GRADE 4 SUPPLEMENT

Set A5  Number & Operations: Multi-digit Multiplication

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Skills & Concepts
★ represent multiplication of two-digit by two-digit numbers
★ multiply by 10 and 100
★ multiply 2- and 3-digit by 1- and 2-digit numbers using efficient methods, including the standard multiplication algorithm
★ mentally multiply 2-digit numbers by numbers through 10 and by multiples of 10
★ compare the values represented by digits in whole numbers using place value
★ multiply one- and two-digit numbers by numbers through 10 and by multiples of 10
★ estimate products to approximate solutions and determine reasonableness of answers
★ solve single-step and multi-step word problems involving multi-digit multiplication and verify the solutions
★ explain why a specific problem-solving strategy was used to determine a solution
Bridges in Mathematics Grade 4 Supplement
Set A5  Numbers & Operations: Multi-digit Multiplication

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

The Math Learning Center is a nonprofit organization serving the education community. Our mission is to inspire and enable individuals to discover and develop their mathematical confidence and ability. We offer innovative and standards-based professional development, curriculum, materials, and resources to support learning and teaching. To find out more, visit us at www.mathlearningcenter.org.
Set A5 ★ Activity 1

Multi-Digit Multiplication Pre-Assessment

Overview
This pre-assessment launches a set of activities that return to the multiplication work started in Unit 2. In the 12 activities that follow, students will move from building and sketching 2-digit by 1-digit multiplication combinations to using the standard algorithm to multiply up to 3-digit by 2-digit numbers. Additional practice with the skills introduced in these activities can be found on pages A5.109–A5.126 in the Independent Worksheet section of the Bridges Supplement.

Skills & Concepts
★ represent multiplication of two-digit by two-digit numbers
★ multiply by 10 and 100
★ multiply one- and two-digit numbers by numbers through 10 and by multiples of 10
★ estimate products to approximate solutions and determine reasonableness of answers
★ solve single-step word problems involving multi-digit multiplication

You’ll need
★ Multi-Digit Multiplication Pre-Assessment (pages A5.7–A5.9, run a class set)
★ Multi-Digit Multiplication Pre-Assessment Class Checklist (page A5.10, run 1 or 2 copies)
★ Multi-Digit Multiplication Pre- & Post-Assessment Scoring & Comparisons (optional, page A5.11 and A5.12, run a class set)
★ Base 10 Grid Paper (page A5.13, run as needed)
★ Student Reflection Sheet: Multiplication (pages A5.14–A5.16, optional, run a class set)
★ access to base 10 area and linear pieces

Instructions for Multi-Digit Multiplication Pre-Assessment
1. Explain to your students that over the next few weeks, the class will return to studying multi-digit multiplication. Today they’ll take a pre-assessment that will give you information about their current strategies for multiplying large numbers. Explain that they will take a similar assessment in several weeks, at which time they will have additional ways to handle problems that may seem challenging today.

2. Give students each a copy of the pre-assessment. Ask them to write their name and the date at the top of each page. Read and review the problems together and have students circle the “doing” words as you go. Remind them that once they get started, they’ll need to mark each checkpoint with an × or a ✓ to show that they have completed the task.
Activity 1  Multi-Digit Multiplication Pre-Assessment (cont.)

1. Ben and his mom got 5 cases of bottled water for the soccer game. There were 24 bottles of water in each case. How many bottles of water was that altogether?
   a. Solve the story problem above. Show your work with labeled sketches, numbers, and/or words.

   b. Ben and his mom got ____ bottles of water in all.

2. Choose one of the problems below and circle it.
   10 × 16  18 × 10  13 × 20  20 × 26
   a. Make a labeled sketch on the grid below to show the problem you chose.
   b. Find the answer to the problem you chose using your sketch. Show all of your work.

3. These base 10 linear pieces show the dimensions of a rectangle.
   a. Label each dimension and fill in the rectangle.
   b. Use this information to find the area of the rectangle. Show your work.

4. Circle the bubbles to show the best estimate for each problem.
   Explain your choice.
   a. 26
      × 6
      o 180
      o 150
      o 200
      o 250
   Why?
   b. 134
      × 5
      o 600
      o 700
      o 800
      Why?

5. Write the answer to each problem.
   60  30  34  100  100
   × 10  × 10  ×100  × 26  × 50

6. Write the answer to each problem.
   30  50  40  60  24  22
   × 3  × 7  × 30  × 50  × 20  × 30

7. Choose one of the multiplication problems below and circle it. Pick the one that seems best for you—not too hard and not too easy.
   12  15  22  26  31  236
   x 14  x 13  x 23  x 23  x 27  x 39
   a. Find the answer to the problem you circled. Be sure to show all of your work.

   b. Make a story problem to match the multiplication problem you just solved.
3. Before students start to work, be sure they understand that they only need to circle and solve one of the multiplication combinations in both problems 2 and 7. Tell students that you’ll place a small stack of base ten grid paper near each table or cluster of desks if they want to use it for any of the problems, and they can also get out their base ten area and linear pieces for use during the assessment.

Remind students that although you can’t explain the tasks to them, you will read any of the problems to them again if needed during the assessment period. Although they may not be sure how to solve some of the problems, encourage them to attempt each one. Partial solutions are fine, and if they are unable to answer a particular problem they can write, “I don’t know yet.”

**LOOKING AT STUDENT WORK**

Students will complete a similar assessment in Set A5, Activity 14, at which time a scoring guide will be included for your use. We recommend that you use the results of today’s pre-assessment to help guide your instruction as you teach this set of activities. To help, you can use the Multi-Digit Multiplication Class Checklist on page A5.10 if you like. By compiling results for your entire class, you can get a sense of the areas in which the class as a whole needs more work.

Students’ responses to this pre-assessment should give you a good sense of how much they have retained from Unit Two, and where they stand with regard to the skills you’ll be teaching over the coming sessions. Problem 1 gives you an opportunity to see how students deal with 2-digit by 1-digit multiplication right now. Some of them will probably make a sketch on base 10 grid paper or a free-hand sketch similar to the one shown on the next page to handle this kind of computation. Some may break 24 into tens and ones and multiply each part, while others use the standard algorithm. Chances are, some of your students will use repeated addition to solve the problem. These students may still be working to develop multiplicative reasoning, and will probably need more support than others to move toward efficient and effective methods for multi-digit multiplication.
1. Ben and his mom got 5 cases of bottled water for the soccer game. There were 24 bottles of water in each case. How many bottles of water was that altogether?

   a. Solve the story problem above. Show your work with labeled sketches, numbers, and/or words.

      5 \times 24
      \begin{array}{r}
      \phantom{0}24 \\
      \times 5 \\
      \hline
      120
      \end{array}

   b. Ben and his mom got 120 bottles of water in all.

2. Choose one of the problems below and circle it.

   10 \times 16 18 \times 10 13 \times 20 20 \times 26

   a. Make a labeled sketch on the grid below to show the problem you chose.

   b. Find the answer to the problem you chose using your sketch. Show all of your work.

   \[
   \begin{array}{c}
   50 \\
   50 \\
   \times 4 \\
   \hline
   200
   \end{array}
   \]

   \[
   \begin{array}{c}
   10 \\
   10 \\
   \times 50 \\
   \times 50 \\
   \hline
   500
   \end{array}
   \]

   \[
   \begin{array}{c}
   120 \\
   120 \\
   \times 20 \\
   \times 20 \\
   \hline
   2400
   \end{array}
   \]

Problems 2 and 3 give you an opportunity to see how your students are doing with the area model. Can they make a labeled sketch on base ten grid paper and use it to find the answer to a problem that involves multiplying by 10 or multiples of 10? Can they fill in a frame and use the sketch to find the solution to 13 \times 17? The area model, introduced in Units One and Two will serve as a scaffold for developing more efficient numeric methods for multi-digit multiplication in the activities to follow.

Problem 4 will help you see whether or not your students can estimate products and justify their estimates. Are they able to consider the results of multiplying tens and ones, or hundreds, tens, and ones, by a single digit to make reasonable estimates? Are they able to explain their thinking?

Problems 5 and 6 will help you see how well your students are able to multiply single- and double-digit numbers by 10, 100, and other multiples of 10. These skills were introduced in Unit Two, and are heavily featured in the upcoming activities, as they are central to developing efficient methods for multi-digit multiplication.

Students’ responses to problem 7 will help you understand how they are currently dealing with 2-digit by 2-digit multiplication. While a few may not be able to respond in any way, you’ll probably see a number of different methods, some of which are summarized on the chart below.
**STUDENT MULTIPLICATION METHODS**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Example</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working from Known Facts</td>
<td>14 \times 2 \cdot 28</td>
<td>Some students may break the numbers apart into more manageable chunks. Such student-invented methods demonstrate good number sense and a solid understanding of the place values involved in multi-digit computation.</td>
</tr>
<tr>
<td></td>
<td>14 \times 10 \cdot 140</td>
<td></td>
</tr>
<tr>
<td></td>
<td>140 + 28 \cdot 168</td>
<td></td>
</tr>
<tr>
<td>Mis-Memorized or Mis-Applied Algorithms</td>
<td>14 \times 12 \cdot 14</td>
<td>Any of the errors shown here will be familiar to fourth grade teachers, and tend to crop up among students who have been encouraged to memorize multi-step procedures without adequate conceptual preparation. Such students, many of whom are still reasoning in an additive rather than a multiplicative manner, are often untroubled by the fact that answers like 32 and 42 do not make sense.</td>
</tr>
<tr>
<td></td>
<td>28 \times 28 \cdot 18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 \times 14 \cdot 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 8 \times 32 \cdot 108</td>
<td></td>
</tr>
</tbody>
</table>

If you have students who get the correct answer using the standard algorithm, you might probe their understanding by asking them to explain their steps. Some may comprehend the process very well, while others may be manipulating the numbers carefully and accurately but with little understanding. Such students are likely to explain their work as follows: "When you do 12 \times 14, first you multiply 2 \times 4, that's 8. Then you multiply 2 \times 1, which is 2, so you have 28. Then you go down to the next row and put a 0 (or skip a space). Then you just go 1 \times 4 is 4 and 1 \times 1 is 2, so it's 14 with a zero (or a space) after it. You add the two rows, and it comes to 168."

You might also ask students who are using the standard algorithm correctly to estimate the results of a problem like 23 \times 15. Students who give an estimate between 300 and 400 and can explain why without resorting to paper and pencil are clearly working with good understanding.

After you have marked the pre-assessments, let your students look them over before you file them away so they have some sense of what they need to work on over the coming weeks. You might also ask them to fill out a Multiplication Student Reflection Sheet. Students may have fairly strong feelings about their own skills, and the experience of solving these kinds of problems will be fresh in their minds. If you decide to use these form, remind students that these are learning targets for the coming weeks, and it's okay if they can't do everything on the list right now. Plan to have them fill out the form again at the end of the activity set, and possibly another copy again later in the year after they've had additional time to practice the skills.
Here are some of the things you need to know to be able to multiply large numbers quickly and easily. Rate your own understandings and skills right now using the following marks.

+ I know how to do this already.
✓ I’m learning to do this, and I feel confident that I’ll be able to do it soon.
← I’m learning to do this, but it still seems pretty confusing.
0 I don’t get it, and it seems frustrating to try to understand it.

<table>
<thead>
<tr>
<th>SKILLS AND UNDERSTANDINGS</th>
<th>START OF THE ACTIVITY SET</th>
<th>END OF THE ACTIVITY SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can write a multiplication story problem.</td>
<td></td>
<td></td>
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<tr>
<td>Can multiply a single digit number by a multiple of 10 in my head. (Examples: 8 x 10 or 9 x 10)</td>
<td></td>
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<tr>
<td>Can use a labeled sketch on base 10 grid paper to solve a problem like 24 x 38.</td>
<td></td>
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<tr>
<td>Can use the standard algorithm to solve a 2-digit by 1-digit multiplication problem like 9 x 38.</td>
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<tr>
<td>Can break a 2-digit by single-digit multiplication problem into 2 parts to solve it more easily. (Example: 5 x 37 = (5 x 30) + (5 x 7)).</td>
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</tr>
<tr>
<td>Can break a 2-digit by single-digit multiplication problem into 2 parts to solve it more easily. (Example: 26 x 35 = (20 x 30) + (6 x 30)).</td>
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<tr>
<td>Can make an estimate to predict how big the answer will be or to see if my answer seems reasonable.</td>
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</table>
Multi-Digit Multiplication Pre-Assessment page 1 of 3

1. Ben and his mom got 5 cases of bottled water for the soccer game. There were 24 bottles of water in each case. How many bottles of water was that altogether?
   a. Solve the story problem above. Show your work with labeled sketches, numbers, and/or words.

   b. Ben and his mom got _____ bottles of water in all.

2. Choose one of the problems below and circle it.
   10 × 16  18 × 10  13 × 20  20 × 26
   a. Make a labeled sketch on the grid below to show the problem you chose.
   b. Find the answer to the problem you chose using your sketch. Show all of your work.
3 These base 10 linear pieces show the dimensions of a rectangle.

a Label each dimension and fill in the rectangle.

b Use the information to find the area of the rectangle. Show your work.

4 Fill in the bubble to show the best estimate for each problem. Explain your choice.

<p>| | | | | | | | | | | |</p>
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<tr>
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</thead>
<tbody>
<tr>
<td>a</td>
<td>26</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>6</td>
<td></td>
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Why?

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</thead>
<tbody>
<tr>
<td>b</td>
<td>134</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>5</td>
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</tbody>
</table>

Why?

5 Write the answer to each problem.

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>68</td>
<td>30</td>
<td>34</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>×10</td>
<td>×10</td>
<td>×10</td>
<td>×100</td>
<td>×26</td>
<td>×50</td>
<td></td>
</tr>
</tbody>
</table>
Multi-Digit Multiplication Pre-Assessment page 3 of 3

6 Write the answer to each problem.

\[
\begin{array}{ccccccc}
30 & 50 & 40 & 60 & 24 & 22 \\
\times 3 & \times 7 & \times 30 & \times 50 & \times 20 & \times 30 \\
\end{array}
\]

7 Choose one of the multiplication problems below and circle it. Pick the one that seems best for you—not too hard and not too easy.

\[
\begin{array}{ccccccc}
12 & 15 & 22 & 26 & 38 & 236 \\
\times 14 & \times 13 & \times 23 & \times 23 & \times 27 & \times 39 \\
\end{array}
\]

a Find the answer to the problem you circled. Be sure to show all of your work.

b Write a story problem to match the multiplication problem you just solved.
## Multi-Digit Multiplication Pre-Assessment Class Checklist

<table>
<thead>
<tr>
<th>Student name</th>
<th>1a Shows work for $5 \times 24$</th>
<th>1b Gives the answer for 1a, 120</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2a Makes a labeled sketch on base 10 grid paper to multiply a 2-digit number by 10 or a multiple of 10</td>
<td>2b Uses the sketch from 2a to find the correct answer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3a Completes and correctly labels a free-hand sketch of a $13 \times 17$ array</td>
<td>3b Uses the sketch from 3a to find the correct answer, 221</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4a Chooses the best estimate for $6 \times 26$ (150), and justifies estimate in a way that makes sense</td>
<td>4b Chooses the best estimate for $5 \times 134$ (700), and justifies estimate in a way that makes sense</td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>5 Multiplies 2-digit numbers by 10 and 100 (Solves ___ out of 6 problems correctly.)</td>
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<tr>
<td></td>
<td>6 Multiplies 1- and 2-digit numbers by multiples of 10 (Solves ___ out of 6 problems correctly.)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7a Shows work and finds the answer to a 2-digit $\times$ 2-digit multiplication problem</td>
<td>7b Writes a story problem to match the multiplication problem from 7a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* + completely correctly, ✓ partially correct, – incorrect

Most students appear confident with these areas:  
I’ll need to focus instruction in this unit on these weaker areas:
Multi-Digit Multiplication Pre-Assessment Scoring & Comparisons

Date of Pre-Assessment ________________

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Performance *</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a Shows work for 5 × 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1b Gives the answer for 1a (120)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a Makes a labeled sketch on base 10 grid paper to multiply a 2-digit number by 10 or a multiple of 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2b Uses the sketch from 2a to find the correct answer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a Completes &amp; labels a free-hand sketch of a 13 × 17 array</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3b Uses the sketch from 3a to find the correct answer (221)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4a Chooses the best estimate for 6 × 26 (150), and justifies estimate in a way that makes sense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4b Chooses the best estimate for 5 × 134 (700), and justifies estimate in a way that makes sense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Multiplies 2-digit numbers by 10 and 100 (Solves ___ out of 6 problems correctly.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Multiplies 1- and 2-digit numbers by multiples of 10 (Solves ___ out of 6 problems correctly.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7a Shows work and finds the answer to a 2-digit × 2-digit multiplication problem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7b Writes a story problem to match the multiplication problem from 7a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* + completely correctly, ✓ partially correct, – incorrect
# Multi-Digit Multiplication Post-Assessment Scoring & Comparisons

Date of Post-Assessment ______________________

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Points</th>
<th>Points Earned</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a Uses any combination of labeled sketches, numbers &amp; words to solve the problem, indicates understanding that 2 steps are necessary</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1b Gives the answer for 1b, 768</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a Uses the standard algorithm for 2-digit by 1-digit multiplication</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2b Uses a different method for 2-digit by 1-digit multiplication</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2c Gives a reasonable explanation about which method was easier</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a Uses the standard algorithm for 2-digit by 2-digit multiplication</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3b Uses a different method for 2-digit by 2-digit multiplication</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4a Chooses the best estimate for $4 \times 248$ (1,000), and justifies estimate</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4b Chooses the best estimate for $25 \times 25$ (600), and justifies estimate</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Multiplies 2-digit numbers by 10, 100, and 1,000</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Multiplies 1- and 2-digit numbers by multiples of 10</td>
<td>6</td>
<td></td>
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</tr>
<tr>
<td>7a Uses the standard algorithm for 3-digit by 2-digit multiplication</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7b Writes a story problem to match the multiplication problem from 7a</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Writes expression; disagrees with estimate &amp; justifies response; solves correctly</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**A** Advanced (working above grade level) 29–32 points (90–100% correct)  
**P** Proficient (working at grade level) 24–28 points (75–89% correct)  
**B** Basic (working toward grade level) 17–23 points (53–74% correct)  
**N** Novice (working below grade level) 16 points or fewer (50% or less correct)

Total Points ____________________  Percentage ____________________  Proficiency Level ______________
Base Ten Grid Paper
Here are some of the things you need to know to be able to multiply large numbers quickly and easily. Rate your own understandings and skills right now using the following marks.

| + | I know how to do this already. |
| ✓ | I’m learning to do this, and I feel confident that I’ll be able to do it soon. |
| ✓– | I’m learning to do this, but it still seems pretty confusing. |
| 0 | I don’t get it, and it seems frustrating to try to understand it. |

<table>
<thead>
<tr>
<th>SKILLS AND UNDERSTANDINGS</th>
<th>START OF THE ACTIVITY SET</th>
<th>END OF THE ACTIVITY SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can write a multiplication story problem.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I know my basic multiplication facts through $12 \times 12$.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can multiply by 10 and 100 in my head. (Examples: $10 \times 52$ or $100 \times 85$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can multiply one multiple of 10 by another in my head. (Examples: $20 \times 30$ or $50 \times 60$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can multiply a single-digit number by a multiple of 10 in my head. (Examples: $6 \times 40$ or $70 \times 5$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use base 10 pieces to model and solve a double-digit problem like $23 \times 27$.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can make a labeled sketch on base 10 grid paper to solve a problem like $24 \times 38$.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can break a double-by single-digit multiplication problem into 2 parts to solve it more easily. (Example: $5 \times 37 = (5 \times 30) + (5 \times 7)$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use the standard algorithm to solve a 2-digit by 1-digit problem like $7 \times 38$.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can break a double-digit multiplication problem into 4 or 2 parts to solve it more easily. (Example: $26 \times 35 = (20 \times 30) + (20 \times 5) + (6 \times 30) + (6 \times 5)$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use the standard algorithm to solve a 2-digit by 2-digit problem like $46 \times 58$.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use the standard algorithm to solve a 3-digit by 2-digit problem like $34 \times 247$.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can make estimates to predict how big the answer will be or to see if my answer seems reasonable.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Here’s how I feel about solving multiplication problems like $6 \times 52$ or $27 \times 23$, and $37 \times 148$:

<table>
<thead>
<tr>
<th>Start of the Activity Set</th>
<th>End of the Activity Set</th>
</tr>
</thead>
</table>

What are two goals for multiplication that are important to you? (What could you improve?)

<table>
<thead>
<tr>
<th>Start of the Activity Set</th>
<th>End of the Activity Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
How will you meet each goal above?

<table>
<thead>
<tr>
<th>Start of the Activity Set</th>
<th>End of the Activity Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Set A5 ★ Activity 2

Multiplying by 10, 100 & 1000

Overview
Students build and discuss some combinations that involve multiplying by 10. Then they make some generalizations about what happens when 10 serves as the multiplier, and extend their thinking to multiplying by 100 and 1000.

Skills & Concepts
★ represent multiplication of a two-digit by a two-digit number with place value models
★ multiply by 10, 100, and 1000
★ compare the values represented by digits in whole numbers using place value
★ solve single- and multi-step word problems involving multi-digit multiplication and verify the solutions

Instructions for Multiplying by 10, 100 & 1000
1. Use your overhead linear pieces to frame a 12 by 10 rectangle as shown below. Ask students to pair-share what the dimensions of the figure are and what the area of the figure would be if you filled it in with base ten pieces. After they have had a moment to discuss the questions, fill in the frame with a mat and 2 strips, and work with student input to label the dimensions and area of the rectangle. Then write an equation to show the relationship between the dimensions and the area.

```
10 cm
12 cm
Area = 120 sq cm
12 \times 10 = 120
```

2. Have students pair up. Give each pair a set of base ten area and linear pieces. Ask each pair to work together to frame a 16 by 10 rectangle between them as you do so at the overhead. Have them pair-share what the area of the figure would be if it was filled in with base ten pieces. Ask 2–3 volunteers to share their answers with the class and explain their reasoning.

**Students**  It’ll be 160 because it will take a mat and then 6 strips to fill in the frame.
We said 160 square centimeters because 16 \times 10 is 160.
Activity 2  Multiplying by 10, 100 & 1000 (cont.)

3. Have each pair use their base ten pieces to fill in the area as you do so at the overhead. Work with input from the class to label the dimensions and area of the rectangle, and write an equation to match. Ask a volunteer to record the equations on the whiteboard for both rectangles you've examined so far.

4. Repeat Steps 2 and 3 with a 23 by 10, and then a 34 by 10 rectangle.

<table>
<thead>
<tr>
<th>Equation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 \times 10</td>
<td>120</td>
</tr>
<tr>
<td>16 \times 10</td>
<td>160</td>
</tr>
<tr>
<td>23 \times 10</td>
<td>230</td>
</tr>
<tr>
<td>34 \times 10</td>
<td>340</td>
</tr>
</tbody>
</table>

5. Next, ask students to pair-share what happens when you multiply any number by 10 and invite volunteers to share their thinking with the class.

**Students** If you multiply by 10, all you have to do is add a 0 at the end.
Like if you have 23 \times 10, you just know the answer is 230 because you add a 0 to the end of 23. It works that way with all of the problems up there.
It’s the same if you multiply by 100, but then you add 2 zeros to the end.

Chances are, your students will make reference to adding a zero to the end of any number multiplied by 10 to get the answer. Help them tease out the idea that multiplying tens times tens results in hundreds in all cases. For example, multiplying the 2 tens in 23 by 10 results in 200. Here are some questions you might ask to spur their thinking:

- How does the starting number compare with the answer in each equation? How do 12 and 120 compare? How do 34 and 340 compare?
- What happens to the value of each digit when a number is multiplied by 10?

6. Then draw a 13 by 100 frame on the whiteboard. Work with the class to label the dimensions and ask students to pair-share what the area of the figure would be if you filled it in with base ten pieces.

After they have had a minute or two to discuss the question, ask volunteers to share their thinking with the class.

**Students** We said it’s going to be 1000 across the top because you would have to fill that part with 10 mats.
It’s harder to figure out the strips.
There are 3 and then 3 more and then 3 more.
It will be 10 times 3, so that’s 30 strips.
Ten strips is 100.
Activity 2  Multiplying by 10, 100 & 1000 (cont.)

Students It’s going to be 1000 and then 300, I think.
It’s going to be like you have ten 130’s going across.

7. Fill in the area with a quick sketch and discuss the result with the class. Work with their input to write a matching multiplication equation. Discuss the fact that thirteen hundred is the same as one thousand three hundred.

8. Erase the whiteboard and repeat Steps 6 and 7 with a 24 by 100 rectangle. This time, encourage students to generate a number of different equations to show the total.

9. Erase the whiteboard. Record 13 × 100, 24 × 100, and several other combinations that involve multiplying by 100. Ask students to supply the answers to each as you go. Have them express the answers in thousands and hundreds as well as just hundreds (i.e., twenty-four hundred or two thousand four hundred).

10. Then ask students to explain what happens when you multiply any number times 100. It’s likely that some will say you just have to add 2 zeros to the end of the number. Help them understand how the tens times 100 results in thousands.
Activity 2  Multiplying by 10, 100 & 1000 (cont.)

11. Distribute copies of Multiplying by 10, 100, and 1000. Give students the rest of the math period to work on these sheets independently. Provide assistance as needed, and encourage students to share and compare their answers as they finish.

**INDEPENDENT WORKSHEET**

Use Set A5 Independent Worksheet 1 to provide students with more practice multiplying by 10, 100, and 1000.
1 For each problem, a–c

• label the dimensions.
• fill in the area and label it.
• write a multiplication equation to match.

**Example**

- **a**
- **b**
- **c**
2 Write the answers.

\[
\begin{array}{cccccccc}
31 & 17 & 10 & 89 & 68 & 10 & 400 \\
\times 10 & \times 10 & \times 72 & \times 10 & \times 10 & \times 50 & \times 10 \\
\end{array}
\]

3 Fill in the rest of this sentence.

When you multiply any number by 10,

\[
\begin{array}{cccccccc}
29 & 13 & 100 & 46 & 20 & 61 & 300 \\
\times 100 & \times 100 & \times 62 & \times 100 & \times 100 & \times 100 & \times 100 \\
\end{array}
\]

\[
35 \times 1,000 = _____ \\
1,000 \times 19 = _____ \\
40 \times 1,000 = _____
\]

5 The Ladybugs are planting a garden. They have a 25 cm by 10 cm rectangle for flowers. Each flower needs exactly 1 square centimeter of space. How many flowers can they plant? Show your work.

The Ladybugs can plant _____ flowers.

6 The Ladybugs have a 30 cm by 10 cm rectangle for pumpkins. Each pumpkin needs exactly 25 square centimeters of space. How many pumpkins can they plant? Show your work on another piece of paper. Include a labeled sketch.

The Ladybugs can plant _____ pumpkins.
Set A5 ★ Activity 3

Multiplying Single Digits by Multiples of Ten

Overview
Students make sketches to investigate and make generalizations about multiplying single digits by multiples of ten. Then they complete two related worksheets independently.

Skills & Concepts
★ multiply by 10, 100, and 1000
★ compare the values represented by digits in whole numbers using place value

You’ll need
★ Explore Six (page A5.26, run 1 copy on a transparency and a class set on paper)
★ Explore More (page A5.27, run a class set)
★ Multiplication Practice (page A5.28, run a class set)
★ overhead pens in black and red
★ red, blue, and regular pencils for students

Instructions for Multiplying Single Digits by Multiples of Ten
1. Give students each a copy of Explore Six, and display the transparency at the overhead. Review the instructions and examine the example at the top of the sheet with the class. Do problem a. together. Use your red overhead pen to label the dimensions of the rectangle, and have students use their red pencils to do so on their own sheets. Work with student input to determine the area of the rectangle and write a matching multiplication equation.

Explore Six

1 Label the dimensions and area of the rectangle on each grid. Write a multiplication equation to match.

example:

2 Use the information above to help solve these equations.

<table>
<thead>
<tr>
<th>6 \times 50 = _____</th>
<th>6 \times 60 = _____</th>
<th>6 \times 70 = _____</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 \times 80 = _____</td>
<td>6 \times 90 = _____</td>
<td>6 \times 100 = _____</td>
</tr>
</tbody>
</table>
Activity 3  Multiplying Single Digits by Multiples of Ten (cont.)

2. When students understand what to do, have them work on the sheet independently. Give assistance as needed. Encourage them to share and compare their answers with neighbors as they finish.

3. When most students have finished the sheet, reconvene the class. Ask children to pair-share any mathematical observations they can make about the worksheet. Here are some questions you might pose to spark their thinking:
   • Did you notice any patterns in your answers?
   • Did the sheet seem easy or challenging?
   • What was easy (or challenging) for you about these problems?

4. Call on volunteers to share their observations with the class. Chances are, some of your students will note the relationship between the basic facts for 6 and multiplying 6 by multiples of 10. If this does not emerge during the discussion, write the combinations shown below on the board as students watch.

   \[
   \begin{array}{ll}
   6 \times 1 &= 6 \\
   6 \times 2 &= 12 \\
   6 \times 3 &= 18 \\
   6 \times 4 &= 24 \\
   6 \times 10 &= 60 \\
   6 \times 20 &= 120 \\
   6 \times 30 &= 180 \\
   6 \times 40 &= 240 \\
   \end{array}
   \]

   Then have them list the rest of the combinations in the series, through \( 6 \times 10 \) and \( 6 \times 100 \), as you record at the board. Here are some additional questions to pose:
   • What do you notice about these pairs of combinations?
   • Why does this pattern work the way it does?
   • What happens to the value of each of the digits in the basic fact products when 6 is multiplied by a multiple of 10? Why?
   • Would this pattern work with a different single-digit number? Why or why not?

5. Give students each a copy of Explore More. This sheet asks them to further explore the relationship between basic facts and multiplying by multiples of 10 by choosing a single-digit number between 4 and 9 (other than 6) to investigate. Review the instructions on the sheet with the class. Clarify and model as needed. Ask students to draw the missing dimension for each rectangle in red, and the rectangle on each grid in blue.

6. When students understand what to do, let them go to work. Give assistance as needed, and encourage children to share their discoveries with one another as they work. As they finish, have students start working on the Multiplication Practice sheet. Unfinished work can be sent home to be completed or assigned as seatwork at another time.
Set A5 Number and Operations: Multi-Digit Multiplication

Activity 3  Multiplying Single Digits by Multiples of Ten (cont.)

<table>
<thead>
<tr>
<th>Set A5 Number and Operations: Multi-Digit Multiplication Blackline</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
</tr>
</tbody>
</table>

**Explore More**

1. Choose a number between 4 and 9 (not 6) to multiply by 10 and multiples of 10. Draw the missing dimension and fill in the rectangle on each grid. Label the dimensions and the area of each rectangle. Write a multiplication equation to match.

   a.
   ![Rectangle a]

   b.
   ![Rectangle b]

   c.
   ![Rectangle c]

   d.
   ![Rectangle d]

2. Use the information above to help complete these equations. Put the number you chose in the blank to the left side of the equation.

   - \( \_ \times 50 = \_ \)
   - \( \_ \times 60 = \_ \)
   - \( \_ \times 70 = \_ \)
   - \( \_ \times 80 = \_ \)
   - \( \_ \times 90 = \_ \)
   - \( \_ \times 100 = \_ \)

**Multiplication Practice**

1. Solve these problems in your head. Write the answers.

   - \( \_ \times 5 = \_ \times 6 = \_ \times 7 = \_ \times 8 = \_ \times 9 = \_ \times 10 = \_
   - \( \_ \times 10 = \_ \times 20 = \_ \times 30 = \_ \times 40 = \_ \times 50 = \_ \times 60 = \_ \times 70 = \_
   - \( \_ \times 1,000 = \_ \times 10,000 = \_ \times 100,000 = \_

2. Explain how you figured out the answers to the problems above.

3. Solve these problems in your head. Write the answers.

   - \( \_ \times 4 = \_ \times 5 = \_ \times 6 = \_ \times 7 = \_ \times 8 = \_ \times 9 = \_ \times 10 = \_
   - \( \_ \times 20 = \_ \times 30 = \_ \times 40 = \_ \times 50 = \_ \times 60 = \_ \times 70 = \_ \times 80 = \_
   - \( \_ \times 100 = \_ \times 1,000 = \_ \times 600 = \_ \times 700 = \_ \times 800 = \_
   - \( \_ \times 400 = \_ \times 500 = \_ \times 600 = \_ \times 700 = \_ \times 800 = \_ \times 900 = \_

**CHALLENGE**

- \( \_ \times 9 = \_ \times 12 = \_ \times 11 = \_ \times 8 = \_ \times 12 = \_

**INDEPENDENT WORKSHEET**

Use Set A5 Independent Worksheet 2 to provide students with more practice multiplying single digit numbers by multiples of 10.
## Explore Six

1. Label the dimensions and area of the rectangle on each grid. Write a multiplication equation to match.

   **Example**
   
   ![Example Grid](example.png)
   
   - $6 \times 10 = 60$

2. Use the information above to help solve these equations.

   - $6 \times 50 = \_\_\_\_\_\_\_\_\_\_\_\_$
   - $6 \times 60 = \_\_\_\_\_\_\_\_\_\_\_$
   - $6 \times 70 = \_\_\_\_\_\_\_\_\_\_\_$
   - $6 \times 80 = \_\_\_\_\_\_\_\_\_\_\_$
   - $6 \times 90 = \_\_\_\_\_\_\_\_\_\_\_$
   - $6 \times 100 = \_\_\_\_\_\_\_\_\_\_\_$
Explore More

1. Chose a number between 4 and 9 (not 6) to multiply by 10 and multiples of 10. Draw the missing dimension and fill in the rectangle on each grid. Label the dimensions and the area of each rectangle. Write a multiplication equation to match.

2. Use the information above to help complete these equations. Put the number you chose in the blank to the left side of the equation.

___ × 50 = _______  ___ × 60 = _______  ___ × 70 = _______
___ × 80 = _______  ___ × 90 = _______  ___ × 100 = _______
Multiplication Practice

1 Solve these problems in your head. Write the answers.

\[
\begin{array}{cccccccc}
10 & 20 & 30 & 40 & 50 & 60 & 70 \\
\times 3 & \_ & \_ & \_ & \_ & \_ & \_ \\
80 & 90 & 100 & 1,000 & 10,000 & 100,000 \\
\times 3 & \_ & \_ & \_ & \_ & \_ & \_ \\
\end{array}
\]

2 Explain how you figured out the answers to the problems above.

3 Solve these problems in your head. Write the answers.

\[
\begin{array}{cccccccc}
10 & 20 & 30 & 40 & 50 & 60 & 70 \\
\times 4 & \_ & \_ & \_ & \_ & \_ & \_ \\
80 & 90 & 100 & 1,000 & 60 & 70 & 80 \\
\times 4 & \_ & \_ & \_ & \_ & \_ & \_ \\
\end{array}
\]

\[
\begin{array}{cccccccc}
400 & 300 & 500 & 600 & 200 & 700 & 800 \\
\times 4 & \_ & \_ & \_ & \_ & \_ & \_ \\
900 & 400 & 800 & 600 & 700 & 800 & 800 \\
\times 9 & \_ & \_ & \_ & \_ & \_ & \_ \\
\end{array}
\]

CHALLENGE

\[
\begin{array}{cccccccc}
900 & 400 & 800 & 600 & 700 & 800 & 800 \\
\times 9 & \_ & \_ & \_ & \_ & \_ & \_ \\
\end{array}
\]

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Set A5 ★ Activity 4

Single-Digit Multiplication with Pictures & Numbers

Overview
Students use the area model to picture and solve 1-digit by 2-digit multiplication problems. In this activity, the focus is on transitioning to using numbers only, connecting them to the area model as needed to support students’ work.

Skills & Concepts
★ multiply two-digit by one-digit numbers
★ estimate products to approximate solutions and determine reasonableness of answers
★ solve single- and multi-step word problems involving multi-digit multiplication and verify the solutions

You’ll need
★ Multiplication Story Problems (page A5.32, run one copy on a transparency)
★ Single-Digit Multiplication (pages A5.33 and A5.34, run a class set)
★ overhead pens
★ a piece of paper to mask portions of the overhead

Instructions for Single-Digit Multiplication with Pictures & Numbers

1. Place the top section of Multiplication Story Problems on display at the overhead. Keep the other two problems covered for now. Read the problem with the class. Work with students’ input to record a matching multiplication expression in vertical form. Ask them to pair-share estimates. Then call on volunteers to share their estimates with the class and explain their reasoning.

Students
- It’s going to be more than 160 square feet because 10 × 8 is 80, and 80 + 80 is 160.
- I said maybe about 180 because 8 × 25 is 200.
- 8 × 20 is 160, so this will be more.

2. Demonstrate how to make a very quick sketch to show 8 × 23 either on the whiteboard or the overhead. First sketch the dimensions, then the total array, and then add a line to show how the array can be divided into two partial products by place value (a step-by-step example is shown on the next page).
Activity 4  Single-Digit Multiplication with Pictures & Numbers (cont.)

3. After you've sketched the array, give students each a copy of the Single-Digit Multiplication worksheet. Ask them to record $8 \times 23$ as the first problem at the top of the sheet and make a quick sketch similar to yours. Then ask everyone to find the total product by filling in and adding together the two partial products. Have them compare their results with a neighbor as they finish, and then reconvene the class.

4. Ask students to share their partial products while you record them in numerical form beside the array. Focus students’ attention on the magnitude of the final answer by starting with the numbers in the tens place, as shown below.

5. Repeat Steps 1–4 with the other two problems at the overhead. Ask students to use your method of recording and computing for Problems 2 and 3. (A filled in copy of the overhead is shown below for your reference.) Then give students the second page of Single-Digit Multiplication (or have them turn their sheets over if you ran the pages back-to-back), and work the rest of the problems independently. Give help as needed, or meet with a small group to provide extra support.
**Activity 4  Single-Digit Multiplication with Pictures & Numbers (cont.)**

1. Use sketches and numbers to solve each of these story problems with your class.

   a

   b

   c

2. Use a sketch and numbers to solve the problems below. Follow the example.

   Sketch | Numbers
   --- | ---
   example | \[
   \begin{array}{c}
   20 \\
   \hline
   4 \times 20 = 80 \\
   4 \times 8 = + 32 \\
   \hline
   112
   \end{array}
   \]

   a | \[
   \begin{array}{c}
   36 \\
   5 \times 30 = \underline{} \\
   5 \times 6 = + \underline{} \\
   \end{array}
   \]

   b | \[
   \begin{array}{c}
   24 \\
   7 \times 20 = \underline{} \\
   7 \times 4 = + \underline{} \\
   \end{array}
   \]

   c | \[
   \begin{array}{c}
   45 \\
   9 \times 40 = \underline{} \\
   9 \times 5 = + \underline{} \\
   \end{array}
   \]

3. Use numbers to solve these problems.

   a | \[
   \begin{array}{c}
   52 \\
   6 \times 50 = \underline{} \\
   6 \times 2 = + \underline{} \\
   \end{array}
   \]

   b | \[
   \begin{array}{c}
   37 \\
   7 \times 30 = \underline{} \\
   7 \times 7 = + \underline{} \\
   \end{array}
   \]

   c | \[
   \begin{array}{c}
   65 \\
   8 \times 4 = \underline{} \\
   \end{array}
   \]

   d | \[
   \begin{array}{c}
   325 \\
   8 \times 7 = \underline{} \\
   \end{array}
   \]

**INDEPENDENT WORKSHEET**

Use Set A5 Independent Worksheet 3 to provide students with more practice finding and adding partial products to multiply double-digit by single-digit numbers.
Multiplication Story Problems

1. The kids in Mr. Gill's class are going to paint a mural in the hallway by the office. The wall is 8 feet high and 23 feet long. How many square feet is the wall they're going to paint?

2. The fourth graders are doing a show for their families. They set up 6 rows of chairs. They put 26 chairs in each row. How many chairs did they use altogether?

3. There is a big party at the park. There are 7 tables with balloons for the kids. Each table has 34 balloons. How many balloons in all?
1 Use sketches and numbers to solve each of these story problems with your class.

a

b

c
2 Use a sketch and numbers to solve the problems below. Follow the example.

<table>
<thead>
<tr>
<th>Sketch</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>example</strong></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Sketch" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td></td>
</tr>
<tr>
<td>4 × 20 = 80</td>
<td></td>
</tr>
<tr>
<td>4 × 8 = +32</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>a</strong></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5 × 30 =</td>
<td></td>
</tr>
<tr>
<td>5 × 6 = +</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>b</strong></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>7 × 20 =</td>
<td></td>
</tr>
<tr>
<td>7 × 4 = +</td>
<td></td>
</tr>
<tr>
<td></td>
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<td>9 × 40 =</td>
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<td>9 × 5 = +</td>
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3 Use numbers to solve these problems.

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<td>7 × 30 =</td>
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Set A5 ★ Activity 5

Introducing the Standard Multiplication Algorithm

Overview
Students use the standard algorithm to multiply two- and three-digit by one-digit numbers.

Skills & Concepts
★ multiply 2- and 3-digit by 1-digit numbers using the standard multiplication algorithm
★ estimate products to approximate solutions and determine reasonableness of answers

You’ll need
★ Roll Your Own Multiplication Problems (page A5.38, run a class set)
★ dice numbered 1–6 (class set)
★ dice numbered 4–9 (class set)
★ several blank transparencies
★ overhead pens
★ Student Math Journals or 1 piece of lined or grid paper per student

Instructions for Introducing the Standard Multiplication Algorithm

1. Write $8 \times 28$ on the board or overhead. Ask students to first pair-share estimates and then call on volunteers to share their thinking with the class.

   **Students**  It's kind of like 8 times 30. That would be 240 because $8 \times 3$ is 24.
   We said 10 times 28 is 280, so it’s going to be less than that.
   Eight times 20 is 160, but then you have to add on the $8 \times 8$.
   It’s going to be more than 200 for sure.

2. Next, ask students to find the product using the computing method they practiced during the previous activity. Encourage them to make sketches to support their thinking if that’s helpful to them. Then ask a volunteer to make a labeled sketch that shows the partial products, and another volunteer to record the computations at the board.

   ![](image)

3. Explain that many people use a method for solving problems like these that features some interesting shortcuts. Before calculators were invented, this method helped people solve large multiplication problems. Then demonstrate the standard algorithm at the overhead or board. Talk your way through each step as you do it. Ask students to watch and listen closely to see if they can make sense of what you’re doing based on all the experiences they’ve had with multiplication.
Activity 5  Introducing the Standard Multiplication Algorithm (cont.)

**Teacher**  This method starts with the ones instead of the tens. So first I multiply $8 \times 8$. That’s 64. I write the 4 in the ones place and move the 6 tens from 64 over to the tens place. Then I multiply 8 times 20. That’s 160. If I add the 60 I carried over to the tens place, it’s 220, and 220 plus 4 is 224.

\[
\begin{array}{c}
6 \\
28 \\
\times \ 8 \\
\hline \\
224 \\
\end{array}
\]

4. When you have finished the demonstration, ask students to explain how this method works. Can they see any connection between the algorithm and the area model? Does the strategy make sense to them?

**Students**  My mom showed me how to do it that way last year.
I don’t get where the little 6 at the top came from.
It’s like carrying when you add.
I like that way of doing it. It seems faster and easier.
Why do they start with the ones instead of the tens? I like the other way better.

Ask your students to connect the algorithm you’ve modeled to the array. Where do they see 224 in the array?

\[
\begin{array}{c}
8 \\
20 \\
\hline \\
160 \\
8 \times 20 = 160 \\
64 \\
8 \times 8 = + 64 \\
\hline \\
224 \\
\end{array}
\]

**Students**  I don’t see 224 in the array at all.
But that’s what you get if you add 160 and 64 together because 160 and 60 makes 220, and then 4 more is 224, right?
It’s kind of like you just do everything at the same time instead of doing it in two steps.

5. Now give students a chance to try the standard algorithm for themselves. Write $6 \times 26$ on the whiteboard and ask students to copy the problem into their journals and jot an estimate to the side. Then work with class input to solve it together, using the standard algorithm. Work the following four problems together in a similar fashion.

- $36 \times 4$
- $48 \times 5$
- $144 \times 6$
- $345 \times 5$

6. Provide students with more practice using the standard algorithm. Depending on the needs and strengths of your class, you may want to have some students solve additional problems with you, while others work independently on the Roll Your Own Multiplication sheet. Students who are very comfortable with the algorithm can be assigned to solve the challenge problem at the bottom of the sheet.
### Activity 5  Introducing the Standard Multiplication Algorithm (cont.)

**Roll Your Own Multiplication Problems**

1. For problems e–g below:
   - Choose a die numbered 1–6 or 4–9.
   - Roll it as many times as you need to fill in each of the boxes below. You can write each number you roll in any box on the sheet, but once all the boxes are filled, you can’t change them.
   - Use the method you just learned in class to solve your problems.
   - When you’re finished, trade papers with a classmate and have him or her check your answers.

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
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</tbody>
</table>

**Challenge**

5. Use each of these digits just one time: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Write them in the spaces below to make each problem correct.

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Note**  If some of your students are confused by the standard algorithm, you may want to share the strategy shown below, in which the partial products are added, but computation starts with the ones instead of the tens. This strategy may help ease some students’ transition into the standard algorithm.

\[
\begin{align*}
2 & \quad 47 \\
\times 4 & \quad \times 4 \\
4 \times 7 &= 28 \quad 188 \\
4 \times 40 &= + 160 \quad 188
\end{align*}
\]

**Independent Worksheet**

Use Set A5 Independent Worksheet 4 to provide students with more practice using the standard algorithm for multiplication for 2-digit by 1-digit multiplication.
Roll Your Own Multiplication Problems

1. For problems e–g below:
   - Choose a die numbered 1–6 or 4–9.
   - Roll it as many times as you need to fill in each of the boxes below. You can write each number you roll in any box on the sheet, but once all the boxes are filled, you can’t change them.
   - Use the method you just learned in class to solve your problems.
   - When you’re finished, trade papers with a classmate and have him or her check your answers.

2. Challenge

5. Use each of these digits just one time: 0 1 2 3 4 5 6 7 8 9
Write them in the spaces below to make each problem correct.
Think before You Multiply

Overview
In this activity, students consider the following questions: Is it always most efficient and effective to use the standard algorithm for multi-digit multiplication? What kinds of combinations are best solved with the algorithm? What kinds of combinations might be better solved using other methods?

Skills & Concepts
★ multiply 2- and 3-digit by 1-digit numbers using the standard multiplication algorithm
★ estimate products to approximate solutions and determine reasonableness of answers
★ identify strategies that can be used to solve a problem, select and use one or more appropriate strategies to solve the problem, and justify the selection
★ explain why a specific problem-solving strategy was used to determine a solution

Instructions for Think before You Multiply
1. Tell students in a minute, you’re going to show them a multiplication problem at the overhead, and ask them to solve it mentally. Let them know that they can use any method that makes sense to them. Then display the first problem on the overhead, keeping the rest covered for now. Ask students to think privately about the problem and raise their hand when they have the answer.

2. When most of the students have raised their hands, call on several to share their solutions and explain their methods to the class. Record each method at the overhead as students share, and label the methods with input from the class.

Danny First I tried doing it the way where you multiply $2 \times 8$ first, but I couldn’t keep the numbers in my head. Then I saw 48 is really close to 50, so I went 50 + 50 is 100, and take away 4 is 96.
Activity 6  Think before You Multiply (cont.)

Rosa  I thought it was pretty easy to start with the ones. I went 2 × 8 is 16, put down the 6 and carry the 10. Then 2 × 40 is 80 plus 10 more is 90, so it’s 96 in all.

Jamal  I just doubled 48. It’s 96 because 40 and 40 is 80, then 8 and 8 is 16, and 80 plus 16 is 96.

Tran  I did it kind of that way with multiplying. I said 2 × 40 is 80 and 2 × 8 is 16. 80 + 16 is 96.

3. Repeat Steps 1 and 2 with the next two problems on the overhead (23 × 4 and 99 × 5). Encourage students to debate and discuss the methods they’re choosing. Some may feel that the standard algorithm or finding and adding partial products is easiest, while others find a basic facts strategy or the use of landmark numbers such as 25, 50, or 100 is more efficient.

Students  It’s too hard to keep the numbers in your head with the regular way. On 99 × 5, you can just go 100 × 5 and take away 5. That’s the easiest! Same with 4 × 23. That’s just like 4 × 25, and then take 8 away.
I like using tens and ones on that one. Just go 4 × 20 is 80, and 4 × 3 is 12, so you get 92.
I think when you’re doing multiplication in your head, the regular way is hard because you have to remember what number you put in the ones place, and what you put over in the tens place.

4. Show the fourth problem, 125 × 4, and ask students if they can solve it in their heads. Some may say they can’t because the numbers are too big. Give them a minute to think about it. Chances are, at least a few will use a basic facts strategy such as double-doubles or landmark numbers. If not, volunteer one of these strategies yourself. Then work with student input to solve the problem using the standard algorithm and then partial products. Which of these methods seems easiest and most efficient? Why?

5. Show the last problem, 469 × 5, on the overhead, and ask students if they can work it in their heads. Why or why not? Many students will probably agree that it’s too big to tackle mentally. Ask them to pair-share estimates, and then work the problem twice in their journals, once using the standard algorithm and once by finding and adding the partial products. Have them share and compare their work with the people sitting next to them to be sure they have the correct answers. Then talk with the group about both methods. Which seemed easier? Which seemed most efficient? Why?
6. Work with the class to make some generalizations about the different multiplication methods they’ve used to solve the problems on the overhead. Is the standard algorithm always the quickest and easiest? What about finding and adding partial products? When does it work best to use a basic facts strategy or a landmark number? Record some of their thoughts on a piece of chart paper.

Which Multiplication Methods Work Best?
- If you’re multiplying numbers like $4 \times 38$ in your head, it’s easy to do the tens and then the ones and add them.
- You should use landmark numbers when you can. Like if you’re doing $6 \times 199$, just think about $6 \times 200$, and take 6 away.
- If you’re multiplying a big number, like $5 \times 469$, the regular way is good. But you have to remember to carry the tens and hundreds, and add them in.
- If you find partial products for $5 \times 469$, it’s $2000 + 300 + 45$. There’s more to write, but you can see all the numbers.

7. Hand out a copy of Multiplication Methods to each student and give children the rest of the math period to work the problems. If some students still need support in solving multi-digit multiplication problems, you may want to meet with a small group while the rest of the class works independently.

1. Use the standard algorithm to solve each problem below. Then solve it a different way. Label your method. Circle the method that seemed quicker and easier.

<table>
<thead>
<tr>
<th>Standard Algorithm</th>
<th>Partial Products</th>
<th>Landmark Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4 \times 199$</td>
<td>$4 \times 100 = 400$</td>
<td>$199$ is almost like $200$</td>
</tr>
<tr>
<td></td>
<td>$4 \times 90 = 360$</td>
<td>$4 \times 200 = 800$</td>
</tr>
<tr>
<td></td>
<td>$4 \times 9 + 36$</td>
<td>$800 - 4 = 796$</td>
</tr>
<tr>
<td></td>
<td>$400 + 360 + 36 = 796$</td>
<td></td>
</tr>
</tbody>
</table>

2. Fill in the bubble to show the best estimate for each problem.

<table>
<thead>
<tr>
<th>$43 \times 7$</th>
<th>$226 \times 4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$200$</td>
<td>$700$</td>
</tr>
<tr>
<td>$250$</td>
<td>$800$</td>
</tr>
<tr>
<td>$300$</td>
<td>$900$</td>
</tr>
<tr>
<td>$350$</td>
<td>$1000$</td>
</tr>
</tbody>
</table>

3. Circle the method that seems to help most for estimating.

<table>
<thead>
<tr>
<th>Standard Algorithm</th>
<th>Partial Products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

4. The fourth and fifth graders at King School went to the museum yesterday in 7 buses. There were 65 students on each bus. How many students were there in all? Show your work.

4. The big building downtown has 27 floors. There are 8 offices on each floor. Each office has 8 computers. How many computers are there in all? Show your work.

INDEPENDENT WORKSHEET
Use Set A5 Independent Worksheet 5 to provide students with additional opportunities to select and use different multiplication methods.
Think Before You Multiply

1

\[
\begin{array}{c}
48 \\
\times 2 \\
\end{array}
\]

2

\[
\begin{array}{c}
23 \\
\times 4 \\
\end{array}
\]

3

\[
\begin{array}{c}
99 \\
\times 5 \\
\end{array}
\]

4

\[
\begin{array}{c}
125 \\
\times 4 \\
\end{array}
\]

5

\[
\begin{array}{c}
469 \\
\times 5 \\
\end{array}
\]
Multiplication Methods  page 1 of 2

Here are three different ways to solve $4 \times 199$.

<table>
<thead>
<tr>
<th>Standard Algorithm</th>
<th>Partial Products</th>
<th>Landmark Numbers</th>
</tr>
</thead>
</table>
| $\begin{array}{c}
33 \\
199 \\
\times 4 \\
\hline
796
\end{array}$ | $\begin{array}{l}
4 \times 100 = 400 \\
4 \times 90 = 360 \\
4 \times 9 = 36 \\
400 + 360 + 36 = 796
\end{array}$ | $\begin{array}{l}
199 \text{ is almost like } 200 \\
4 \times 200 = 800 \\
800 - 4 = 796
\end{array}$ |

1 Use the standard algorithm to solve each problem below. Then solve it a different way. Label your method. Circle the method that seemed quicker and easier.

<table>
<thead>
<tr>
<th>Standard Algorithm</th>
<th>A Different Way</th>
</tr>
</thead>
</table>
| a $\begin{array}{c}
37 \\
\times 4 \\
\hline
\end{array}$ |                  |
| b $\begin{array}{c}
63 \\
\times 7 \\
\hline
\end{array}$ |                  |
| c $\begin{array}{c}
299 \\
\times 6 \\
\hline
\end{array}$ |                  |
| d $\begin{array}{c}
749 \\
\times 7 \\
\hline
\end{array}$ |                  |
## Multiplication Methods  page 2 of 2

### 2 Fill in the bubble to show the best estimate for each problem.

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<td>a</td>
<td>43</td>
<td>×</td>
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<tbody>
<tr>
<td>b</td>
<td>226</td>
<td>×</td>
<td>4</td>
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<td>700</td>
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<td>900</td>
<td></td>
<td></td>
<td>1,000</td>
<td></td>
</tr>
</tbody>
</table>

|   |   |   |   |   |
|---|---|---|---|
| c | Circle the method that seems to help most for estimating. |
|   | Standard Algorithm | Partial Products |

### 3 The fourth and fifth graders at King School went to the museum yesterday in 7 buses. There were 65 students on each bus. How many students were there in all? Show your work.

### 4 The big building downtown has 27 floors. There are 8 offices on each floor. Each office has 8 computers. How many computers are there in all? Show your work.
Set A5 ★ Activity 7

Splat!

Overview
Students are asked to make some generalizations about multiplying two multiples of 10. Then they play a new game to practice multiplying combinations such as 20 × 30, 40 × 50, and so on, first as a whole class, and then in pairs.

Skills & Concepts
- represent multiplication of two-digit by two-digit numbers
- multiply by 10 and multiples of 10
- compare the values represented by digits in whole numbers using place value

You’ll need
- Splat! Hundreds Grid (page A5.50, run one copy on a transparency and a half-class set on paper)
- Introducing the Game of Splat! (page A5.51, run one copy on a transparency)
- Splat! Spinner (page A5.52, run a half-class set)
- Splat! Record Sheet (page A5.53, run a half-class set)
- overhead pens
- 2 overhead triangle pattern blocks or overhead base 10 units
- half class set of transparent spinner overlays
- game markers (1 per student)
- 5 \( \frac{1}{2} \) × 8 \( \frac{1}{2} \) colored copy paper, 1 piece for each student plus a few extra

About the Game In the game of Splat, players take turns spinning a spinner numbered 10, 20, 30, 40, 50, and 60 twice and multiplying the 2 numbers spun. Each player gets 4 turns per round and adds the results to get a total for the round. If a player spins a 10, she scores 0 for that turn. If she spins two 10s in a single turn, she scores 0 for the entire round. After they have played several rounds, players compute and compare their game totals.

Instructions for Splat!
1. Ask students to pair up. Give each pair one copy of the Splat! Hundreds Grid to share, and place the transparency on display at the overhead.

Without giving them any instruction other than to pay attention to the key at the top of the page, ask students to determine the area of the entire grid. Have them pair-share their ideas for a minute, and then ask volunteers to share their thinking at the overhead.

Students We said the whole grid is a 6-by-6 square, and the area is 36.
We thought the area was 360 because 6 × 6 is 36, and then you just add a zero.
We looked at the key and said okay, the grid is a 60-by-60 square because each of those lines is like a skinny base 10 strip.
We said the same thing, and then we figured out that the area must be 36 hundred because each of the small squares is worth 100.
That’s the same as \( 3,600 \), right?
Work with student input to record a multiplication sentence at the whiteboard to match the dimensions and area of the grid (60 × 60 = 3,600).

2. Now use two half-sheets of copy paper to mask the overhead grid until only a 20-by-20 square remains in the top corner, as shown below.

Have student pairs work together, each using their half sheet of paper, to do the same on the Hundreds Grid they’re sharing. What is the area of the region that’s showing? Ask a student volunteer to record a multiplication sentence to match the dimensions and area of the region (20 × 20 = 400) on the whiteboard.
3. Then write $30 \times 30$ on the board and ask students to move their paper masks until the dimensions you've identified are showing on their grid. What is the area of this region? Record the answer as students share it. Repeat this exercise with $40 \times 50$, $30 \times 40$, $50 \times 50$, and $50 \times 60$.

4. Ask students to explain what happens when two multiples of 10, such as the examples listed on the board, are multiplied. Some students will probably respond with the idea that you simply multiply the digits at the front of each number and then “add on” 2 more zeros at the end. Press the class to think a little more deeply about the question using the visual model provided by the grid to support them in doing so.

   **Students**  $3 \times 3$ is 9, right? What's weird is that 30 is only 10 times bigger than 3, but 900 is 100 times bigger than 9.
   
   But each one of the squares in the grid is 100 instead of 1, so the area of a 30-by-30 is 900.
   
   10 times 30 is 300, so 30 times 30 is 3 times more than that. $3 \times 300$ is 900.
   
   All the answers on the board are 100 times bigger than they would be if the numbers were in 1's instead of 10's. Like $4 \times 5$ is 20, so $40 \times 50$ is 2,000.
   
   Just pretend like you're multiplying like $3 \times 3$ or $4 \times 5$, and then make the answer 100 times bigger.

5. Place the game introduction overhead on display and explain that you're going to play a new game with the class. Ask student pairs to keep their Hundreds Grid and half-sheets of copy paper in front of them. Then set the transparent spinner overlay on top of the spinner and spin twice. Use a triangle from your set of overhead pattern blocks to mark the results of both spins at the top of the transparency. (Students will use game markers when they play the game independently, but since those markers won't fit on the transparency, you'll have to use overhead pattern block triangles instead.) Give student pairs a moment to multiply the two numbers you spun, using their Hundreds Grid and half-sheets of paper for support if needed, or computing the answer mentally. Then record the answer in your Round 1, Turn 1 box.
6. Continue until you've taken 4 turns. Then work with class input to add the numbers and record your total for the round. If you spin a 10 on one of your turns, you score 0 for that turn. If you spin two 10's on one of your turns, you record an “S” for Splat! in that box. You lose the rest of your turns for the round, and you score 0 for the entire round, no matter how many points you got in previous turns. You have to take all 4 turns unless you get wiped out by a Splat! first.

7. Ask student volunteers to spin and record for the class on the lower part of the overhead. As they take 4 turns, encourage all your students to do as much of the computation as they can mentally, continuing to use their Hundreds Grid for visual support as needed.

8. After students have completed their first round, play your second round. Then have volunteers spin and record a second round for the class. When you and the class have both completed 2 rounds, ask students to find the game total for each team and determine the difference between the 2 scores. Finally, show the class how to record the results for each team at the overhead.
9. When the game is finished, give students time to play it again in partners. Each student pair will need:

- one copy of the Splat! Spinner
- one Splat! Record Sheet
- 2 game markers
- one spinner overlay

Both partners will record their turns on the same sheet, just as in the demonstration game. Their version of the record sheet has room to play 5 rounds, however, so they may need extra time to complete the game during another math period.

**Extensions**

- Meet with small groups of students who need additional support in multiplying multiples of 10 to play a small-group version of Splat. Model and share your own thinking, and encourage students to help one another as you play.
- Run extra copies of the Splat! Record Sheet and have students revisit the game during Work Places. If you run more copies of the spinner and have students use a pencil and paper clip for a spinner arrow, you can also assign the game as homework.
Introducing Splat!

*If you spin a 10, you score 0 for that turn.
If you spin two 10's in a single turn, that's a Splat! and you score 0 for the round.

**Teacher**

<table>
<thead>
<tr>
<th></th>
<th>Turn 1</th>
<th>Turn 2</th>
<th>Turn 3</th>
<th>Turn 4</th>
<th>Round Total</th>
<th>Scratch Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td></td>
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<td>Round 2</td>
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<td></td>
<td>Game Total</td>
<td></td>
</tr>
</tbody>
</table>

I won/lost by ________ points.

**Class**

<table>
<thead>
<tr>
<th></th>
<th>Turn 1</th>
<th>Turn 2</th>
<th>Turn 3</th>
<th>Turn 4</th>
<th>Round Total</th>
<th>Scratch Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Round 2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Game Total</td>
<td></td>
</tr>
</tbody>
</table>

We won/lost by ________ points.
Splat! Spinner

First Spin

<table>
<thead>
<tr>
<th>First Spin</th>
</tr>
</thead>
<tbody>
<tr>
<td>10*</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
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<tr>
<td>40</td>
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<tr>
<td>50</td>
</tr>
<tr>
<td>60</td>
</tr>
</tbody>
</table>

Second Spin

<table>
<thead>
<tr>
<th>Second Spin</th>
</tr>
</thead>
<tbody>
<tr>
<td>10*</td>
</tr>
<tr>
<td>20</td>
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<tr>
<td>30</td>
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<tr>
<td>40</td>
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<tr>
<td>50</td>
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<tr>
<td>60</td>
</tr>
</tbody>
</table>
# Splat! Record Sheet

<table>
<thead>
<tr>
<th>Player 1</th>
<th>Turn 1</th>
<th>Turn 2</th>
<th>Turn 3</th>
<th>Turn 4</th>
<th>Round Total</th>
<th>Scratch Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Round 2</td>
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<td>Round 3</td>
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<tr>
<td>Round 4</td>
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<tr>
<td>Round 5</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Game Total

I won/lost by _________ points.

<table>
<thead>
<tr>
<th>Player 2</th>
<th>Turn 1</th>
<th>Turn 2</th>
<th>Turn 3</th>
<th>Turn 4</th>
<th>Round Total</th>
<th>Scratch Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 2</td>
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<td>Round 3</td>
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<tr>
<td>Round 4</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Round 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Game Total

I won/lost by _________ points.
Set A5 ★ Activity 8

Sketching Arrays & Partial Products

Overview
The teacher introduces a technique for drawing quick sketches of 2-digit by 2-digit multiplication combinations. Students then practice the sketching technique and use it to solve a variety of multiplication problems.

Skills & Concepts
★ represent multiplication of two-digit by two-digit numbers
★ multiply two-digit by two-digit numbers
★ estimate products to approximate solutions and determine reasonableness of answers

You’ll need
★ The Ladybugs’ Park (page A5.58, run one copy on a transparency)
★ Multiplication Sketches (pages A5.59 and A5.60, run a class set)
★ overhead pens
★ a piece of paper to mask portions of the overhead

Instructions for Sketching Arrays & Partial Products
1. Place the top section of The Ladybugs’ Park on display at the overhead. Read the problem with the class. Ask students to estimate the area of the sandbox, and call on volunteers to share their thinking with the class.

Students
I think about 210 square centimeters because 10 × 18 is 180, and then 2 × 18 is 36.
I said 200 because 12 × 18 is kind of like 10 × 20, and that’s 200.

2. As students watch, sketch a frame for 12 × 18 at the overhead. Then fill in the array as shown at the top of the next page. Let students know that you are drawing lines based on the place values in the dimensions (between the 10 and the 8 in 18, and the 10 and the 2 in 12).

3. After you have drawn in the lines, ask the students to help you fill in the area of each part of the array. Prompt their thinking, if necessary, by labeling the tens and ones on the frame.
4. After you’ve labeled all 4 parts of the array, remind students that each part is called a *partial product*, and that the sum of the partial products is the total product of $12 \times 18$. Then ask students to find the sum of the partial products mentally. Record their thinking as an equation beside the array. Also record a multiplication equation to show the dimensions and total area together.

5. Repeat Steps 1–4 with the second problem on the overhead.

6. Now give students each a copy of the Multiplication Sketches worksheets. Ask them to complete the first problem on their own or in pairs. Circulate as they work, and then reconvene the class to discuss their thinking when most are finished. Walk through the problems step by step as a whole group, starting with a sketch of the array on the whiteboard that replicates the picture on the first worksheet and finishing with an addition and a multiplication equation to express the total area.
7. When students understand what to do, have them complete the rest of the first sheet and all of the second independently. Provide assistance as needed. Encourage students to share and compare their answers as they finish the assignment.

INDEPENDENT WORKSHEET

Use Set A5 Independent Worksheet 6 to provide students with more practice multiplying multiples of 10 by multiples of 10.
The Ladybugs’ Park

1 The ladybugs over in Leafington are building a park for their children. They are planning to make a sandbox that is 12 centimeters wide and 18 centimeters long. How many square centimeters will their sandbox be?

2 There is patch of dirt near the sandbox that measures 24 by 29 centimeters. The ladybugs want to divide it into different sections as shown below. Use a multiplication equation to label each section. Then find the total area of the 24 by 29 cm patch.
1a Mrs. Hill’s pre-school classroom is 16 feet wide and 28 feet long. She is planning to divide it into 4 sections. Here is her plan. Use a multiplication equation to label the area of each section. (in square feet)

28’

16’

- Rug
- Tables
- Art Area
- Library Corner

b What is the total area of the 16-by-28-foot classroom? Show your work.

2 Write the answers.

<table>
<thead>
<tr>
<th></th>
<th>20</th>
<th>30</th>
<th>50</th>
<th>40</th>
<th>10</th>
<th>60</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>× 30</td>
<td>× 40</td>
<td>× 30</td>
<td>× 20</td>
<td>× 90</td>
<td>× 30</td>
<td>× 30</td>
</tr>
</tbody>
</table>
Double-digit Multiplication Sketches  page 2 of 2

3 Sketch an array for each of the frames below. Label each part with a multiplication equation to show its area. Then find the total area of the array.

![Array Sketches](image)

4 Write the answers.

\[
\begin{array}{cccccccc}
20 & 40 & 50 & 70 & 30 & 60 & 80 \\
\times 9 & \times 8 & \times 7 & \times 4 & \times 8 & \times 5 & \times 8 \\
\end{array}
\]
Double-Digit Multiplication with Pictures & Numbers

Overview
Students use the area model to picture and solve 2-digit by 2-digit multiplication problems. In this activity, the focus is on transitioning to using numbers only, connecting them to the area model as needed to support students’ work.

Skills & Concepts
- represent multiplication of two-digit by two-digit numbers
- multiply two-digit by two-digit numbers
- estimate products to approximate solutions and determine reasonableness of answers
- solve single- and multi-step word problems involving multi-digit multiplication and verify the solutions

You’ll need
- Double-Digit Multiplication (pages A5.64 and A5.65, run a class set)
- overhead pens
- Student Math Journals or 1 piece of lined or grid paper per student

Instructions for Double-Digit Multiplication with Pictures & Numbers
1. Write $23 \times 35$ in vertical format on the whiteboard or the overhead.

   ![35 x 23]

Have students each write a story problem to match the expression in their journals, along with an estimate of the answer. When they’ve had a few minutes to work, ask them to pair-share their story problems and estimates. Then call on several volunteers to share their story problems with the class, and several others to share and justify their estimates.

2. Now make a quick sketch to match the expression. First sketch the dimensions, then the total array, and then add two lines to show how the array can be divided into four partial products by place value.
Activity 9  Double-Digit Multiplication with Pictures & Numbers (cont.)

3. After you’ve sketched the array, give students each a copy of the Double-Digit Multiplication worksheets. Ask them to make a similar quick sketch on the first sheet, which includes $23 \times 35$ as the example problem. Then ask everyone to find the total product by filling in and adding together the four partial products.

4. After they have had a few minutes to work, ask students to compare their results with a neighbor. Then reconvene the class. Ask students to share their partial products one at a time, while you record them in numerical form beside the array. Each time, use a short line segment to show which two numbers are being multiplied, as shown below. If you work from top left to top right, and then lower left to lower right, you can keep students’ attention on the magnitude of the final answer.

**Teacher**  Okay, what was the product for this part of the array?

**Briana**  It’s 20 times 30. That’s 600.

**Teacher**  I’ll write that over here like this. I am drawing a line from the 2 down below to the 3 up top to show that we have multiplied 20 times 30. What does this tell us right away, before we go any further, about how big our final answer will be?

**James**  It’s going to be more than 600. There’s still more to go.

5. Continue in this manner until students have reported the total product. Each time you add a partial product, draw a line from a digit in the bottom number to a digit in the top number to show which numbers were multiplied. In the end, the recording will look like this:
Activity 9  Double-Digit Multiplication with Pictures & Numbers (cont.)

6. Leave the example on the overhead or whiteboard and give students the rest of the period to work on the Double-Digit Multiplication sheets, using this method of recording and computing. Let them know that they don't have to draw the lines between the numbers they're multiplying if they don't want to. However, the lines can help them keep track of which numbers they have already multiplied, especially if they choose to drop the sketches, which is also an option. Circulate as they're working, and encourage students who seem confused to continue sketching before they compute. You may also want to meet with a small group to provide extra support if necessary.

```
35
x 23
```

\[
20 \times 30 = 600 \\
20 \times 5 = 100 \\
3 \times 30 = 90 \\
3 \times 5 = + 15 \\
\hline
805
\]

INDEPENDENT WORKSHEET

Use Set A5 Independent Worksheet 7 to provide students with more practice multiplying double-digit numbers by finding and adding 4 partial products.
Find the product of each pair of numbers below. Make a labeled sketch to help, or just use numbers. Show all of your work.

**Example**

\[
\begin{array}{c}
35 \\
\times 23
\end{array}
\]

\[
\begin{array}{c}
24 \\
\times 18
\end{array}
\]

\[
\begin{array}{c}
27 \\
\times 25
\end{array}
\]

\[
\begin{array}{c}
36 \\
\times 13
\end{array}
\]

\[
\begin{array}{c}
46 \\
\times 36
\end{array}
\]
2 Solve the story problems below. Make a labeled sketch to help, or just use numbers. Show all of your work.

a Jon works at T-Shirts R Us. Yesterday, he unpacked 28 boxes of new shirts. Each box had 24 shirts in it. How many shirts did he unpack?

b Jon made 23 stacks of long-sleeved t-shirts. He put 17 shirts in each stack. How many shirts did he stack in all?

C Challenge

C Then Jon made 24 stacks of short-sleeved t-shirts. He put 16 shirts in each stack. The store he works for had to pay $4.99 for each shirt. How much did they have to pay for all the shirts Jon stacked?
Set A5 ★ Activity 10

Multiplication Menus

Overview
A “multiplication menu” is a set of related multiplication facts that revolves around a single multiplicand. Menus are introduced in this activity to help students think flexibly and easily about double-digit multiplication.

Skills & Concepts
★ multiply by 10 and multiples of 10
★ mentally multiply 2-digit numbers by numbers through 10 and by multiples of 10
★ apply the distributive property to calculations with whole numbers

You’ll need
★ A Multiplication Menu (page A5.70, run one copy on a transparency)
★ Multiplication Menus (pages A5.71 and A5.72, run a class set)
★ overhead pen
★ a piece of paper to mask portions of the overhead
★ calculators available
★ Student Math Journals or 1 piece of lined or grid paper per student

Instructions for Multiplication Menus

1. Ask students to find the next available page in their journal. Explain that you’re going to do some mental math together, and ask them to write the letters a–i down the left side of the page, leaving a line between each letter.

2. Show just the first multiplication problem at the top of the transparency on display. Have students copy the problem, 1 × 14, and write the answer. Show the next 2 problems one at a time and repeat the process with each. Although the focus is on mental strategies, let students know they can make little “arithmetic notes” off to one side of their journal page to track their thinking. (Some students may recognize, for instance, 2 × 14 is 14 doubled but still need to record 14 + 14 to get the answer.)

3. Next, show Problem d, 20 × 14. Have students copy this combination into their journals and record the answer, using information from the first three combinations, mental strategies, and such “arithmetic notes” as they need to track their own thinking. Ask them to pair-share their solutions and strategies and then call on volunteers to share their thinking with the class.

Set A5 Number and Operations: Multi-Digit Multiplication

The Math Learning Center

Bridges in Mathematics Grade 4 Supplement • A5.67
**Activity 10  Multiplication Menus (cont.)**

**Students**  I said $20 \times 14$ is 280 because it's just double 140.  
If you know that $10 \times 14$ is 140, you can add 140 and 140 to get 280.  
At first I thought it was 168, because I added the answer for $2 \times 14$ and the answer for $10 \times 14$, but then I realized it would have to be $10 \times 14$ plus $10 \times 14$.  
I said it was 280 because $2 \times 14$ is 28, and $20 \times 14$ is ten times more than that.

4. Record the answer, 280, at the overhead. Work through Problems e–h in a similar fashion, stopping after each one to have students share their thinking as you record the answer. In each case, encourage students to use the information that's already available to them to solve the problem.

<table>
<thead>
<tr>
<th>A Multiplication Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>a  $1 \times 14 = 14$</td>
</tr>
<tr>
<td>b  $2 \times 14 = 28$</td>
</tr>
<tr>
<td>c  $10 \times 14 = 140$</td>
</tr>
<tr>
<td>d  $20 \times 14 = 280$</td>
</tr>
</tbody>
</table>

Use the information above to find these products using mental strategies.

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>e  $3 \times 14 = 42$</td>
</tr>
<tr>
<td>f  $5 \times 14 = 70$</td>
</tr>
</tbody>
</table>

**Teacher**  Who'd like to share their solution and strategy for solving $5 \times 14$?

**Students**  I took the answer for $3 \times 14$ and added on two more 14's. First I got up to 56, and then 70.  
I did kind of the same thing, but I added the answers for $2 \times 14$ and $3 \times 14$ to get $5 \times 14$.  
I said $5 \times 14$ must be like half of $10 \times 14$. $10 \times 14$ is 140; cut it in half and you get 70.  
I just went $5 \times 10$ is 50 and $5 \times 4$ is 20, so the answer must be 70.

5. After the class has completed Problems a–h, display the prompt and the last combination at the bottom of the overhead.

Find the product shown below. Explain how you got your answer.

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i  $23 \times 14 = $</td>
</tr>
</tbody>
</table>

Ask students, working individually or in pairs, to use the information provided by the previous combinations to solve the problem, and to write a brief explanation of how they got the answer in their journals. Students who finish well ahead of their classmates may be invited to find a few more related products, such as $8 \times 14$, $14 \times 14$, $25 \times 14$, and so on. After they've had a few minutes to work, ask a couple of volunteers to share how they found the answer to $23 \times 14$ with the class. As they do so, record their strategies on the overhead.
Activity 10  Multiplication Menus (cont.)

Use the information above to find these products using mental strategies.

\[
\begin{array}{c}
e \quad 3 \times 14 = 42 \\
f \quad 5 \times 14 = 70 \\
g \quad 30 \times 14 = 420 \\
h \quad 15 \times 14 = 210 \\
\end{array}
\]

Find the product shown below. Explain how you got your answer.
\[
\begin{array}{c}
i \quad 23 \times 14 = 322 \\
j \quad 20 \times 14 = 280 \\
k \quad 3 \times 14 = 42 \\
l \quad 10 \times 14 = 140 \\
m \quad 23 \times 14 = 322 \\
n \quad 3 \times 14 = 42 \\
o \quad 20 \times 14 = 280 \\
p \quad 3 \times 14 = 42 \\
\end{array}
\]

6. Give students each a copy of the Multiplication Menus sheets. Review the instructions with the class and then give them the remainder of the session to work the problems on the two sheets.

Use Set A5 Independent Worksheet 8 to give students more practice with multiplication menus.
A Multiplication Menu

a  \(1 \times 14 = \) ________

b  \(2 \times 14 = \) ________

c  \(10 \times 14 = \) ________

d  \(20 \times 14 = \) ________

Use the information above to find these products using mental strategies.

e  \(3 \times 14 = \) ________

f  \(5 \times 14 = \) ________

g  \(30 \times 14 = \) ________

h  \(15 \times 14 = \) ________

Find the product shown below. Explain how you got your answer.

i  \(23 \times 14 = \) ________
Multiplication Menus  page 1 of 2

1a  Find the product on the left side of the page. Then use the information to find the products on the right side of the page.

\[
\begin{align*}
1 \times 13 &= \underline{\phantom{00}} \\
2 \times 13 &= \underline{\phantom{00}} \\
3 \times 13 &= \underline{\phantom{00}} \\
10 \times 13 &= \underline{\phantom{00}} \\
20 \times 13 &= \underline{\phantom{00}} \\
2 \times 13 &= \underline{\phantom{00}} \\
5 \times 13 &= \underline{\phantom{00}} \\
30 \times 13 &= \underline{\phantom{00}} \\
15 \times 13 &= \underline{\phantom{00}} \\
\end{align*}
\]

b  Find the product shown below. Explain how you got your answer.

\[
23 \times 13 = \underline{\phantom{00}}
\]

2a  Find the product on the left side of the page. Then use the information to find the products on the right side of the page.

\[
\begin{align*}
1 \times 22 &= \underline{\phantom{00}} \\
2 \times 22 &= \underline{\phantom{00}} \\
3 \times 22 &= \underline{\phantom{00}} \\
10 \times 22 &= \underline{\phantom{00}} \\
20 \times 22 &= \underline{\phantom{00}} \\
2 \times 22 &= \underline{\phantom{00}} \\
5 \times 22 &= \underline{\phantom{00}} \\
30 \times 22 &= \underline{\phantom{00}} \\
15 \times 22 &= \underline{\phantom{00}} \\
\end{align*}
\]

b  Find the product shown below. Explain how you got your answer.

\[
25 \times 22 = \underline{\phantom{00}}
\]
3a Find the product on the left side of the page. Then use the information to find the products on the right side of the page.

1 × 34 = ________  3 × 34 = ________  
2 × 34 = ________  5 × 34 = ________  
10 × 34 = ________  30 × 34 = ________  
20 × 34 = ________  15 × 34 = ________

b Find the product shown below. Explain how you got your answer.

40 × 34 = ________

4a Make up your own multiplication menu. You can choose any 2, 3, or 4-digit number that doesn't end in a zero to be your multiplier.

1 × ________ = ________  3 × ________ = ________  
2 × ________ = ________  5 × ________ = ________  
10 × ________ = ________  30 × ________ = ________  
20 × ________ = ________  15 × ________ = ________

b Now write one more combination using your multiplier that can be solved using the information on your menu. Find the answer and explain how you got it.

_______ × ________ = ________
Introducing a Two-Part Area Model

Overview
Students review some of their current strategies for double-digit multiplication and then explore a variation of the area model in which the rectangular array is divided into 2 instead of 4 parts.

Skills & Concepts
★ represent multiplication of 2-digit by 2-digit numbers
★ mentally multiply 2-digit numbers by numbers through 10 and by multiples of 10
★ estimate products to approximate solutions and determine reasonableness of answers
★ explain why a specific problem-solving strategy was used to determine a solution

Instructions for Introducing a Two-Part Area Model
1. Give each student a piece of copy paper and write the following multiplication problem on the whiteboard.

```
  25
x 23
```

Ask students to jot an estimate of the answer on their paper and explain their thinking to the person sitting next to them.

2. Next ask students to solve the problem, but leave the choice of a strategy up to them. As they finish, have them pair-share their answers and strategies. Then place the top portion of the Multiplication Strategies overhead on display. Ask students to examine the four different responses and locate the one most similar to their own. Then call on a different volunteer to explain each strategy to the class.
Mr. Ozuna asked his 4th graders to solve $23 \times 25$. Here are the answers from four of his students. How do they compare with yours?

<table>
<thead>
<tr>
<th></th>
<th>Jon</th>
<th>Josie</th>
<th>Nick</th>
<th>Kamela</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>400</td>
<td>100</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>15</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

+ 15  

____

575

20 \times 25 = 500 
3 \times 25 = 75 
500 + 75 = 575

1 \quad 1 

25

\times 23 

\underline{75} 

\underline{+ 500} 

\underline{575}

25

3

23 20
25

\times 23 

\underline{24}

2

22 20
24

\times 22 

\underline{20 5} 

4001 00 
60 153 
20

3. Ask students to compare and contrast these four strategies. How are the strategies alike and how are they different? Does one seem to have any advantage over the others? Why or why not? Which might your students choose if they had to do the problem in their head instead of on paper?

**Students** Kamela’s way is really fast, but it’s a little confusing. I don’t quite get how to do that one. I do! I think it’s the easiest.

I like Josie’s way because you can see all the steps.

I still like drawing a picture like Jon did. It just seems easier to see what’s going on.

Nick’s way is really fast too. I think it would be the easiest one to do in your head.

I can make a sketch in my head and just see what the answer would be.

4. Now reveal the middle portion of the overhead. Ask students to examine the sketch quietly for a moment and then invite them to share their observations first in pairs and then with the class.

**Students** It’s the area model, but it’s different.

It’s like Jon’s way up there, except there are 2 parts instead of 4.

I think that’s a pretty easy way to do it. The top part would be 20 \times 25, and that’s 500.

Hey, this is kind of like Nick’s way, because it’ll be 500 for the top part and 75 for the bottom part.

5. After students have shared their observations, work with input from the class to label the lower region with a multiplication equation. Then transfer the information to the expression at the right of the sketch, looping the numbers as shown on the top of the next page to emphasize the fact you’ve multiplied 25 by the number of ones in 23. Repeat the process with the top region, again looping the numbers to emphasize the fact that you’ve multiplied 25 by the number of tens in 23.
6. Now reveal the problem at the bottom of the overhead, 22 × 24. Work with input from the class to fill in the frame with a rectangle, divide the rectangle into two parts, write a multiplication equation to show the area of each part, and transfer the information to the expression at the right of the sketch.

7. Give students each a copy of the Two-Part Multiplication sheets.
Use the top part of the corresponding overhead to review the instructions for page 1. Work through Problem 1a and, if necessary, Problem 1b, with the class. Many students find it helpful to break the side dimension on each rectangle into tens and ones, so you may want to model this and encourage them to do so.

![Two-Part Multiplication](image)

8. Use the lower part of the overhead to review the instructions for the second sheet. Here, students are asked to work with numbers alone, multiplying first by the 1’s in the multiplier, then by the 10’s, and finally adding the two partial products to get the answer. Work through Problems 2a and 2b together at the overhead, and then give students the remainder of the session to complete the assignment.
Multiplication Strategies

Mr. Ozuna asked his 4th graders to solve $23 \times 25$. Here are the answers from four of his students. How do they compare with yours?

<table>
<thead>
<tr>
<th></th>
<th>Jon</th>
<th>Josie</th>
<th>Nick</th>
<th>Kamela</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 5</td>
<td>25</td>
<td>20 $\times$ 25 = 500</td>
<td>25 $\times$ 23 = 575</td>
</tr>
<tr>
<td></td>
<td>400 100 60</td>
<td>+ 23</td>
<td>3 $\times$ 25 = 75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ 15</td>
<td>400 100 60</td>
<td></td>
<td>25 + 75</td>
</tr>
<tr>
<td></td>
<td>60 15</td>
<td>+ 15</td>
<td></td>
<td>+ 500  575</td>
</tr>
<tr>
<td></td>
<td></td>
<td>575</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1

$23 \times 25 = 575$

2

$22 \times 24 = 528$
Two-Part Multiplication

1 For problems a–f:
• label the frame to show the 2 numbers that are being multiplied.
• sketch in the rectangle and divide it into 2 parts.
• label each of the parts with a multiplication equation.
• add the partial products to get the answer.

a
\[
\begin{array}{c}
21 \\ \times 15
\end{array}
\]

b
\[
\begin{array}{c}
14 \\ \times 16
\end{array}
\]

2 For problems a–f:
• multiply the top number by the ones and then by the tens.
• add the partial products to get the answer.

Example
\[
\begin{array}{c}
24 \\ \times 12
\end{array}
\]
\[
\begin{array}{c}
2 \times 24 = 48 \\ 10 \times 24 = 240 \\ \underline{288}
\end{array}
\]

a
\[
\begin{array}{c}
23 \\ \times 13
\end{array}
\]

b
\[
\begin{array}{c}
25 \\ \times 22
\end{array}
\]
1 For problems a–f:
- label the frame to show the 2 numbers that are being multiplied.
- sketch in the rectangle and divide it into 2 parts.
- label each of the parts with a multiplication equation.
- add the partial products to get the answer.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>21</td>
<td>× 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>14</td>
<td>× 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>22</td>
<td>× 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>17</td>
<td>× 13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>23</td>
<td>× 23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>24</td>
<td>× 14</td>
</tr>
</tbody>
</table>

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Two-Part Multiplication page 2 of 2

2 For problems a–f:
• multiply the top number by the ones and then by the tens.
• add the partial products to get the answer.

Example

\[
\begin{array}{c}
24 \\
\times 12
\end{array}
\]
\[
\begin{array}{c}
2 \times 24 = 48 \\
10 \times 24 = 240 \\
\hline
288
\end{array}
\]

a
\[
23 \\
\times 13
\]

b
\[
25 \\
\times 22
\]

c
\[
25 \\
\times 26
\]

d
\[
33 \\
\times 22
\]

e
\[
36 \\
\times 12
\]

f
\[
42 \\
\times 24
\]
Extending the Standard Multiplication Algorithm

Overview
Students use the standard algorithm to multiply two- and three-digit by two-digit numbers.

Skills & Concepts
★ multiply 2- and 3-digit by 2-digit numbers using the standard multiplication algorithm
★ estimate products to approximate solutions and determine reasonableness of answers
★ identify strategies that can be used to solve a problem, select and use one or more appropriate strategies to solve the problem, and justify the selection
★ explain why a specific problem-solving strategy was used to determine a solution

You’ll need
★ Roll Your Own Double-Digit Multiplication Problems (page A5.85, run a class set)
★ dice numbered 1–6, class set
★ dice numbered 4–9, class set
★ several blank transparencies
★ overhead pens
★ Student Math Journals

Instructions for Extending the Standard Multiplication Algorithm
1. Write \(23 \times 27\) on the board or overhead. Ask students to record the problem in their journal, along with an estimate of the answer. Then call on volunteers to share and explain their estimates.

   Students: It will be more than 400 because 20 times 20 is 400. 27 is pretty close to 30, and 20 \(\times\) 30 is 600, so maybe it will be around 600.

2. Next, ask students to find the product using either the four-part area model, or the two-part area model they explored during the previous activity. Let students know that if they can solve the problem without a sketch by finding the partial products mentally and adding them, that’s fine.

3. Have students pair-share their solutions and strategies as they finish. Then work with input from the class to record both the four-part and the two-part strategies on the whiteboard.
Activity 12  Extending the Standard Multiplication Algorithm (cont.)

4. Ask the class to compare and contrast the two strategies. What are the advantages and disadvantages of each?

   **Students**  It's easier to see what you're doing with the four-part model.
   The multiplication is easier to do in your head with four parts. You just have to think of stuff like 20 × 20 and 20 × 7. With the 2-part model, you have to do 20 × 27.
   That's easy, though! 27 + 27 is 54, so the answer is 540.
   I like the 2-part way because you only have to multiply two things instead of four.
   I did 3 × 27 in my head because it's like 3 × 25, and then just add 6 more for the extra.

5. Then explain that you want to share the standard algorithm for double-digit multiplication. It is called the standard algorithm because it is widely used, and provides a method that is very useful in many situations. Demonstrate the algorithm at the overhead or board. We recommend that you do it in two parts, as shown below, to make the two steps of multiplying first by the 1's and then by the 10's in 23 a little more clear. Explain each step as you do it. Ask students to watch and listen closely to see if they can make sense of what you're doing based on all the experiences they've had with multiplication.

   27
   x  23
   = 621
   27
   x  23
   + 540
   621

6. When you have finished the demonstration, ask students to explain how this method works. Can they see any connection between the algorithm and the area model? Does the strategy make sense to them? If they don't mention it, ask students to connect the algorithm you've modeled to the arrays on the board. Where do they see the partial products 81 and 540 in the array?

   **Students**  They're right there in the 2-part array. They're just switched around, so first it's 540 and then it's 81.
   I don't see them on the other array, though.
   If you add the numbers going across it works. It's 400 + 140 on top. That's 540. Then it's 60 + 21 on the bottom. That's 81.
   With the standard algorithm, it's kind of like multiplying and adding at the same time.

7. Now write 36 × 77 on the board:
Activity 12 Extending the Standard Multiplication Algorithm (cont.)

Ask students whether they would choose to use the 4-part model, the 2-part model, or the standard algorithm to solve this problem. Why? Which strategy would be most efficient and effective? Some may opt for the 4-part model, while others argue in favor of the standard algorithm. Chances are, many will feel that the 2-part model is too difficult given the numbers in this combination, which aren’t nearly as friendly as 23 × 27.

8. Ask students to copy the problem into their journal, along with an estimate. Have a few volunteers share their estimates. Then work with class input to solve the problem together, using the standard algorithm. If some students believe that the 4-part model would be equally efficient and effective, work it that way as well. Then compare and contrast the two methods.

<table>
<thead>
<tr>
<th>Standard Algorithm</th>
<th>4-Part Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>× 77</td>
<td>× 77</td>
</tr>
<tr>
<td>252</td>
<td>252</td>
</tr>
<tr>
<td>2520</td>
<td>2520</td>
</tr>
<tr>
<td>2772</td>
<td>2772</td>
</tr>
</tbody>
</table>

Students There’s so much more writing with the 4-part way!

There’s not so much if you just write each of the answers, and don’t write the multiplication sentences too.

But you still have to add 4 numbers. It just seems like more work.

I think it’s easier to understand.

9. Acknowledge the usefulness of both methods, and then explain that most people find the standard algorithm to be the most efficient and effective as the numbers get larger. Solve the problems below with the class, using the standard algorithm. In each case, have students copy the problem into their journal, record an estimate, and then work through the steps with you. If you have students who are already quite proficient with the algorithm, you might call on them to lead the class in solving some of these combinations.

58    69    72    138    243
× 24  × 35  × 34  × 33  × 46

10. Give students more practice using the standard algorithm. Depending on the needs and strengths of your class, you may want to have some students solve additional problems with you, while others work independently on the Roll Your Own Double-Digit Multiplication sheet. Students who are very comfortable with the algorithm can be assigned to solve the challenge problems at the bottom of the sheet.
Roll Your Own Double-Digit Multiplication Problems

- Choose a die numbered 1–6 or 4–9
- Roll it as many times as you need to fill in each of the boxes below. You can write each number you roll in any box on the sheet, but once all the boxes are filled, you can’t change them.
- Use the method you just learned in class to solve your problems.
- When you’re finished, trade papers with a classmate and have him or her check your answers.

Note If some of your students are confused by the standard algorithm, you may want to share the strategy shown at the left below, in which the partial products are added, but computation starts with the ones instead of the tens. This strategy may help ease some students’ transition into the standard algorithm a little.

INDEPENDENT WORKSHEET

Use Set A5 Independent Worksheet 9 to provide students with more practice with the standard algorithm for double-digit multiplication.
Roll Your Own Double-Digit Multiplication Problems

Directions:
• Choose a die numbered 1–6 or 4–9.
• Roll it as many times as you need to fill in each of the boxes below. You can write each number you roll in any box on the sheet, but once all the boxes are filled, you can't change them.
• Use the method you just learned in class to solve your problems.
• When you're finished, trade papers with a classmate and have him or her check your answers.

1 \[ \times \] 2 \[ \times \] 3
4 \[ \times \] 5 \[ \times \] 6

CHALLENGE
7 \[ \times \] 8
Set A5 ★ Activity 13

Reviewing & Evaluating Multiplication Methods

Overview
Students review some of the multi-digit multiplication methods they have explored and think critically about which strategies are most effective when. Then they work independently on a set of problems and discuss their solutions, as well as the strategies they selected.

Skills & Concepts
- multiply 2- and 3-digit by 2-digit numbers using the standard multiplication algorithm
- solve single- and multi-step word problems involving multi-digit multiplication and verify the solutions
- identify strategies that can be used to solve a problem, select and use one or more appropriate strategies to solve the problem, and justify the selection
- explain why a specific problem-solving strategy was used to determine a solution

You’ll need
- Reviewing Multiplication Methods (page A5.91, run one copy on a transparency and a class set on paper)
- Evaluating Multiplication Methods (pages A5.92 and A5.93, run a class set)
- overhead pens

Instructions for Reviewing & Evaluating Multiplication Methods
1. Give students each a copy of Reviewing Multiplication Methods, and display a copy of the sheet at the overhead.

2. On this sheet, students will find five of the multiplication methods they’ve explored over the past few weeks. Give them a minute to examine the sheet quietly and star the methods they find easiest and most effective right now. Ask them to share and explain their choices in pairs, and then invite volunteers to share with the class.

Students
I put a star by Method A because it’s easy, like with 4 × 124, you can just do doubles and then double it again.
I still like the 4-part way because it’s easy for me to do the multiplication in my head and then add up the numbers.
I really like that 2-part way—it’s faster than the other one.
I think the regular way on E is the best because it works with big numbers.
But with numbers like 299, you don’t even need to do hardly any work. Just think it’s like 3 × 300, and then subtract 3.
Activity 13  Reviewing & Evaluating Multiplication Methods (cont.)

3. Then work with class input to complete the examples at the overhead as students do so on their copies of the sheet.

   Teacher  Let’s complete the example for Method A together. It says 4 × 124 and tells us to double it and then double it again. What do we need to write on the sheet to show this?

   Justin  You could just write 124 + 124, or 124 × 2 and do it in your head. Then just double that to get the answer.

   Teacher  What if the problem had been 3 × 124 or 5 × 124 instead of 4 × 124? Would our basic fact strategies still work? Talk with the person sitting next to you—what do you think?

   Students  If it was 3 × 124, you could just double it and add another 124. For 5 × 124, you could just multiply by 10 and cut the answer in half, just like if you were doing 5 × 9 or 5 × 12.
Teacher So if you're multiplying a number—even a big number—by a single digit, you might remember back to some of the basic fact strategies you already know. Let’s look at Method B, the 4-part model. What do we have to do to use this method?

Students We have to look at the 4 little lines and do those multiplication problems. Like on the first one, it’s 20 × 30. That’s 600. And the next one is 20 × 4, and that’s 80.

Teacher Let’s write each step down on our papers. I’ll do that up here, and you work on your sheets.

4. Complete the rest of the examples on the sheet together in a similar fashion, reviewing and discussing each strategy as you enter the needed information at the overhead and students do so on their worksheets.

5. Leave the overhead on display, and give students each a copy of the Evaluating Multiplication Methods sheets. Review the instructions at the top of the first page, and explain to students that for each problem, they’ll need to choose the multiplication method that seems best to them, and then use that method to solve the problem. Decisions will vary from one student to the next, and that’s okay. If a few students raise the point that there are multiplication methods other than the ones shown on the overhead, acknowledge the fact, but ask them to make their selections from Methods A–E for this assignment.
Activity 13  Reviewing & Evaluating Multiplication Methods (cont.)

6. Once students understand what to do, give them time to complete the sheets. When most have finished the assignment, ask them to meet in pairs to share and compare their answers, as well as the methods they chose. If their answers don't match, ask them to re-examine the problem and see if they can resolve the difference.

7. Reconvene the class toward the end of the period. Work with student input to record each multiplication problem at the whiteboard along with the answer.

\[
\begin{array}{ccc}
158 & \times & 40 \\
\times & 8 & \times 16 \\
\hline
1,264 & 640 & 4,550 & 2,205
\end{array}
\]

Then ask volunteers to share the methods they chose to help solve each problem and explain their choices to the class. During the discussion, elicit these ideas:

- There are a variety of ways to solve multi-digit multiplication problems; it's not necessary to use the same method every time. What's important is to choose the method that is most efficient and effective.

- The method you choose to solve a particular problem depends on the numbers themselves. Here are some examples:
  - Use a basic fact strategy if the multiplier is a single digit.
  - Use a 2-part method when it's relatively easy to compute each partial product mentally (i.e., \(16 \times 40\)).
  - Use a 4-part method or the standard algorithm when the numbers are not as “friendly” (i.e., \(49 \times 45\)).
  - Use the standard algorithm when you're multiplying 3 digits by 2 digits.
Reviewing Multiplication Methods

Read and review these multiplication methods with your class. Then complete the example in each strategy box, A–E.

**Method A**  Use basic fact strategies.

**example** 4 × 124  
Double it and then double it again.

**Method B**  Multiply to get 4 partial products and add them up.

**example** 27 × 34
\[
\begin{array}{c}
\times
\end{array}
\]

**Method C**  Multiply by the 10’s and then by the 1’s. Add the partial products.

**example** 16 × 25
\[
\begin{array}{c}
\times
\end{array}
\]

**Method D**  Use landmark numbers.

**example** 3 × 299
\[
\begin{array}{c}
\times
\end{array}
\]

**Method E**  Use the standard algorithm.

**example** 46 × 73
\[
\begin{array}{c}
\times
\end{array}
\]
Evaluating Multiplication Methods  page 1 of 2

For each problem on this page and the next,
• write the letter of the method you think will work best.
• use the method to solve the problem. Show all your work.

1 People need to drink about 8 cups of water each day. Zoo elephants need to drink about 158 quarts of water each day. How many cups of water are there in 158 quarts of water? (Remember that there are 4 cups in a quart.)

I think Method ____ will work best for this problem.

2 So far, the elephant keeper has brought in 40 gallons of water for the elephants. How many cups of water are there in 40 gallons? (Remember that there are 16 cups in a gallon.)

I think Method ____ will work best for this problem.
3  Zoo elephants eat about 175 pounds of food a day. Most of their food is hay, but they also eat fruits and vegetables. How many pounds of food would it take to feed 26 elephants for one day?

I think Method ____ will work best for this problem.

4  Each elephant at our zoo gets about 45 pounds of vegetables a day. How many pounds of vegetables does it take to feed one elephant for 49 days (7 weeks)?

I think Method ____ will work best for this problem.

5  An elephant can spend up to 18 hours a day eating. How many hours would that total in one year? About how many months’ worth of time is that?
Set A5 ★ Activity 14

Multi-Digit Multiplication Post-Assessment

Overview
The pre-assessment given in Activity 1 is re-administered in somewhat different form during this activity. Students’ work on the post-assessment will provide information about what they have learned, as well as the areas in which they need continued support.

Skills & Concepts
★ multiply by 10, 100, and 1000
★ multiply one- and two-digit numbers by numbers through 10 and by multiples of 10
★ multiply up to 3-digit by 1- and 2-digit numbers accurately using the standard algorithm
★ estimate products to approximate solutions and determine reasonableness of answers
★ solve single- and multi-step word problems involving multi-digit multiplication

You’ll need
★ Multi-Digit Multiplication Post-Assessment (pages A5.100–A5.103, run a class set)
★ Multi-Digit Multiplication Post-Assessment Class Checklist (page A5.104, run 1 or 2 copies)
★ Multi-Digit Multiplication Pre- & Post-Assessment Scoring & Comparisons (optional, pages A5.11 and A5.12, run a class set)
★ Student Reflection Sheet: Multiplication (see note)
★ Base 10 Grid Paper (page A5.13, run as needed)

Note: If you had students fill out the Student Reflection Sheet (pages A5.14–A5.16) after the Multi-Digit Multiplication Pre-Assessment, plan to have them fill it out again when you return their scored post-assessments.

Instructions for Multi-Digit Multiplication Post-Assessment
1. Give each student a copy of the 4-page post-assessment and then read and review the tasks with the class. Have students write their names on their papers and circle each “doing” word as you read through the items together. Remind students that they’ll need to check off each checkpoint as they complete the items.

2. Before they start to work, be sure students understand that they only need to circle and solve one combination in problems 2, 3, and 7. Take a minute, if necessary, to review the standard multiplication algorithm, because students are specifically asked to use that method to solve problems 2, 3, and 7. In problems 2 and 3, they’re also asked to use a second method. You might take a minute to review some of the methods they’ve explored over the past few weeks: sketches on base 10 grid paper, freehand 4-part and 2-part area models, finding and adding 4 or 2 partial products, and so on. Tell students that you’ll place a stack of base ten grid paper near each table or cluster of desks if they want to use it for any of the problems other than problem 7.

3. Remind students that you are available to re-read any of the directions or problems for them while they work. Advise them to complete the items they find easiest and most familiar first, even if that means skipping around a bit, and then return to the questions they find more challenging and writing “I don’t know yet” if necessary.
4. If you plan to score this assessment as suggested in “Looking at Student Work” below, let students know that you will be scoring their papers. In many of the problems, they will be given a point for the answer and a point for showing their work. In problems 2 and 3, they will get a point for using the standard algorithm to solve the combination they’ve selected, and another point for solving it using a different method. In problems 4 and 8, they need to estimate answers and explain their estimates; points will be given for the estimate and the explanation. While it may seem that this will create more test anxiety, we find that it is very helpful to students when we share our expectations before they start.

5. Give students the rest of the period to complete the assessment. Make sure your students understand what they are expected to do when they complete the assessment and where you want them to place their finished papers.

<LOOKING AT STUDENT WORK>

Below you’ll find an item-by-item answer key and scoring suggestions for this post-assessment. We generally use the percentage of points earned to determine whether a student is working at an advanced, proficient, basic, or novice level with regard to the material on the assessment. You may need to adjust the scoring system for this assessment to ensure that it reflects the expectations for fourth-graders in your district.

<table>
<thead>
<tr>
<th>POINTS SCORED</th>
<th>PERCENTAGE OF TOTAL</th>
<th>LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 – 32 points</td>
<td>90 – 100 %</td>
<td>Advanced (Working above grade level)</td>
</tr>
<tr>
<td>24 – 28 points</td>
<td>75 – 89%</td>
<td>Proficient (Working at grade level)</td>
</tr>
<tr>
<td>17 – 23 points</td>
<td>53 – 74%</td>
<td>Basic (Working toward grade level)</td>
</tr>
<tr>
<td>16 points or fewer</td>
<td>50% or lower</td>
<td>Novice (Working below grade level)</td>
</tr>
</tbody>
</table>

In addition to scoring these post-assessments, you may find it helpful to compare them to students’ pre-assessments. Although some students may not score particularly well on the post-assessment, you may find that they have actually made quite a bit of progress based on what they were able to do at the beginning of this collection of activities.
**Activity 14  Multi-Digit Multiplication Post-Assessment (cont.)**

### PROBLEM 1

1. There are 24 crayons in a box. There are 4 boxes of crayons in a jumbo pack. Mrs. Perez bought 4 jumbo packs of crayons for her class. How many crayons did she get in all?

   a. ____ Mrs. Perez got _____ crayons in all.

   b. ____ Use the standard algorithm to solve the problem you circled. Show all your work in the box below.

   \[24 \times 4 = 96\]

   \[4 \times 4 = 16\]

   \[96 + 16 = 112\]

   Mrs. Perez got 112 crayons in all.

   c. ____ Use a different method to solve the problem you circled. Show all your work in the box below.

   \[24 \times 4 = 96\]

   \[4 \times 4 = 16\]

   \[96 + 16 = 112\]

   Mrs. Perez got 112 crayons in all.

   d. ____ Use labeled sketches on base 10 grid paper to solve the problem you circled. Show all your work in the box below.

   e. ____ Use a basic facts strategy such as double-double-doubles to solve the problem you circled. Show all your work in the box below.

   \[24 \times 4 = 96\]

   \[4 \times 4 = 16\]

   \[96 + 16 = 112\]

   Mrs. Perez got 112 crayons in all.

   f. ____ Use repeated addition to solve the problem you circled. Show all your work in the box below.

   \[24 \times 4 = 96\]

   \[4 \times 4 = 16\]

   \[96 + 16 = 112\]

   Mrs. Perez got 112 crayons in all.

### SCORING: 3 POINTS POSSIBLE

- 1 point for a strategy that indicates the student understands this is a 2-step problem requiring two different calculations or sets of calculations.
- 1 point for work that uses any combination of labeled sketches, numbers, and words to demonstrate how the solution was found.
- 1 point for the correct answer, 768.

### Comments

It is possible for a student to score 2 points on this problem, even if she doesn’t get the correct answer. One of the goals of multi-digit multiplication activities was to help students develop skills at solving multi-step problems. Even if the student makes errors in her calculations, using a strategy that reflects good understanding of the problem can be awarded 2 points.

### PROBLEM 2

2. Choose one of the problems below and circle it.

   a. ____ Use the standard algorithm to solve the problem you circled. Show all your work in the box below.

   Responses will vary. Sample: \[32 \times 8 = 256\]

   b. ____ Use a different method to solve the problem you circled. Show all your work in the box below.

   Responses will vary. Sample: The standard algorithm is faster, but doubling seems easier.

   c. ____ Which method was easier and faster for you? Why?

   Responses will vary. Sample: The standard algorithm is faster, but doubling seems easier.

### SCORING: 3 POINTS POSSIBLE

- 1 point for using the standard algorithm to get the correct answer.
- 1 point for using any other method to get the correct answer (see Comments).
- 1 point for any reasonable response to the question about which method was easier and faster.

### Answers to the 4 problems

- \[6 \times 24 = 144\]
- \[8 \times 32 = 256\]
- \[7 \times 42 = 294\]
- \[5 \times 99 = 495\]

### Comments

Possible strategies include a labeled sketch on base 10 grid paper, a freehand sketch of the area model divided into 4 or 2 parts, finding and adding 4 or 2 partial products, a basic facts strategy such as double-double-doubles, or repeated addition. Student who are still using repeated addition and are not yet using the standard algorithm for 1-by-2 digit multiplication accurately will need extra support to develop proficiency with this skill. (See Grade 4 Support Activity 22, Spin & Multiply. You’ll find this activity at the back of the Grade 4 Number Corner Blacklines.)

### PROBLEM 3

3. Choose one of the problems below and circle it.

   a. ____ Use the standard algorithm to solve the problem you circled. Show all your work in the box below.

   Responses will vary. Sample: \[51 \times 32 = 1,632\]

   b. ____ Use a different method to solve the problem you circled. Show all your work in the box below.

   Responses will vary. Sample: The standard algorithm is faster, but doubling seems easier.

   c. ____ Which method was easier and faster for you? Why?

   Responses will vary. Sample: The standard algorithm is faster, but doubling seems easier.

### SCORING: 2 POINTS POSSIBLE

- 1 point for using the standard algorithm to get the correct answer.
- 1 point for any other method to get the correct answer (see Comments).

### Answers to the 4 problems

- \[18 \times 25 = 450\]
- \[23 \times 33 = 759\]
- \[23 \times 43 = 989\]
- \[32 \times 51 = 1,632\]

### Comments

Possible methods include a labeled sketch on base 10 grid paper, a freehand sketch of the area model divided into 4 or 2 parts, finding and adding 4 or 2 partial products, or repeated addition. Student who are still using repeated addition and are not yet using the standard algorithm for 2-by-2 digit multiplication accurately will need extra support to develop proficiency with this skill. (See Grade 5 Support Activities 31, Spin & Multiply Big Time, and 36, Multiplication Tic-Tac-Toe. You’ll find these activities at the back of the Grade 5 Number Corner Blacklines.)
### Problem 4

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</table>

**Scoring:** 4 Points Possible

- 1 point for selecting the closest estimate to each problem (1,000 and 600)
- 1 point for each reasonable explanation of the selected estimate (see Comments)

**Comments**

If a student hasn’t chosen the closest estimate, but has given an explanation that demonstrates good number sense, consider awarding 1 point for the item.

### Problem 5

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**Scoring:** 6 Points Possible

- 1 point for each correct answer

**Comments**

Because they should be able to do these problems mentally, students are not required to show their work. Don’t penalize them, however, if they’ve used the standard algorithm or some other method to get the answers.

### Problem 6

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</table>

**Scoring:** 6 Points Possible

- 1 point for each correct answer

**Comments**

Because they should be able to do these problems mentally, students are not required to show their work. Don’t penalize them, however, if they’ve used the standard algorithm or some other method to get the answers. Of greater concern are those students who are trying to manipulate the numbers without adequate understanding. Such students may give an answer of 150 for 30 × 50 or 400 for 50 × 80 because they have latched onto the idea of multiplying the digits in the tens place as if they were ones (i.e., 5 × 8 = 40), but aren’t sure how many zeros to add. You might ask these students to continue using Base Ten Grid Paper or even base ten pieces to solve such problems so that they can develop a greater understanding of the place value concepts at work.
**Activity 14 Multi-Digit Multiplication Post-Assessment (cont.)**

### PROBLEM 7

#### SCORING: 3 POINTS POSSIBLE

- 1 point for using the standard algorithm to get the correct answer
- 2 points for a multiplication story problem that matches the selected combinations
(A story problem that involves repeated addition rather than multiplication may be awarded 1 point.)

**Answers to the 6 problems:**
- $24 \times 112 = 2,688$
- $17 \times 125 = 2,125$
- $26 \times 332 = 8,632$
- $25 \times 254 = 6,350$
- $37 \times 382 = 14,134$
- $48 \times 569 = 27,312$

**Comments**

Students' story problems will give you some indication of how well they understand the operation of multiplication. Even if they're able to go through the mechanics of the standard algorithm, students who write story problems that involve addition rather than multiplication may still be using additive rather than multiplicative reasoning when they think about multiplication.

### PROBLEM 8

#### SCORING: 5 POINTS POSSIBLE

- 1 point for the correct expression: $24 \times 49$ or $49 \times 24$
- 1 point for the correct response to part b: No or I disagree
- 1 point for a reasonable explanation of why Andy’s estimate is too low (see Comments)
- 1 point for a method other than repeated addition
- 1 point for the correct answer, 1,176

**Answers to the 6 problems:**
- $24 \times 112 = 2,688$
- $17 \times 125 = 2,125$
- $26 \times 332 = 8,632$
- $25 \times 254 = 6,350$
- $37 \times 382 = 14,134$
- $48 \times 569 = 27,312$

**Comments**

If a student agrees with Andy that 800 is a reasonable estimate, and gives an explanation that reflects good number sense, you might consider awarding a point for the explanation. Possible methods for solving the problem include a labeled sketch on base 10 grid paper, a freehand sketch of the area model divided into 4 or 2 parts, finding and adding 4 or 2 partial products, or the standard algorithm. Repeated addition is not acceptable.

---

**Note:** In order to help students develop fluency with the skills taught during this activity set, you'll want to provide more practice over the coming months. Independent Worksheets 1–9 that follow this activity are provided for this purpose. Additional multi-digit multiplication exercises and problems can be found on The Math Learning Center website: www.mathlearningcenter.org.
Multi-Digit Multiplication Post-Assessment  page 1 of 4

1 There are 24 crayons in a box. There are 8 boxes of crayons in a jumbo pack. Mrs. Perez bought 4 jumbo packs of crayons for her class. How many crayons did she get in all?

a ___ Solve the story problem above. Show your work with labeled sketches, numbers, and/or words.

b ___ Mrs. Perez got ________ crayons in all.

2 Choose one of the problems below and circle it.

24 32 42 99
× 6 × 8 × 7 × 5

a ___ Use the standard algorithm to solve the problem you circled. Show all your work in the box below.

b ___ Use a different method to solve the problem you circled. Show all your work in the box below.

c ___ Which method was easier and faster for you? Why?
Multi-Digit Multiplication Post-Assessment  page 2 of 4

3  Choose one of the problems below and circle it.

\[
\begin{array}{cccc}
25 & 33 & 43 & 51 \\
\times 18 & \times 23 & \times 23 & \times 32 \\
\end{array}
\]

a  ___ Use the standard algorithm to solve the problem you circled. Show all your work in the box below.

b  ___ Use a different method to solve the problem you circled. Show all your work in the box below.

4  ___ Fill in the bubble to show the best estimate for each problem. Explain your choice.

a  248 
\times 4 

\begin{array}{ccc}
\bigcirc & 800 & \\
\bigcirc & 900 & \\
\bigcirc & 1,000 & \\
\bigcirc & 1,200 & \\
\end{array}

Why?

b  25 
\times 25 

\begin{array}{ccc}
\bigcirc & 400 & \\
\bigcirc & 500 & \\
\bigcirc & 600 & \\
\bigcirc & 700 & \\
\end{array}

Why?

5  ___ Write the answer to each problem.

\[
\begin{array}{cccccccc}
45 & 10 & 29 & 100 & 1,000 & 60 \\
\times 10 & \times 50 & \times 100 & \times 60 & \times 18 & \times 1,000 \\
\end{array}
\]
Multi-Digit Multiplication Post-Assessment  page 3 of 4

6  ____ Write the answer to each problem.

\[
\begin{align*}
40 \times 2 & = & 80 \\
60 \times 4 & = & 240 \\
50 \times 30 & = & 1500 \\
80 \times 50 & = & 4000 \\
21 \times 30 & = & 630 \\
32 \times 30 & = & 960
\end{align*}
\]

7  Choose one of the multiplication problems below and circle it. Pick the one that seems best for you - not too hard and not too easy.

\[
\begin{align*}
112 \times 24 & = & 2688 \\
125 \times 17 & = & 2125 \\
332 \times 26 & = & 8632 \\
254 \times 25 & = & 6350 \\
382 \times 37 & = & 14144 \\
569 \times 48 & = & 27112
\end{align*}
\]

a  ____ Use the standard algorithm to find the answer to the problem you circled. Be sure to show all of your work.

b  ____ Write a story problem to match the multiplication problem you just solved.
8 We can hear someone out mowing the lawn in front of our school. The lawn is 24 feet wide and 49 feet long. How many square feet of grass do they have to mow?

**a** Write an expression to match this problem.

**b** Andy says the answer is going to be about 800. Do you agree with Andy? Why or why not?

**c** Use any method except repeated addition to solve the problem. Show all of your work.
### Multi-Digit Multiplication Post-Assessments Class Checklist

<table>
<thead>
<tr>
<th>Student name</th>
<th>1a Uses any combination of labeled sketches, numbers, and words to solve the problem; indicates understanding that 2 steps are necessary</th>
<th>2*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1b Gives the answer for 1b, 768</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2a Uses the standard algorithm for 2-digit by 1-digit multiplication</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2b Uses a different method for 2-digit by 1-digit multiplication</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2c Gives a reasonable explanation about which strategy was easier</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3a Uses the standard algorithm for 2-digit by 2-digit multiplication</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3b Uses a different method for 2-digit by 2-digit multiplication</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>4a Chooses the best estimate for 4 × 248 (1,000), and justifies estimate</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4b Chooses the best estimate for 25 × 25 (600), and justifies estimate</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>5 Multiplies 2-digit numbers by 10, 100, and 1,000</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>6 Multiplies 1- and 2-digit numbers by multiples of 10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7a Uses the standard algorithm for 3-digit by 2-digit multiplication</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7b Writes a story problem to match the multiplication problem from 7a</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>8a Records a correct expression</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8b Disagrees with Andy’s estimate and justifies response</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>8c Uses a method other than repeated addition to multiply 24 × 79</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8d Gives correct answer, 1176</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total score / Level of proficiency</strong></td>
<td>32</td>
</tr>
</tbody>
</table>

* The total possible number of points for each problem is shown. ** A Advanced (working above grade level) 29–32 points (90–100% correct)  P Proficient (working at grade level) 24–28 points (75–89% correct)  B Basic (working toward grade level) 17–23 points (53–74% correct)  N Novice (working below grade level) 16 points or fewer (64% or less correct)
More Practice Multiplying by 10, 100 & 1000

1 Write the answers.
   \[
   \begin{array}{ccccccc}
   43 & 15 & 10 & 67 & 40 & 10 & 600 \\
   \times 10 & \times 10 & \times 29 & \times 10 & \times 10 & \times 11 & \times 10 \\
   \end{array}
   \]

2 Write the answers.
   \[
   \begin{array}{ccccccc}
   22 & 16 & 100 & 30 & 44 & 71 & 500 \\
   \times 100 & \times 100 & \times 73 & \times 100 & \times 100 & \times 100 & \times 100 \\
   \end{array}
   \]

3 Fill in the rest of this sentence.
When you multiply any number by 100,

4 Write the answers
   \[
   \begin{array}{ccc}
   79 \times 1,000 = \_\_\_\_ & 1,000 \times 20 = \_\_\_\_ & 500 \times 1,000 = \_\_\_\_ \\
   \end{array}
   \]

5 The painters are painting one of the walls in the gym. The wall is 10 feet high and 45 feet long. They have already painted 133 square feet. How many square feet do they have left to paint?
   a Write the question in your own words.
   b Underline the information in the problem that will help you answer the question.

(Continued on back.)
Independent Worksheet 1  More Practice Multiplying by 10, 100 & 100 (cont.)

5c  Circle the operations you will need to solve this problem:
addition (+)     subtraction (–)     multiplication (×)     division (÷)

5d  Solve problem 5 in the space below. Show all your work.

E  Write your answer here. Include the units. ______________________

CHALLENGE

6  The painters are going to paint the hallway wall. The wall is 10 feet high and 80 feet long. It takes one gallon of paint to cover 200 square feet. A gallon of paint costs $26.25. How much will it cost to paint the wall?

6a  Write the question in your own words.

6b  Underline the information in the problem that will help you answer the question.

6c  Circle the operations you will need to solve this problem:
addition (+)     subtraction (–)     multiplication (×)     division (÷)

6d  Solve this problem in the space below. Show all your work.

6e  Write your answer here. Include the units. ______________________
Set A5 ★ Independent Worksheet 2

INDEPENDENT WORKSHEET

More Tens, Hundreds & Thousands

1 Solve these problems in your head. Write the answers.

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</thead>
<tbody>
<tr>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
<td>900</td>
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</thead>
<tbody>
<tr>
<td>800</td>
<td>900</td>
<td>2,000</td>
<td>3,000</td>
<td>4,000</td>
<td>5,000</td>
<td>6,000</td>
<td>900</td>
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<tr>
<td>× 9</td>
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2 Solve these problems in your head. Write the answers.

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</thead>
<tbody>
<tr>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
<td>90</td>
</tr>
<tr>
<td>× 5</td>
<td>× 6</td>
<td>× 8</td>
<td>× 3</td>
<td>× 6</td>
<td>× 9</td>
<td>× 4</td>
<td>× 9</td>
</tr>
</tbody>
</table>

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</thead>
<tbody>
<tr>
<td>900</td>
<td>800</td>
<td>700</td>
<td>600</td>
<td>500</td>
<td>400</td>
<td>300</td>
<td>90</td>
</tr>
<tr>
<td>× 9</td>
<td>× 8</td>
<td>× 7</td>
<td>× 6</td>
<td>× 5</td>
<td>× 4</td>
<td>× 3</td>
<td>× 9</td>
</tr>
</tbody>
</table>

3 Write the answers to these problems.

200 × 10 = _____
400 × 100 = _____
30 × 1,000 = _____

200 × 20 = _____
400 × 200 = _____
30 × 2,000 = _____

200 × 30 = _____
400 × 300 = _____
30 × 3,000 = _____

(Continued on back.)
Independent Worksheet 2  More Tens, Hundreds & Thousands (cont.)

4 Circle one of the expressions below. Write a story problem to match. Solve your own problem.

400 \times 40 \quad 1,000 \times 18 \quad 300 \times 30 \quad 2,000 \times 24
Set A5 ★ Independent Worksheet 3

**Double-Digit by Single-Digit Multiplication**

1. Use a sketch and numbers to solve the problems below. Follow the example.

<table>
<thead>
<tr>
<th>Sketch</th>
<th>Numbers</th>
</tr>
</thead>
</table>
   | example | 24  
           | 7 × 7 |
           | 7 × 20 = 140 |
           | 7 × 4 = + 28 |
           | ____ 168 |
   | a  | 27  
   | 5 × 5 |
   | 5 × 20 = |
   | 5 × 7 = +  |
   | ____ |
   | b  | 23  
   | 9 × 9 |
   | 9 × 20 = |
   | 9 × 3 = +  |
   | ____ |
   | c  | 35  
   | 8 × 8 |
   | 8 × 30 = |
   | 8 × 5 = +  |
   | ____ |

2. Use numbers to solve these problems.

   | a  | 43  
   | 6 × 6 |
   | 6 × 40 = |
   | 6 × 3 = +  |
   | ____ |
   | b  | 68  
   | 6 × 6 |
   | 6 × 60 = |
   | 6 × 8 = +  |
   | ____ |
   | c  | 65  
   | 4 × 4 |
   | 6 × 40 = |
   | 6 × 3 = +  |
   | ____ |
   | d  | 83  
   | 4 × 4 |
   | 8 × 40 = |
   | 8 × 3 = +  |
   | ____ |

(Continued on back.)
Independent Worksheet 3  Double-Digit by Single-Digit Multiplication (cont.)

3  There is an area on our playground for kids to ride their bikes. It is 9 feet wide and 26 feet long. How many square feet is the bike area?

a  Write the question in your own words.

b  Underline the information in the problem that will help you answer the question.

c  Solve this problem in the space below. Show all your work.

d  Write your answer here. Include the units. ________________________

CHALLENGE

4  A professional basketball court is 94' long and 50' wide. A highschool basketball court is 84' long and 50' wide. How many more square feet is a professional basketball court than a highschool basketball court?

a  Write the question in your own words.

b  Underline the information in the problem that will help you answer the question.

c  Circle the operations you will need to solve this problem:

addition (+)  subtraction (−)  multiplication (×)  division (÷)

d  Solve this problem in the space below. Show all your work.

Write your answer here. Include the units. ________________________
Set A5 ★ Independent Worksheet 4

Using the Standard Algorithm for 2-Digit by 1-Digit Multiplication

Maddie and her mom got 6 boxes of treats for their dogs. There are 34 treats in each box. How many treats did they get for their dogs?

To solve this problem, multiply $6 \times 34$. Here are two different methods:

- You can make a sketch and list the partial products. Then you can add them.

\[
\begin{array}{c}
6 \\
\hline
30 \\
4 \\
\hline
180 \\
24
\end{array}
\]

\[
6 \times 30 = 180 \\
6 \times 4 = 24
\]

\[
= 204 \text{ treats}
\]

- You can also multiply by using the standard algorithm. If you use this method, you don’t have to list the partial products.

\[
\begin{array}{c}
2 \times 34 \\
\hline
\end{array}
\]

Multiply the ones, $6 \times 4 = 24$ ones.

Since 24 is 2 tens plus 4 ones, write the 4 in the ones place and write the 2 tens above the 3 in the tens place.

Multiply the tens, $6 \times 3 = 18$ tens.

Add the 2 tens you carried over to the 18 tens. Write 20 tens in the tens and hundreds place.

1 Use the standard algorithm to solve the problems below.

\[
\begin{array}{ccccccc}
23 & 35 & 29 & 44 & 67 & 19 \\
\times 4 & \times 7 & \times 3 & \times 4 & \times 2 & \times 8 \\
\hline
132 & 234 & 416 & 240 & 321 & 439
\end{array}
\]

\[
\begin{array}{ccccccc}
\times 4 & \times 3 & \times 6 & \times 4 & \times 7 & \times 5
\end{array}
\]
Set A5 ★ Independent Worksheet 5

Choose Your Strategy

Here are three different ways to solve $4 \times 29$.

<table>
<thead>
<tr>
<th>Standard Algorithm</th>
<th>Partial Products</th>
<th>Landmark Numbers</th>
</tr>
</thead>
</table>
| $\begin{array}{c}
3 \\
29 \\
\times 4 \\
\end{array}$ | $4 \times 20 = 80$ | 29 is almost like 30. |
|                     | $4 \times 9 = 36$ | $4 \times 30 = 120$ |
|                     | $80 + 36 = 116$  | $120 - 4 = 116$   |

1 Use the standard algorithm to solve each problem below. Then solve it a different way. Label your method. Circle the method that seemed quicker and easier.

<table>
<thead>
<tr>
<th></th>
<th>Standard Algorithm</th>
<th>A Different Way</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a</strong></td>
<td>$39$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\times 6$</td>
<td></td>
</tr>
<tr>
<td><strong>b</strong></td>
<td>$51$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\times 7$</td>
<td></td>
</tr>
<tr>
<td><strong>c</strong></td>
<td>$65$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\times 7$</td>
<td></td>
</tr>
<tr>
<td><strong>d</strong></td>
<td>$199$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\times 8$</td>
<td></td>
</tr>
</tbody>
</table>

(Continued on back.)
2 Fill in the bubble to show the best estimate for each problem. Explain your choice.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>51</td>
<td>× 8</td>
<td>350</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>450</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>326</td>
<td>× 3</td>
<td>700</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>900</td>
<td>1,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C Circle the method that seems to help most for estimating.

- Standard Algorithm
- Partial Products
- Landmark Numbers

3 Sam, Sarah, Deena, and TJ each have 37 marbles. How many marbles do they have in all? Show your work.

4 The kids at the high school are having a car wash. They charge $6.00 to wash a car. If they wash 28 cars a day for 4 days, how much money will they make? Show your work.
Set A5 ★ Independent Worksheet 6

Multiplying Multiples of 10 & More

1 Write the answers.

\[
\begin{array}{cccccccc}
20 & 30 & 40 & 50 & 60 & 70 & 80 \\
\times 20 & \times 30 & \times 40 & \times 50 & \times 60 & \times 70 & \times 80 \\
\end{array}
\]

\[
\begin{array}{cccccccc}
20 & 30 & 60 & 20 & 40 & 70 & 90 \\
\times 40 & \times 50 & \times 50 & \times 60 & \times 90 & \times 80 & \times 80 \\
\end{array}
\]

2 Multiply each number in the top row by the number at the left. The first one is done for you as an example.

\[
\begin{array}{cccccccccccc}
\times & 2 & 4 & 8 & 3 & 6 & 12 & 5 & 10 & 7 & 9 \\
20 & 40 & & & & & & & & & \\
\end{array}
\]

\[
\begin{array}{cccccccccccc}
\times & 2 & 4 & 8 & 3 & 6 & 12 & 5 & 10 & 7 & 9 \\
4 & & & & & & & & & & \\
\end{array}
\]

\[
\begin{array}{cccccccccccc}
\times & 2 & 4 & 8 & 3 & 6 & 12 & 5 & 10 & 7 & 9 \\
24 & & & & & & & & & & \\
\end{array}
\]

3 Katy says you can use the answers in the first 2 rows of Problem 2 to help figure out the answers in the third row. Do you agree with her? Why or why not?
### Using 4 Partial Products to Multiply 2-Digit Numbers

1. Multiply to get four partial products and add them up.

#### Example

\[
\begin{array}{c}
29 \\ \times 25 \\
\hline
20 \times 20 = 400 \\
20 \times 9 = 180 \\
5 \times 20 = 100 \\
5 \times 9 = +45 \\
\hline
725
\end{array}
\]

<table>
<thead>
<tr>
<th>Example</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 (\times) 25</td>
<td>37 (\times) 24</td>
<td>26 (\times) 32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 (\times) 36</td>
<td>24 (\times) 18</td>
<td>76 (\times) 15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>f</th>
<th>g</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 (\times) 28</td>
<td>53 (\times) 39</td>
<td>34 (\times) 73</td>
</tr>
</tbody>
</table>
More Multiplication Menus

1a Fill in the blanks on the left side of the page. Then use the information to fill in the blanks on the right side of the page.

\[
\begin{align*}
1 \times 23 &= \underline{} & 3 \times 23 &= \underline{} \\
2 \times 23 &= \underline{} & 5 \times 23 &= \underline{} \\
10 \times 23 &= \underline{} & 30 \times 23 &= \underline{} \\
20 \times 23 &= \underline{} & 15 \times 23 &= \underline{} \\
\end{align*}
\]

b Find the product shown below. Explain how you got your answer.

\[
25 \times 23 = \underline{} 
\]

2a Fill in the blanks on the left side of the page. Then use the information to fill in the blanks on the right side of the page.

\[
\begin{align*}
1 \times 35 &= \underline{} & 3 \times 35 &= \underline{} \\
2 \times 35 &= \underline{} & 5 \times 35 &= \underline{} \\
10 \times 35 &= \underline{} & 30 \times 35 &= \underline{} \\
20 \times 35 &= \underline{} & 15 \times 35 &= \underline{} \\
\end{align*}
\]

b Find the product shown below. Explain how you got your answer.

\[
36 \times 35 = \underline{} 
\]
3a Fill in the blanks on the left side of the page. Then use the information to fill in the blanks on the right side of the page.

1 × 45 = ________
2 × 45 = ________
10 × 45 = ________
20 × 45 = ________

3 × 45 = ________
5 × 45 = ________
30 × 45 = ________
15 × 45 = ________

b Find the product shown below. Explain how you got your answer.

19 × 45 = ________

4a Make up your own multiplication menu. You can choose any 2, 3, or 4-digit number that doesn't end in a zero to be your multiplier.

1 × ________ = ________
2 × ________ = ________
10 × ________ = ________
20 × ________ = ________

3 × ________ = ________
5 × ________ = ________
30 × ________ = ________
15 × ________ = ________

b Now make up one more combination using your multiplier that can be solved using the information on your menu. Find the answer and explain how you got the answer.

________ × ________ = ________
Pine Cones & School Supplies

The scouts made bags of pine cones to sell at the crafts fair. They made 24 bags. Each bag had 36 pine cones in it. How many pine cones did they use in all?

To solve this problem, multiply $24 \times 36$.

<table>
<thead>
<tr>
<th>One way to do this is to multiply to find 4 partial products and then add them up.</th>
<th>Another way is to use the standard algorithm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$36$</td>
<td>$1 \times$</td>
</tr>
<tr>
<td>$\times 24$</td>
<td>$36$</td>
</tr>
<tr>
<td>$20 \times 30 = 600$</td>
<td>$\times 24$</td>
</tr>
<tr>
<td>$20 \times 6 = 120$</td>
<td>$144$</td>
</tr>
<tr>
<td>$4 \times 30 = 120$</td>
<td>$+ 720$</td>
</tr>
<tr>
<td>$4 \times 6 = + 24$</td>
<td>$864$ pine cones</td>
</tr>
<tr>
<td>$\text{864}$ pine cones</td>
<td></td>
</tr>
</tbody>
</table>

Some people call the standard algorithm a short-cut because you don't have to write as much.

1. Use the standard algorithm to solve the problems below. Show your work.

Example

$$
\begin{array}{ccccccc}
\times & 28 & 32 & 45 & 53 & 18 \\
\times & 23 & 27 & 23 & 26 & 19 \\
\hline
84 & 560 & 644 & \text{Continued on back.}
\end{array}
$$

(Continued on back.)
2 Use the standard algorithm to solve the multiplication problems below. Show your work.

a Mr. Wu got 35 boxes of crayons for his fourth graders. Every box had 24 crayons in it. How many crayons in all?

b Ms. Penny got 18 packs of felt markers for her fifth graders. Each pack had 36 markers in it. How many markers in all?

C The office got 15 cartons of envelopes. Each carton had 12 boxes of envelopes in it. Each box had 54 envelopes in it. How many envelopes did they get in all?