Ltd. | Copyright @ 2011 by Nelson Education Ltd | Leaps and Bounds Multiplying Whole Numbers, Diagnostic | Teel 1 | | is to prepare them for working with a broader range of products and, eventually, decimal products as well. | 1 |
| | | | | | | There are 3 pathways: • Pathway 1: Multiplying Two-Digit Numbers • Pathway 2: Multiplying by One-Digit Numbers | |
| Teacher Reso | ource | | | | | Pathway 3: Multiplication Fact Strategies Use the chart below (or the Key to Pathways on Teacher's Resource pages 52 | |
| | | | | | | of students. Disconting Test Description Internation Destroyers | 1 |
| | | | | | | If studients struggle with use Pathway 1: Multiplying Two-Digit Numbers Questions 30–e, 3th, 4e–L, Shuder Bearum agains 54–55 Shud Pr | 1 |
| | | | | | | Income relations plage 20-02 If students struggle with Quastions 2b-c, 3e-g, 4a-d, Tacher's Resource pages 26-57 | 1 |
| | | | | Step 2: Selec | t the | Sil-O, GL-O SILOWIT MICULES pages 60-54 If students struggle with Questions 1, 2a, 3a-d Taecher's Neocurce pages 53-59 | |
| | | | i | ntervention | nathway | Student Maiscurse pages 65–89 If students successfully complete Pathway 3 (or 2), they may or may not need | |
| | | | | | pating | the additional inservention provided by Pathway 2 (or 1). Either e-administer Pathway 2 (or 1) questions from the diagnostic tool or encourage students to do a portion of the open-raded inservention for Pathway 2 (or 1) to decide if more | 1 |
| Multiplying T | wo-Digit Numbers | | | | | work in that pathway would be beneficial. | 1 |
| Raven is arranging book She has to put between | s on bookshelves. 30 and 90 books on each shelf. You will need | | | | | | 1 |
| There are about 3000 be How many shelves can | ooks altogether. | | | | | Copyright © 2011 by Nelson Education Ltd. Leaps and Bounds Eris Number: Multiplying Whole Numbers 40 | 1 |
| How many books are a How many books allog | an each shelf? jether are on the shelves? | | | | | | - |
| Think of as many soluti Explain how you chose | ions as you can. a your numbers and | | | | | Teacher Resource | |
| now you aid some or yo | | | | | | | |
| | Multiplying Two-Digit Numbers | Pathway O GUIDED | Try These 1. Write the multiplication expression the | at goes with each | | | |
| | Sarah has 12 boxes of baking cups. | You will need | model. One expression has no match 34×15 23×34 52×41 | h. 18 × 28 32 × 43 | | | |
| | You can multiply using a variety of strategies to figure out the total number of baking cups. | base ten blocks | a) c) | | | | |
| | You can use a doubling strategy. For example, for us and the number of suce | · | | | | | |
| | in 6 boxes. Then double the product. $6 \times 24 = 144$ so | | | | | | |
| | 12 × 24 = 2 × 144 = 268 | 2388 2388 2388 | b) d) | | | | |
| | | | | | | | |
| | You can separate the tens and ones. For example, think of 12 as 10 + 2. | | | | Step 3: C | hoose an open- | |
| | There are 10 × 24 = 240 baking cups in 10 baxes. There are 2 × 24 = 48 baking cups in 2 baxes. 200 + U8 = 288 baking cups discetter. | the result when you multiply | | | onded in | torvention or | |
| | You can use an array. Imagine the baking cups in an array. | | Draw a line to match each multiplicat description of how to complete it. | fon expression with a | | | |
| Copyright © 2011 by Nelson Education Ltd | Use base ten blocks to represent the array. 12 rows of 24 looks like this: | | 23×26 $30 \times 60 + 2 \times 32 \times 62$ $30 \times 20 + 6 \times 32 \times 62$ | $60 + 2 \times 30 + 2 \times 2$ $30 + 2 \times 20 + 2 \times 6$ | guided in | itervention based | |
| | | | 63 × 22 20 × 20 + 3 × 32 × 26 20 × 60 + 3 × 32 | $20 + 6 \times 20 + 3 \times 6$ $20 + 2 \times 60 + 3 \times 2$ | on your s | students' learning | |
| | There are 2 hundreds, 8 tens, and 8 ones. 24 That is 288. v 12 | Remember | Estimate. Your estimates should hav tens digits. | e Os in the ones and | preference | ces or your | |
| | The 2 hundreds come from 10 × 20. 200 (10 The 8 tens come from 10 × 4 and 2 × 20. 40 (10 | × 20) × 4) When you look at an arroy of 12 rows | a) 53 × \$47 is about b) 29 × \$37 is about | | instruction | and situation | |
| | The 8 ones come from 2 × 4. <u>+ 8</u> (2 <u>288</u> | (4) 12 equal groups of 24 squares. Each row is cope group. So | c) 62 × \$13 is about | | instructio | onar situation | |
| | Which strategy makes the most sense to you? Why? | you have 12 × 24. | d) 72 × \$22 is about | - 🔰 | | | |
| | 0 | | | 57 | | | |

Student Resource

Contents

Program Overview

What Is *Leaps and Bounds*? A Research Foundation How to Use *Leaps and Bounds* Frequently Asked Questions Components

Teaching Notes

Strand: Number

Leaps and Bounds 5/6 covers all math strands. This sampler includes Topics 4 and 5 from the Number strand.

x xiv xvii xix

ix

| Number Strand Overview | | | 2 |
|---|---|--|----------------------|
| Penrecenting Whole | Pathway 1: Representing Numbers to 100 000 | Open-ended Guided Open-ended | 14 15 16 |
| Numbers | Betheward 2 | Guided | 17 |
| Topic Overview (page 6) Diagnostic Tool (page 8) | Pathway 3: Representing Numbers to 1000 Pathway 4: Multiplying and Dividing by 10s | Open-ended Guided Open-ended Guided | 18 19 20 21 |
| Comparing Whole Numbers | Pathway 1: Comparing Numbers to 100 000 Pathway 2: Comparing Numbers to 10 000 | Open-ended Guided Open-ended | 28 29 30 |
| Topic Overview (page 22) Diagnostic Tool | Pathway 3: Comparing Numbers to 10000 | Guided Open-ended Guided | 31 32 33 |
| (pages 24) | Pathway 1: Different Numbers of Digits Pathway 2: Same Number of Digits | Open-ended Guided Open-ended Cuided | 40 41 42 43 |
| Topic Overview (page 34) Diagnostic Tool | Pathway 3: Using Mental Math to Subtract Pathway 4: Using Mental Math to Add | Open-ended Guided Open-ended Open-ended Guided | 44 45 46 47 |
| (page 50) | | | |

| | Pathway 1: | | E /. |
|---------------------------|--|--------------|----------|
| | Multiplying Two-Digit Numbers 🦟 | |)4 55 |
| | Pathway 2: | Guided |)) 50 |
| Multiplying Whole Numbers | Multiplying by One-Digit Numbers < | Open-ended | 56 |
| Topic Overview | $\begin{array}{c} \text{Pathway 3:} \end{array}$ | Guided | 57 |
| (page 48) | Multiplication Fact Strategies | • Open-ended | 58 |
| Diagnostic Tool | Wultiplication Fact Strategies | | 59 |
| (page 50) | Pathway 1: | \sim 11 | ((|
| | Dividing Three-Digit Numbers | | 66 |
| Dividing Whole Numbers | Pathway 2: | Guided | 6/ |
| Topic Overview | Dividing Two-Digit Numbers | Open-ended | 68 |
| (page 60) | Pathway 3: | Guided | 69 |
| Diagnostic Tool | Division Fact Strategies | • Open-ended | 70 |
| (page 62) | | | 71 |
| | Pathway 1: | Onen en de d | 70 |
| | Division Situations | Open-ended | / 0 |
| Relating Situations to | Pathway 2: | Guided | /9 |
| Operations | Multiplication Situations | Open-ended | 80 |
| Topic Overview | Pathway 3: | Guided | 81 |
| (page 72) | Subtraction Situations | Open-ended | 82 |
| Diagnostic Tool | | Guided | 83 |
| (page 74) | Pathway 1: | Dopen-ended | 92 |
| | Improper Fractions: Parts of Sets 🦟 | Guided | 92 |
| | Pathway 2: | Onen anded | 94 |
| Representing Fractions | Improper Fractions: Parts of Wholes < | Cuided | 94 |
| Topic Overview | Pathway 3: | Guiaca | 95 |
| (page 84) | Proper Fractions: Parts of Sets | Open-ended | 90 |
| Diagnostic Tool | Pathway 4: | Guiaea | 9/ |
| (page 86) | Proper Fractions: Parts of Wholes << | Open-ended | 98 |
| (1490 00) | | Guided | 99 |
| | Pathway 1: | • Open-ended | 108 |
| | Fractions More and Less Than 1 | Guided | 100 |
| | Pathway 2: | Open-ended | 110 |
| | Equivalent Fractions | Cuided | 111 |
| | Pathway 3: | Onen anded | 111 |
| Comparing Fractions | Comparing: Same Numerators </td <td>Cuided</td> <td>112</td> | Cuided | 112 |
| Topic Overview | Pathway 4: | | 113 |
| (page 100) | Comparing: Same Denominators << | | 114 |
| Diagnostic Tool | Pathway 5: | | 11) |
| (page 102) | Comparing Fractions to $\frac{1}{2}$ and 1 | Open-ended | 116 |
| | Somparing Fractions to 2 and 1 | Guided | 117 |

| Representing Decimals Topic Overview (page 118) Diagnostic Tool (page 120) | Pathway 1: Representing Thousandths Pathway 2: Representing Hundredths Pathway 3: Representing Tenths | Open-ended Guided Open-ended Guided Open-ended Guided Guided | 126 127 128 129 130 131 |
|---|---|--|--|
| Comparing Decimals Topic Overview (page 132) Diagnostic Tool (page 134) | Pathway 1: Comparing Mixed Decimals Pathway 2: Comparing Thousandths Pathway 3: Comparing Tenths and Hundredths < | Open-ended Guided Open-ended Guided Open-ended Guided | 138 139 140 141 142 143 |
| (page 154) Decimal Computation Topic Overview (page 144) Diagnostic Tool (page 146) | Pathway 1: Multiply and Divide by 10 or 100 Pathway 2: Add and Subtract to Thousandths Pathway 3: Add and Subtract Thousandths Pathway 4: Add and Subtract to Hundredths Pathway 5: Add and Subtract Tenths or Hundredths | Open-ended Guided | 152 153 154 155 156 157 158 159 160 161 |

Strand: Patterns and Algebra

| Patterns and Algebra Strand Overview | | | 162 |
|---|---|--|--|
| Patterns Topic Overview (page 164) Diagnostic Tool | Pathway 1: Using Pattern Rules Pathway 2: Growing and Shrinking Patterns Pathway 3: Repeating Patterns | Open-ended Guided Open-ended Guided Open-ended Guided Guided | 172 173 174 175 176 177 |
| (page 166) Equality — Topic Overview (page 178) | Pathway 1: Using Algebra Pathway 2: Solving Equations | Open-ended Guided Open-ended Guided | 184 185 186 187 |

(page 178) Diagnostic Tool (page 180)

Strand: Geometry

244

| Geometry Strand Overview | | | 188 |
|--|---|--|---|
| 3-D Shapes Topic Overview (page 190) Diagnostic Tool | Pathway 1: Modelling with Nets Pathway 2: Modelling with Skeletons Pathway 3: Modelling with Solid Shapes | Open-ended Guided Open-ended Guided Open-ended Guided Guided | 198 199 200 201 202 203 |
| (page 192) 2-D Shapes Topic Overview (page 204) Diagnostic Tool | Pathway 1: Classifying Triangles Pathway 2: Classifying Quadrilaterals Pathway 3: Line Symmetry | Open-ended Guided Open-ended Guided Open-ended Guided Guided | 210 211 212 213 214 215 |
| (page 206) Location and Movement Topic Overview (page 216) Diagnostic Tool (page 218) | Pathway 1: Using Cardinal Directions on Grids Pathway 2: Locating Objects on Grids Pathway 1: Single Rotations Pathway 2: | Open-ended Guided Open-ended Guided Open-ended Guided Open-ended | 224 225 226 227 236 237 238 |
| Transformations Topic Overview (page 228) Diagnostic Tool (page 230) | Multiple Reflections Pathway 3: Multiple Translations Pathway 4: Single Reflections and Translations | Guided Open-ended Guided Open-ended Guided | 239 240 241 242 243 |

Strand: Measurement

Measurement Strand Overview

| Length Topic Overview (page 246) Diagnostic Tool | Pathway 1: Perimeter of a Rectangle Pathway 2: Perimeter: Using Standard Units Pathway 3: Length: Using Standard Units | Open-ended Guided Open-ended Guided Open-ended Guided | 252 253 254 255 256 257 |
|---|---|--|--|
| (page 248) Area Topic Overview (page 258) Diagnostic Tool (page 260) | Pathway 1: Area of a Rectangle Pathway 2: Using Standard Units of Area | Open-ended Guided Open-ended Guided | 264 265 266 267 |

Contents

vi

| Time Topic Overview (page 268) Diagnostic Tool (page 270) Mass Topic Overview (page 278) Diagnostic Tool (page 280) Volume and Capacity Topic Overview (page 288) Diagnostic Tool (page 290) | Pathway 1: Using Elapsed Time Pathway 2: Reading a Clock Pathway 1: Mass: Kilograms and Grams Pathway 2: Mass: Using One Standard Unit Pathway 1: Volume Related to Area of Base Pathway 2: Relating Volume and Capacity Pathway 3: Volume: Cubic Centimetres Pathway 4: Capacity: Litres or Millilitres | Open-ended Guided | 274 275 276 277 284 285 286 287 296 297 298 299 300 301 302 303 |
|--|---|--|--|
| Angles Topic Overview (page 304) Diagnostic Tool (page 306) | Pathway 1: Measuring and Drawing Angles Pathway 2: Comparing Angles | Open-ended Guided Open-ended Guided | 310 311 312 313 |

Strand: Data and Probability

| Data and | l Probab | ility | Strand | Overview |
|----------|----------|-------|--------|----------|
|----------|----------|-------|--------|----------|

| Summarizing Data Topic Overview (page 316) Diagnostic Tool (page 318) | Pathway 1: Data: Using the Mean Pathway 2: Data: Using the Median and Mode Pathway 1: Data: Using Broken-Line Graphs Pathway 2: | Open-ended Guided Open-ended Guided Open-ended Guided | 322 323 324 325 336 337 |
|---|---|--|--|
| Displaying Data Topic Overview (page 326) Diagnostic Tool (pages 328) | Pathway 2: Data: Using Stem-and-Leaf Plots Pathway 3: Data: Using Double Bar Graphs Pathway 4: Data: Using Line Plots | Open-ended Guided Open-ended Guided Open-ended Guided Guided | 338 339 340 341 342 343 |
| Probability Topic Overview (page 244) Diagnostic Tool (page 246) | Pathway 1: Probability: Using Numbers Pathway 2: Probability: Using Words | Open-ended Guided Open-ended Guided | 350 351 352 353 |

vii

Multiplying Whole Numbers

Planning For This Topic

Materials for assisting students with multiplying whole numbers consist of a diagnostic tool and 3 intervention pathways. Pathway 1 involves multiplying two-digit by two-digit numbers. Pathway 2 involves multiplying three-digit or two-digit numbers by one-digit numbers. Pathway 3 involves strategies for multiplication facts.

Each pathway has an open-ended intervention and a guided intervention. Choose the type of intervention more suitable for your students' needs and your particular circumstances.

Curriculum Connections

Grades 3 to 6 curriculum connections for this topic are provided online. See www.nelson.com/leapsandbounds. The Ontario and WNCP curricula for multiplication are aligned, except that in Grade 4 the WNCP outcomes include two-digit by one-digit and three-digit by one-digit multiplication, whereas the Ontario expectations include only two-digit by one-digit multiplication. Although the WNCP curriculum is somewhat more explicit about what fact strategies students should use, those same strategies are implicit in the Ontario curriculum and should not affect the appropriateness of the various interventions.

Why might students struggle with multiplying whole numbers?

Students might struggle with multiplying for any of the following reasons:

- They might have difficulty skip counting by 2s and 5s, making it difficult to build other facts from these.
- They might not know all of the multiplication facts, making it difficult to perform calculations using several facts.
- They might be unfamiliar with principles such as the commutative principle (that it does not matter in which order you multiply 2 numbers), the associative principle (that when 3 numbers are multiplied, they can be grouped in 2s in any way for the purpose of multiplying), and, particularly, the distributive principle (that to multiply $a \times b$, you can multiply a by the parts of b and add the products)—making it hard for them to relate facts to each other (e.g., they might not realize they could figure out 6×4 by using $5 \times 4 + 1 \times 4$).
- They might multiply 2 two-digit numbers "in columns" just like addition (e.g., they might think of 34 × 25 as 620 by multiplying the 3 × 2 and then appending the 4 × 5).
- They might not be able to relate multiplications (e.g., not realizing that 6×34 is double 3×34).

Professional Learning Connections

- PRIME: Number and Operations, Background and Strategies (Nelson Education Ltd., 2005), pages 49–62, 82–89, 94–97
- Making Math Meaningful to Canadian Students K–8 (Nelson Education Ltd., 2008), pages 173–182, 186–189
- *Big Ideas from Dr. Small Grades K–3* (Nelson Education Ltd., 2010), pages 44–48
- *Big Ideas from Dr. Small Grades 4–8* (Nelson Education Ltd., 2009), pages 25–38 *Good Questions* (dist. by Nelson Education Ltd., 2009), pages 27, 29, 31, 44, 47, 50–51

Diagnostic Tool: Multiplying Whole Numbers

Use the diagnostic tool to determine the most suitable intervention pathway for multiplying whole numbers. Provide Diagnostic Tool: Multiplying Whole Numbers, Teacher's Resource pages 50 and 51, and have students complete it in writing or orally. Have base ten blocks and counters available for students to use.

See solutions on Teacher's Resource pages 52 and 53.

Intervention Pathways

The purpose of the intervention pathways is to help students multiply. The focus is to prepare them for working with a broader range of products and, eventually, decimal products as well.

There are 3 pathways:

- Pathway 1: Multiplying Two-Digit Numbers
- Pathway 2: Multiplying by One-Digit Numbers
- Pathway 3: Multiplication Fact Strategies

Use the chart below (or the Key to Pathways on Teacher's Resource pages 52 and 53) to determine which pathway is most suitable for each student or group of students.

| Diagnostic Tool Results | Intervention Pathway |
|--|---|
| If students struggle with | use Pathway 1: Multiplying Two-Digit Numbers |
| Questions 2d–e, 3h, 4e–f, | Teacher's Resource pages 54–55 |
| 5c–d, 6c | Student Resource pages 55–59 |
| If students struggle with | use Pathway 2: Multiplying by One-Digit Numbers |
| Questions 2b–c, 3e–g, 4a–d, | Teacher's Resource pages 56–57 |
| 5a–b, 6a–b | Student Resource pages 60–64 |
| If students struggle with Questions 1, 2a, 3a-d | use Pathway 3: Multiplication Fact Strategies Teacher's Resource pages 58–59 Student Resource pages 65–69 |

If students successfully complete Pathway 3 (or 2), they may or may not need the additional intervention provided by Pathway 2 (or 1). Either re-administer Pathway 2 (or 1) questions from the diagnostic tool or encourage students to do a portion of the open-ended intervention for Pathway 2 (or 1) to decide if more work in that pathway would be beneficial.

Date:_

Diaanostic

Tool

Multiplying Whole Numbers





b) 7 × 14

c) 22 × 23

Solutions and Key to Pathways





Multiplying Two-Digit Numbers

You will need

- base ten blocks
- Student Resource
 page 55

Open-Ended Intervention

Before Using the Open-Ended Intervention

Ask students to imagine a school with 12 classes, each with 26 students. Ask:

- ► How would you figure out how many students are in the school? (e.g., *I would multiply 12 × 26*.)
- How else could you do it?
 (e.g., *I would multiply 6 × 26 and double it.*)
- How would you use base ten blocks to model 12 × 26?
 (e.g., *I would make 12 groups of 2 tens blocks and 6 ones blocks.*)
- ► About how much is 12 × 26? How do you know? (e.g., *about 350 since it's about 12 × 30*)

Using the Open-Ended Intervention (Student Resource page 55)

Read through the task on the student page together. Make sure students understand that, for each situation, they must put the same number of books on each shelf (between 30 and 90 books), and the total must be close to 3000. The number of books on a shelf can change when the number of shelves used changes. Students should come up with several possibilities and describe their thinking each time. Provide base ten blocks for modelling.

Give students time to work, ideally in pairs.

Observe whether students

- estimate to come up with reasonable possibilities for a given number of books on a shelf
- multiply correctly to get the total number of books
- persevere to come up with many possibilities

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- ▶ How did you decide on the number of books for 33 shelves?
 (e.g., *I know that 3000 = 30 × 100, so for 33 shelves, it would have to be less than 100; I tried 90; 90 × 33 = 2970.*)
- Suppose you knew that there were 55 books on a shelf. How would you figure out the number of shelves?

(e.g., I would multiply different numbers by 55 to see which is close to 3000.)

- How would you explain to someone how you multiply 60 by 49?
 (e.g., *I would multiply 60 by 50 and take away 60.*)
- Would you multiply 42 by 66 the same way? If not, how would you multiply?
 (e.g., No. I would figure out that 10 × 66 = 660, so 40 × 66 is 4 × 660; then I would add 2 × 66.)

Multiplying Two-Digit Numbers

Guided Intervention

Before Using the Guided Intervention

Ask students to imagine a school with 12 classes, each with 26 students. Then ask:

- ► How would you figure out how many students are in the school? (e.g., *I would multiply 12 × 26*.)
- How else could you do it?
 (e.g., *I would multiply 6 × 26 and double it.*)
- How would you use base ten blocks to model 12 × 26?
 (e.g., *I would make 12 groups of 2 tens blocks and 6 ones blocks.*)
- About how much is 12 × 26? How do you know?
 (e.g., *About 350; it's just a bit smaller than 12 × 30.*)

Using the Guided Intervention Student Resource pages 56–59

Work through the instructional section together. Students should represent the array of 12 by 24 with base ten blocks. Make sure students have an understanding of all 3 strategies—doubling, separating the tens and ones, and using an array.

Have students work through the Try These questions in pairs or individually.

Observe whether students

- relate a concrete model to a multiplication situation (Questions 1, 6)
- relate the multiplication of a two-digit number by a two-digit number to the separate multiplication of each of its parts (Question 2)
- estimate products (Questions 3, 7)
- explain multiplication strategies (Questions 4, 6)
- multiply numbers (Questions 4, 5, 8)

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- What are some different ways to calculate 22 × 16?
 (e.g., *I could multiply 20 × 10 + 20 × 6 + 10 × 2 + 6 × 2 and add them,* or *I could double 22 × 8.*)
- What base ten block model would you create to show 14 × 14?
 (e.g., *I would set up a rectangle 14 wide and 14 deep.*)
- How did you create a big product in Question 8?
 (e.g., I made the group size really big and had a lot of groups. I wasn't sure if 91 × 75 or 71 × 95 would be greater until I tried.)
- How can you predict the ones digit of the product for 43 × 36?
 (e.g., *I know that the ones come from 3 groups of 6 ones, so I know 3 × 6 is 18, and there are 8 ones.*)
- How would you estimate 43×36 ? (e.g., *I would think* 40×40 *is* 1600.)

You will need

Pathway

- base ten blocks
- Student Resource pages 56–59

Multiplying by One-Digit Numbers

You will need

- base ten blocks
- Student Resource
 page 60

Open-Ended Intervention

Before Using the Open-Ended Intervention

Provide base ten blocks and ask:

- ► How could you use the blocks to show what 4 × 20 is? (e.g., 4 sets of 2 tens blocks is 8 tens, so that is 80.)
- What about 4 × 200?
 (e.g., 4 sets of 2 hundreds blocks is 8 hundreds blocks, so that is 800.)
- Suppose you didn't have enough blocks to show 4 × 20 or 4 × 200. Why would you really only need to know what 4 × 2 is?
 (e.g., *I showed 4 groups of 2 and just knew if it was tens blocks or hundreds blocks.*)
- What does 4×23 mean? (4 groups of 23)
- ► How would you calculate 4 × 23 if you knew 4 × 20 and 4 × 3? (e.g., You would just add the 4 groups of 20 and 4 groups of 3.)
- ▶ How would you calculate 4 × 213?
 (e.g., *It would be* 4 × 200 + 4 × 10 + 4 × 3.)

Using the Open-Ended Intervention Student Resource page 60

Read through the task on the student page together. Make sure students realize that they can use different numbers of crates, but that, for each situation, the crates have the same mass and the total is close to 3000 kg. The mass of a crate can change when the number of crates used changes. Students should come up with several possibilities and describe their thinking. Provide base ten blocks. Give students time to work, ideally in pairs.

Observe whether students

- estimate to come up with reasonable possibilities for a given crate size
- multiply correctly to get the total mass
- persevere to come up with many possibilities

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- How did you decide the crate size for 4 crates?
 (e.g., I knew it would be 1000 kg for 3 crates, so it had to be less. I know that
 - $4 \times 700 = 2800$, so I tried a mass of 730 kg. I decided I could go a bit higher.)
- Suppose you knew that a crate had a mass of 425 kg. How would you figure out the number of crates the truck could carry?
 - (e.g., I would multiply different numbers by 425 to see which is close to 3000.)
- How would you explain to someone how you would multiply 6 by 499? (e.g., *I would multiply by 500 and take away 6.*)
- ▶ Would you multiply 5 by 589 the same way? If not, how would you multiply? (e.g., *No. I would calculate* 5 × 500 + 5 × 80 + 5 × 9.)

Multiplying by One-Digit Numbers

Guided Intervention

Before Using the Guided Intervention

Provide base ten blocks and ask:

- How could you use the blocks to show what 4 × 20 is? (e.g., 4 sets of 2 tens blocks is 8 tens, so that is 80.)
- What about 4 × 200?
 (e.g., 4 sets of 2 hundreds blocks is 8 hundreds blocks, so that is 800.)
- Suppose you didn't have enough blocks to show 4 × 20 or 4 × 200. Why would you really only need to know what 4 × 2 is? (e.g., *I showed 4 groups of 2 and just knew if it was tens blocks or hundreds blocks.*)
- What does 4×23 mean? (4 groups of 23)
- How would you calculate 4 × 23 if you knew 4 × 20 and 4 × 3? (e.g., You would just add the 4 groups of 20 and 4 groups of 3.)

Using the Guided Intervention (Student Resource pages 61–64)

Work through the instructional section on student page 61 together as students model the multiplication with base ten blocks. Make sure students get an understanding of all 3 strategies—repeated addition, multiplying in parts, and using base ten blocks.

Have students work through the Try These questions in pairs or individually.

Observe whether students

- relate a concrete model to a multiplication situation (Questions 1, 2, 7)
- relate the multiplication of a two-digit number to the separate multiplication of each of its parts (Question 3)
- estimate products (Questions 4, 8)
- explain multiplication strategies (Questions 5, 7)
- multiply numbers (Questions 5, 6, 9)

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- ▶ What are some different ways to calculate 5 × 16? (e.g., *I could multiply*
- 5×10 and 5×6 and add them, or I could double 5×8 .)
- What model would you create to show 8 × 281?
 (e.g., *I would make 8 groups of 2 hundreds blocks, 8 tens blocks, and 1 ones block.*)
- How did you create a big product in Question 9?
 (e.g., I made the group size really big and a lot of groups. I wasn't sure if it should be 9 × 75 or 7 × 95 until I tried.)
- How would you estimate 4 × 236?
 (e.g., I would think 4 × 200 is 800, so it's more than that but less than 1000 since 4 × 250 = 1000.)

You will need

Pathway 2

- base ten blocks
- Student Resource pages 61–64

You will need

counters (about 50)
Student Resource page 65

Open-Ended Intervention

Before Using the Open-Ended Intervention

Provide counters and ask:

- Arrange your counters to show what 5 × 4 means. How does it show that?
 (e.g., 5 × 4 means 5 groups of 4, and that is what I showed.)
- How would 4×5 look different? (e.g., *It would be 4 groups of 5 instead.*)

Have students arrange the 4 groups of 5 counters in an array, if they are not already arranged that way, and split the array in 2. Ask:

- How does this show that 4×5 is double 2×5 ? (e.g., *There are 2 sets of 2 \times 5.*)
- ► How could you split the original array to show that 4 × 5 = 4 × 3 + 4 × 2? (e.g., *Split each 5 into 3 + 2.*)

Using the Open-Ended Intervention (Student Resource page 65)

Read through the tasks on the student page together. Make sure students realize that, first, they need to relate multiplying by 3, 4, 6, 7, 8, and 9 to multiplying by 2 and/or 5, as well as using the value of that number itself. In the second part of the task, students need to replace either the 2 or 5 or both and then repeat the exercise. Provide counters.

Give students time to work, ideally in pairs.

Observe whether students

- think of multiplication as repeated addition or using arrays or the total size of equal groups
- recognize when to use the doubling strategy (e.g., 6 × is twice 3 × i; 8 × is twice 4 × i)
- correctly apply the distributive principle (e.g., $6 \times \blacksquare$ is $5 \times \blacksquare + \blacksquare$)
- make reasonable choices for the replacements for 2 and 5

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- How is multiplying by 3 related to multiplying by 2?
 (*Just add the number you are multiplying by to the double.*)
- What are some different strategies you can use to multiply by 6?
 (e.g., I could multiply by 5 and add the number, or I could figure out the answer for multiplying by 3 and double it.)
- What are some different strategies you can use to multiply by 9?
 (e.g., I could multiply by 5, double the product, and then subtract the number, or I could double the double of the double and then add the number.)
- Why did you decide to use 4 and 5 in the second part?
 (e.g., *I knew that if you could multiply by 4, you just take half to multiply by 2, so it would have to work if 2 and 5 work.*)

Multiplication Fact Strategies

Guided Intervention

Before Using the Guided Intervention

Provide counters and ask:

- ► Arrange your counters to show what 5 × 4 means. How does it show that? (e.g., 5 × 4 means 5 groups of 4, and that is what I showed.)
- How would 4×5 look different? (e.g., *It would be 4 groups of 5 instead.*)

Have students arrange the 4 groups of 5 in an array if they are not already arranged that way and split the array in 2. Ask:

- How does this show that 4×5 is double 2×5 ? (e.g., *There are 2 sets of 2 \times 5.*)
- ► How could you split the original array to show that 4 × 5 = 4 × 3 + 4 × 2? (e.g., Split each 5 into 3 + 2.)

Using the Guided Intervention (Student Resource pages 66–69)

Work through the instructional section on student pages 66 and 67 together as students model the strategies using counters. Make sure students have a sense of all 3 strategies—doubling, skip counting, and multiplying in parts.

Have students work through the Try These questions in pairs or individually.

Observe whether students

- use a doubling strategy (Questions 1, 4)
- use the distributive principle (multiplying in parts) (Questions 1, 2, 4)
- use a halving strategy (Question 2)
- are familiar with multiplication facts (Question 3)
- can explain strategies (Questions 5, 6)

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- How is multiplying by 3 related to multiplying by 2?
 (Just add the number you are multiplying by to the double.)
- What are some different strategies you can use to multiply by 6?
 (e.g., *I could multiply by 5 and add the number, or I could figure out the answer for multiplying by 3 and double it.*)
- What are some different strategies you can use to multiply by 9?
 (e.g., *I could multiply by 5, double the product, and then subtract the number, or I could double the double of the double and then add the number.*)
- How was drawing the pictures in Question 5 useful?
 (e.g., *It sort of explains the way to think when you see the picture.*)
- What was the first answer you thought of for Question 6?
 (e.g., I thought of multiplying by 4 being easy if you know how to double since you just double the double.)

You will need

Pathway 3

• counters (about 50)

 Student Resource pages 66–69

Dividing Whole Numbers

Planning For This Topic

Materials for assisting students with dividing whole numbers consist of a diagnostic tool and 3 intervention pathways. The pathways differ based on the size of the dividend used.

Each pathway has an open-ended intervention and a guided intervention. Choose the type of intervention more suitable for your students' needs and your particular circumstances.

Curriculum Connections

Grades 3 to 6 curriculum connections for this topic are provided online. See www.nelson.com/leapsandbounds. There are no significant differences between the work in division of whole numbers across the country in Grades 3 to 5.

Why might students struggle with dividing whole numbers?

Students might struggle with dividing whole numbers for any of the following reasons:

- They might not correctly interpret $a \div b$ as a sharing situation.
- They might not recognize division as the inverse operation to multiplication (e.g., that answering 45 ÷ 5 is the same as asking what 5 × = 45 is).
- They might have difficulty relating division of multiples of 10 or 100 to related facts (e.g., they may not realize that $60 \div 2$ is simply based on $6 \div 2$).
- They might not know how to handle remainders (e.g., they might be able to solve $36 \div 4$ but not $38 \div 4$, or, if using a more traditional algorithm, they might write $51 \atop 4)215$ instead of $53 \atop 4)215$ Remainder 3,

since in their second step they divided 5 by 4 instead of 15 by 4).

- They might not know all of the multiplication facts and therefore not know the division facts.
- They might not understand how to separate the dividend into convenient parts for dividing (e.g., they may not realize that to divide 120 by 9, it might be convenient to think of it as $90 \div 9 + 30 \div 9$).
- They might ignore internal 0s when dividing (e.g., dividing 6003 by 3 and getting 21).

Professional Learning Connections

PRIME: Number and Operations, Background and Strategies (Nelson Education Ltd., 2005), pages 51-62, 84, 90-97 Making Math Meaningful to Canadian Students K-8 (Nelson Education Ltd., 2008), pages 175-177, 182-189 Big Ideas from Dr. Small Grades K-3 (Nelson Education Ltd., 2010), pages 44-48 Big Ideas from Dr. Small Grades 4-8 (Nelson Education Ltd., 2009), pages 25-34, 38-41 Good Questions (dist. by Nelson Education Ltd., 2009), page 50

Diagnostic Tool: Dividing Whole Numbers

Use the diagnostic tool to determine the most suitable intervention pathway for dividing whole numbers. Provide Diagnostic Tool: Dividing Whole Numbers, Teacher's Resource pages 62 and 63, and have students complete it in writing or orally. Have base ten blocks, counters, and 10-frames available for students to use.

See solutions on Teacher's Resource pages 64 and 65.

Intervention Pathways

The purpose of the intervention pathways is to help students divide. The focus is to prepare them for working with a broader range of quotients and, eventually, decimal quotients as well.

There are 3 pathways:

- Pathway 1: Dividing Three-Digit Numbers
- Pathway 2: Dividing Two-Digit Numbers
- Pathway 3: Division Fact Strategies

Use the chart below (or the Key to Pathways on Teacher's Resource pages 64 and 65) to determine which pathway is most suitable for each student or group of students.

| Diagnostic Tool Results | Intervention Pathway |
|---|---|
| If students struggle with Questions 6 to 8 | use Pathway 1: Dividing Three-Digit Numbers Teacher's Resource pages 66–67 Student Resource pages 70–74 |
| If students struggle with Questions 4 to 5 | use Pathway 2: Dividing Two-Digit Numbers Teacher's Resource pages 68–69 Student Resource pages 75–79 |
| If students struggle with Questions 1 to 3 | use Pathway 3: Division Fact Strategies Teacher's Resource pages 70–71 Student Resource pages 80–84 |

If students successfully complete Pathway 3 (or 2), they may or may not need the additional intervention provided by Pathway 2 (or 1). Either re-administer Pathway 2 (or 1) questions from the diagnostic tool or encourage students to do a portion of the open-ended intervention for Pathway 2 (or 1) to decide if more work in that pathway would be beneficial.

Diagnostic

Tool

Dividing Whole Numbers

 What multiplication does each picture show? What division does each picture show?

| a) | | | | | 000 | | |
|----|-----------|--------|------|----------|-----|------|---|
| | multiplic | ation: | | divisior | ו: | | _ |
| b) | | | | | | | |
| | multiplic | ation: | | divisior | ו: | | _ |
| c) | | | | | | | |
| | multiplic | ation: | | divisior | ו: | | _ |

2. Draw a picture to show each division sentence. Record the value of .



c) 56 ÷ 8 =

| Name:_ | | Date: | | | | |
|--------|--|-------|--|--|--|--|
| 3. | Suppose you know that $4 \times 7 = 28$. What division facts would that help you with? | | | | | |
| 4. | a) How much more is 66 ÷ 3 than 60 ÷ 3? | | | | | |
| | more b) How much more is 76 ÷ 4 than 36 ÷ 4? | | | | | |
| | more | | | | | |
| 5. | Calculate. | | | | | |
| | a) 42 ÷ 2 = c) 78 ÷ 7 = | - | | | | |
| | b) 96 ÷ 8 = d) 79 ÷ 3 = | - | | | | |
| 6. | b. Use words or draw a picture to show that $315 \div 3 = 300 \div 3 + 15 \div 3$. | | | | | |
| | | | | | | |
| 7. | Circle the division expressions with answers close t | 0 60. | | | | |
| | 357 - 0 134 - 3 211 - 3 548 - | 9 | | | | |
| 8. | Calculate. a) 262 ÷ 2 = c) 142 ÷ 5 = | | | | | |
| | b) 424 ÷ 8 = d) 651 ÷ 9 = | | | | | |

Solutions and Key to Pathways

| | Name: Date: |
|---------|---|
| | Dividing Whole Numbers Diagnostic Tool |
| | 1. What multiplication does each picture show? What division does each picture show? |
| | |
| | multiplication: $\underline{e.g., 5 \times 4 = 20}$ division: $\underline{e.g., 20 \div 5 = 4}$ |
| | |
| | multiplication: $\underline{e.g., 6 \times 5 - 30}$ division: $\underline{e.g., 30 - 6 - 5}$ |
| | multiplication: <u>e.g.</u> $2 \times 9 = 18$ division: <u>e.g.</u> $18 \div 9 = 2$ |
| Pathway | 2. Draw a picture to show each division sentence. Record the value of . |
| 9 | a) $25 \div 5 = 1$ e.g., $25 \div 5 = 5$ |
| | |
| | b) 18 ÷ 3 = |
| | $e.g., 18 \div 3 = 6$ |
| | c) $56 \div 8 = \blacksquare$ |
| | $\begin{bmatrix} e.g., 56 \div 8 = 7 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0$ |
| | 62 Dividing Whole Numbers, Diagnostic Tool Leaps and Bounds Copyright © 2011 by Nelson Education Ltd. |



Dividing Three-Digit Numbers

You will need

- base ten blocks
- Student Resource
 page 70

Open-Ended Intervention

Before Using the Open-Ended Intervention

Have students model 412 with base ten blocks and ask:

Suppose you had to divide that amount into 3 piles so that each pile had exactly the same amount in it. How do you know each pile would have more than 100 in it? (e.g., 3 × 100 is only 300, and that's too low)

How could you share the 412?
 (e.g., I would put 1 hundreds block in each pile. I would trade the other hundreds block for 10 tens blocks. Then I could put 3 tens blocks in each pile. I would have 2 tens blocks left, so I would trade them for ones blocks. I could put 7 ones blocks in each pile. I would have 1 ones block left.)

Why might it make sense to write 412 ÷ 3 = 137 Remainder 1?
 (e.g., You write division when you are sharing, and there were 412 to start with; there are 3 piles, and each pile has 137 in it, and there is 1 left over.)

Using the Open-Ended Intervention (Student Resource page 70)

Read through the tasks on the student page together. Make sure students realize they should select different total numbers of comic books and that they must use 3 different numbers of piles for each total number of comic books. Provide base ten blocks and give students time to work, ideally in pairs.

Observe whether students

- use reasonable estimates to make predictions
- divide, or share, in parts
- use convenient parts (or easy numbers) to divide
- recognize that the number in a pile must be less if there are more piles for the same number of comics
- use multiplication knowledge to solve division (e.g., think about a number that might lead to 5 × = a given number of comic books)

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

How did you predict the number of comic books in a pile when there were 516 comic books in 5 piles?

(e.g., I know it's just a bit more than 100, since $5 \times 100 = 500$.)

- Why might it be useful to realize that 600 = 500 + 100 to divide 600 comic books into 5 piles? (e.g., *because it's easy to split 500 into 5 piles, and then you just split 50 more and 50 more into the 5 piles*)
- How does knowing that 5 × 80 = 400 help you figure out the number of comic books in a pile if there were 408 comics in 5 piles? (e.g., *I would know that 400 ÷ 5 = 80, and then I would just divide up the last 8 and add to 80.*)

Dividing Three-Digit Numbers

Guided Intervention

Before Using the Guided Intervention

Present the situation that 3 people were sharing \$412. Ask:

- How do you know each person will get more than \$100?
 (e.g., *If each person got \$100, that would be only \$300.*)
- How do you know they would get more than \$130 each?
 (e.g., *because that would be \$390, and \$412 is still more than \$390*)
- Why might you represent the question as 412 ÷ 3?
 (e.g., *You use division when you share.*)

Using the Guided Intervention (Student Resource pages 71–74)

Work through the instructional section on the student pages together as students do the calculations and model using base ten blocks. Make sure students understand all 3 strategies—estimating and adjusting, breaking up a number into "friendly" components, and sharing using base ten materials. For the last strategy, make sure students realize that it is not required but is much more efficient to start by sharing the largest blocks first. Point out how the recordings describe the actions.

Have students work through the Try These questions in pairs or individually.

Observe whether students

- relate a concrete model to a division situation (Question 1)
- relate the division of a three-digit number by a one-digit number to the separate division of its parts (Question 2)
- estimate quotients (Question 3)
- explain division strategies (Question 4)
- calculate quotients (Questions 4, 5, 6, 7)

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- How did you estimate Question 3d)?
 (e.g., *I realized it was close to 720 ÷ 9 and knew that it was 80.*)
- ▶ What if you had divided 708 by 8? Would it be more or less than 708 ÷ 9? Explain.

(e.g., More, there is the same amount to share, but fewer people are sharing it.)

Why might it be useful to realize that 520 = 400 + 100 + 20 to figure out Question 4a)?

(e.g., because it's easy to split 400, 100, and 20 into 4)

How does knowing that 8 × 6 = 48 help you figure out Question 4c)?
 (e.g., *I would know that 8 × 60 = 480, and then I would just need to share the last 14 cookies.*)



Pathway

- base ten blocks
- Student Resource
 pages 71–74

Dividing Two-Digit Numbers

You will need

- base ten blocks or counters and 10-Frames (BLM 5)
- Student Resource page 75

Open-Ended Intervention

Before Using the Open-Ended Intervention

Provide either base ten blocks or counters and 10-Frames. Ask:

- ▶ How would you model 43? (e.g., 4 tens blocks and 3 ones blocks, or 4 full 10-frames and a 10-frame with only 3 counters in it.)
- Suppose you had to divide that amount into 3 piles so that each pile had exactly the same amount in it. How do you know each pile would have more than 10 in it? (e.g., 3 × 10 is only 30, and that's too low.)
- How could you share the 43?
 (e.g., I would put 1 tens block in each pile. I could trade the other tens for 10 ones then I could put 4 ones in each pile. I would still have 1 ones block left.)
- Why might it make sense to write 43 ÷ 3 = 14 Remainder 1?
 (e.g., You write division when you are sharing and there were 43 to start with; there are 3 piles, and each pile has 14 in it and there is 1 left over.)

Using the Open-Ended Intervention (Student Resource page 75)

Read through the tasks on the student page together. Make sure students realize they should select a few different total numbers of papers and that they must use 3 different numbers of friends for each number of papers selected. Remind students that they need to count Evan in the number of people delivering papers.

Provide the materials and give students time to work, ideally in pairs.

Observe whether students

- use reasonable estimates to make predictions
- divide, or share, in parts
- use convenient parts (or easy numbers) to divide
- use multiplication knowledge to help them get an answer (e.g., think about a number that might lead to 5 ×
 a given number of papers)

Consolidating and Reflecting

Ensure understanding by asking questions like these based on students' work:

- How did you predict the number of papers each person would deliver when there were 51 papers and 3 people delivering? (e.g., *I know there would be* 3 people delivering. It's fewer than 20, since 3 × 20 = 60.)
- What if there had been 2 people delivering instead of 3—would there be more or fewer papers for each person to deliver? Explain. (*more*; e.g., *If each person delivered the same number as with 3 people delivering, there would have been* 1 pile that was not delivered.)
- How does knowing that 5 × 8 = 40 help you figure out how many papers each of 5 people delivers if there were 42 papers to deliver? (e.g., *I would know that 40 ÷ 5 = 8, and then one person would deliver an extra 2 papers*)

Dividing Two-Digit Numbers

Guided Intervention

Before Using the Guided Intervention

Present the situation that 3 people were sharing \$82. Ask:

- ► How do you know each person will get more than \$20? (e.g., *because 3 × \$20 = \$60, so that would only use \$60*)
- ► How do you know that it makes sense that each person would get \$27? (e.g., 3 groups of 27 is 3 × 27, and that's 81 and really close to 82.)
- Why might you represent the question as 82 ÷ 3? (e.g., You use division when you share.)

Using the Guided Intervention (Student Resource pages 76–79)

Work through the instructional section on the student pages together as students model the division with base ten blocks or 10-frames and counters. Make sure students understand all 3 strategies—estimating and adjusting, breaking up a number into "friendly" components, and sharing using base ten materials or 10-frames and counters. For the last strategy, make sure students realize that it is not required but is much more efficient to start by sharing the tens blocks or full 10-frames first.

Have students work through the Try These questions in pairs or individually.

Observe whether students

- relate a concrete model to a division situation (Questions 1, 6)
- relate the division of a two-digit number by a one-digit number to the separate division of its parts (Question 2)
- estimate quotients (Question 3)
- explain division strategies (Question 4)
- calculate quotients (Questions 4, 5, 7, 8)

Consolidating and Reflecting

Ensure understanding by asking questions such as these, based on students' work:

- How did you estimate Question 3c)?
 (e.g., *I realized it was close to 90 ÷ 3 and knew that it was 30.*)
- What if you had divided 98 by 8 in Question 3d)? Would the answer be more or less? Explain.

(more, e.g., There is the same amount to share, but fewer people are sharing it.)

- ▶ Why might it be useful to realize that 80 = 60 + 18 + 2 to figure out Question 4b)? (e.g., *It's easy to divide 60 and 18 by 6.*)
- How would you figure out how to share \$52 among 3 people?
 (e.g., *I know it would be \$10 if there were \$30, so I just need to share the last \$22. Each person gets \$7 more, and there is a remainder of \$1.*)

You will need

Pathway 2

- base ten blocks or counters and 10-Frames (BLM 5)
- Student Resource pages 76–79

Division Fact Strategies

You will need

- multiplication tables
- counters (about 50)
- Student Resource
 page 80

Open-Ended Intervention

Before Using the Open-Ended Intervention

Provide multiplication tables. Ask:

Look at the number in the row beginning with 2 and the column beginning with 8. What does the 16 mean?

(e.g., It's 2×8 , since there are 2 groups of 8.)

- How would that help you figure out 16 ÷ 2?
 (e.g., It would have to be 8, since 16 ÷ 2 means how much is in each of 2 groups if there are 16 altogether, and that's what you have with 2 groups of 8.)
- ▶ What division does the number in the row beginning with 4 and the columns beginning with 9 help you solve? (36 ÷ 4 or 36 ÷ 9)

Using the Open-Ended Intervention (Student Resource page 80)

Read through the tasks on the student page together. Make sure students realize they have 3 tasks—one dealing with 24, one with 26, and the last one requiring them to consider as many divisions as possible. Provide counters and multiplication tables and give students time to work, ideally in pairs.

Observe whether students

- recognize the relationship between multiplication and division
- consider all possible factor pairs for a given product
- look for alternative nearby numbers (e.g., realize that for 35 ÷ 4, they could look for 32 ÷ 4 or 36 ÷ 4 to help them)
- recognize when the table won't help them calculate a quotient because the quotient is too great (and, therefore, not close to numbers in the table for the given factor)
- persevere in finding quotients both with and without remainders, based on the multiplication table

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

- How does knowing that 4 × 6 = 24 help you figure out 24 ÷ 4? Use a picture to explain. (e.g., *I know that a picture with 4 groups of 24 shows 24 being shared 4 ways, but it also shows that 4 groups of 6 makes 24.*)
- Suppose you wanted to figure out 57 ÷ 7. What row in the table would you look at? (*the 7 row*)
- What could you do when you don't see 57? (e.g., *I look for a number close to it, like 56.*) Then what? (e.g., *If* 7 × 8 = 56, *then I know 56* ÷ 7 = 8, *so 57* ÷ 7 *is 8 R1.*)
- Why does the table not help you solve 96 ÷ 2?
 (e.g., because there is nothing even close to 96 in the 2 row)

Division Fact Strategies

Guided Intervention

Before Using the Guided Intervention

Create an array with 2 rows of 8 counters. Ask:

- What multiplication fact does this model? (e.g., $2 \times 8 = 16$)
- How do you know that? (e.g., because there are 2 groups of 8)
- How would that help you figure out $16 \div 2$? (e.g., It would have to be 8, since $16 \div 2$ means how much is in each of 2 groups if there are 16 altogether, and that's what you have with 2 rows of 8.)
- How would you show $36 \div 4$? (e.g., I would put 36 counters in 4 rows and see how many there are in each row.)

Using the Guided Intervention (Student Resource pages 81–84)

Work through the instructional section on the student pages together as students model the division with counters. Make sure students have an understanding of all 3 strategies—using counters, estimating and then adjusting, and backwards multiplication.

Provide multiplication tables. Have students work through the Try These questions in pairs or individually.

Observe whether students

- model division situations (Questions 1, 2, 5)
- relate multiplication facts to division situations (Question 3)
- calculate quotients with and without remainders (Questions 1, 2, 4)
- explain the relationship between various division situations (Questions 5, 6)

Consolidating and Reflecting

Ensure understanding by asking questions such as these based on students' work:

 Suppose you had decided to draw a picture to solve Question 1c)—what would it look like?

(45 divided into 9 groups of 5)

- What multiplication does Question 1c) relate to? $(9 \times 5 = 45)$
- How could knowing that $9 \times 4 = 36$ help you figure out the answer to Question 2a)?

(e.g., I know that a picture with 9 groups of 4 shows 36 being shared 9 ways, but it also shows that 9 groups of 4 makes 36.)

- What was different about solving $59 \div 8$ in Question 2c)? (e.g., The groups could not all be equal so I had a remainder.)
- What might be some different ways you could have calculated $63 \div 9$ in Question 4b)?

(e.g., I could have just remembered that $9 \times 7 = 63$; I could have put 63 counters into 7 equal piles; I could have figured out $45 \div 9$ and added it to $18 \div 9$.)



counters (about 50)

Pathway 🖪 GUIDED

- multiplication tables
- Student Resource pages 81-84



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