Name: __________________

**Multiplying 2-Digit Numbers**

Find the product. Use models to help you.

1) \[ \begin{array}{c}
2 \ 2 \\
\times \ 4 \\
\hline
\end{array} \]

2) \[ \begin{array}{c}
3 \ 4 \\
\times \ 2 \\
\hline
\end{array} \]

3) \[ \begin{array}{c}
2 \ 8 \\
\times \ 3 \\
\hline
\end{array} \]

4) \[ \begin{array}{c}
1 \ 6 \\
\times \ 5 \\
\hline
\end{array} \]

5) \[ \begin{array}{c}
3 \ 7 \\
\times \ 2 \\
\hline
\end{array} \]

6) \[ \begin{array}{c}
4 \ 4 \\
\times \ 2 \\
\hline
\end{array} \]

7) \[ \begin{array}{c}
2 \ 1 \\
\times \ 4 \\
\hline
\end{array} \]

8) \[ \begin{array}{c}
1 \ 2 \\
\times \ 8 \\
\hline
\end{array} \]

9) \[ 16 \times 4 \]

10) \[ 24 \times 3 \]

11) \[ 39 \times 2 \]

12) Mrs. Sagato gave her son $2 each day in February for helping around the house. If February has 28 days, how much money did her son earn that month?

13) My sister bought 7 new shirts at the store. Each shirt cost $13 dollars. How much did my sister have to pay for all her shirts?
Objective 6: Multiply 1- and 2-digit numbers by powers and multiples of ten. Use sampling to estimate large quantities.

Vocabulary
estimate
multiple
sample
sampling
shortcut

Materials
overhead base ten blocks

Transparencies:
  Multiplying by Ten
  Estimating Large Amounts
  Mental Math Shortcuts

Student Copies:
  Multiplying by Ten Cards (Set A and B)
  Practice With Tens
  How Many Do You Think?
  Multiply by 10 or 100 or 1,000
  Let's Multiply With Zeros
  Fun Factors

Language Foundation
1. Explain to students that when stores want customers to buy a certain product or food, they will sometimes give out or serve a small portion or sample of the product. This sample is a small example of what the product tastes like when cooked. Sampling is a way of trying out a certain product before buying it. If you like the sample, you might buy the product.

2. Explain that a shortcut is a way of doing something that will make it faster or easier. For example, put a small map on the board showing a shortcut from Sara's house to school (see sample below). In this lesson, students will be using shortcuts to do mental math.
Mathematics Component

1. Place the Multiplying by Ten transparency on the overhead.
   - Point to 1 x 10 and say, "I can use a base ten rod to represent a 1 x 10 array." Place an overhead tens rod in the workspace provided on the transparency.
   - Have students give the product and record it beside the problem. (10)
   - Repeat this procedure for 2 x 10, 3 x 10, 4 x 10, and 5 x 10, using the workspace to build an array for each multiplication sentence and then recording the product beside the problem.
     \[
     \begin{align*}
     2 \times 10 &= 20 & & \begin{array}{cccccccc}
     & & & & & & & & \\
     & & & & & & & & \\
     \end{array} \\
     3 \times 10 &= 30 & & \begin{array}{cccccccc}
     & & & & & & & & \\
     & & & & & & & & \\
     \end{array} \\
     4 \times 10 &= 40 & & \begin{array}{cccccccc}
     & & & & & & & & \\
     & & & & & & & & \\
     \end{array} \\
     5 \times 10 &= 50 & & \begin{array}{cccccccc}
     & & & & & & & & \\
     & & & & & & & & \\
     \end{array}
     \end{align*}
   \]
   - Ask students to talk with a partner about any patterns they see.
   - Point to the last multiplication sentence on the transparency (15 x 10) and ask students to discuss the product with their partner. When students have had time to talk, allow several groups to share their thinking. (Pattern: To get the product, a zero is added to each number being multiplied by ten. For example, when 15 is multiplied by 10 the product is 150. HINT: 10 has one zero, so add one zero to the other number!)
   - Record 150 beside 15 x 10.
   - Ask students to verbalize the pattern of multiplying by 10 as you write on the transparency.
   - Write the following problems on the board. Have students discuss the answers with their partners and then come up to write their responses on the board.
     \[
     \begin{align*}
     1) \ 9 \times 10 &= & 2) \ 26 \times 10 &= & 3) \ 11 \times 10 &= & 4) \ 39 \times 10 &= & 5) \ 60 \times 10 &= \\
     \end{align*}
     \]
   - Make a copy of Multiplying by Ten Cards (Set A white) and Set B (colored) for each pair of students. Cut the cards apart on the dotted lines and give each pair of students one stack of each set.
     - Tell students that there are two types of cards - multiplication sentences and answer cards. (Be sure the cards are separated into these two groups.)
     - Have students mix up one of the two piles of cards without looking at them and place them face down on the desk in arrays. Repeat this procedure with the second pile of cards placing them face down on another desk.
     - Explain that students will take turns turning over two cards - one from each desk.
     - If the multiplication sentence matches the answer, the student keeps the two cards and chooses two new cards. If they do not match, the cards are returned to the piles and it is the other student's turn.
• When all cards have been picked up, the winner is the student with the greatest
number of matching pairs.
• The activity sheet Practice With Tens may be completed in class or for homework.

2. Place the transparency Estimating Large Amounts on the overhead.
• Review the verb estimate. Estimate means to find an answer that is close but not exact.
• Ask students if they can estimate the number of dots on the transparency. Be sure
to point out that just making a wild guess is not estimating. They need to explain why they think
their answer is close.
• Allow several students to give an answer and explain their thinking.
• Write the word sample on the board. Ask students if they have gone to a store that was giving
out a sample of something. Lead students to understand that a sample is a small amount of
something taken from a larger amount. For example, a sample of ice cream might be a spoonful
from a large container.
• Write the word sampling on the transparency. Tell students that sampling is one way of
estimating large amounts.
• Explain that sampling is counting a small amount (sample) and using that to make an estimate of
the larger amount.
• Tell students that you can use any number for sampling.
• Count ten dots out loud and draw a circle around them. Say, “I will use 10 as my sample.”
• Ask students how you can use the circle with ten dots to estimate the total number of dots on the
transparency. Lead students to understand that you can estimate how many circles it would take
to group all of the dots into 10s.
• Demonstrate drawing circles around approximately every 10 dots. (Do not count the dots.)
• Count the total number of circles and say, “I have ( ) circles with about 10 in each circle. About
how many dots altogether?” Lead students to see that a multiplication sentence can be written to
find the answer. For example, if there are 7 circles it would be 7 x 10 = 70.
• After you have determined a good estimate for the number of dots on the page, erase the circles
and count the exact number. Compare the estimate to the exact number to show that it is close.
• Ask students why they think you chose 10 to do your sampling? (Because it is easy to multiply by
10.)
• Have students suggest other numbers which might be easy to use when sampling. Lead them to
understand that the total number of items will affect which number they use for sampling. For
example, counting by 5s is easy but might take a long time if there are many items.
• The activity page How Many Do You Think? is provided for additional practice with sampling.

3. Write 24 x10 on the board and ask students to give the answer and explain why it is easy to find the
product mentally. (The answer is 240 because one 0 is added to 24 when multiplying by 10.)
• Tell students that now you will look to see if there is a pattern when multiplying by 100.
• Begin by writing $1 \times 100$ on the board and asking students what the product is and why.
  (The product is 100. Lead students to remember that any number multiplied by 1 is the number itself.)
• Record the product beside the problem and make the following list beneath the first problem.
  
  \[ \begin{align*}
  1 \times 100 &= 100 \\
  2 \times 100 &= \\
  3 \times 100 &= \\
  4 \times 100 &= \\
  5 \times 100 &= 
  \end{align*} \]
• Ask students for suggestions on how we might find the answers (products) for these
  multiplication sentences. Lead students to understand that building arrays would be difficult
  because of the size of the numbers. Repeated addition might be an easier model to use.
• Point to $2 \times 100$ and say, “We have 2 equal groups of 100.” On the board, write:
  \[ \begin{array}{c}
  100 \\
  +100 \\
  \hline
  200
  \end{array} \]
• Ask a student to come up and record the sum. Say, “100 plus 100 equals 200 so 2 equal groups
  of 100 equals 200.” Record the product beside $2 \times 100$.
• Repeat this procedure for $3 \times 100$, $4 \times 100$, and $5 \times 100$. Add another problem to the list as shown
  below.
  
  \[ \begin{align*}
  1 \times 100 &= 100 \\
  2 \times 100 &= 200 \\
  3 \times 100 &= 300 \\
  4 \times 100 &= 400 \\
  5 \times 100 &= 500 \\
  \downarrow \\
  18 \times 100 &= ?
  \end{align*} \]
• Have students talk with a partner and see if they can find any pattern that would help them find the
  product of the new multiplication sentence. Allow students to share their thinking and then write
  the new product and the pattern on the board.
  
  \[ \begin{align*}
  1 \times 100 &= 100 \\
  2 \times 100 &= 200 \\
  3 \times 100 &= 300 \\
  4 \times 100 &= 400 \\
  5 \times 100 &= 500 \\
  \downarrow \\
  18 \times 100 &= 1,800
  \end{align*} \]

  \textbf{Pattern:} Add two 0s to a number
  being multiplied by 100 to get the
  product.

  \textbf{HINT:} 100 has two zeros, so add two
  0s to the other number!
• Write 306 x 100 and have students discuss the product and their reasoning. (30,600)
• Write 13 x 1,000 = ? on the board and ask students if they can give the product. (13,000) Lead students to understand that the pattern for adding ending 0s continues for larger powers of ten.
• Ask students to each make up a multiplication sentence multiplying any number by 10, 100, or 1,000 and write it on a piece of paper. Have them switch papers and tell their partners the product of their problem. (Papers may be rotated around the room for additional practice.)
• The activity page Multiply by 10, 100, 1,000 will provide further practice.

4. Lead a discussion with students about shortcuts. Explain that shortcuts make us faster at certain things. For example, you may want to start by telling students that when you were a child, you left your shoes tied all the time so that you could just slip your feet into them quickly in the morning. Leaving your shoes tied was a shortcut.
• Tell students that there are also shortcuts that we can learn to make math faster! Some of these shortcuts help us find answers in our head so that we don’t have to write the problem on paper. Explain that math we do in our head without writing is called mental math.
• Place the transparency Mental Math Shortcuts on the overhead.
• Go over the two examples at the top of the page, explaining each of the steps involved in this multiplication shortcut.
• Have different students come up and write answers for the problems at the bottom of the page, explaining how they got their answers.
• The activity sheets Let’s Multiply With Zeros, and Fun Factors may be assigned for additional practice.

Note: Encourage students to use mental math strategies throughout the year. One way to accomplish this is by placing a few warm-up problems on the board each day. Warm-ups help students get focused and can be tailored to review concepts students have learned throughout the year. Making sure some of the warm-ups are mental math with no writing will give students practice and strengthen their mental math skills.
Multiplying by Ten

\[
\begin{align*}
1 \times 10 &= \\
2 \times 10 &= \\
3 \times 10 &= \\
4 \times 10 &= \\
5 \times 10 &= \\
15 \times 10 &=
\end{align*}
\]

Pattern: 

10
## Multiplying by Ten Cards

<table>
<thead>
<tr>
<th>8 x 10</th>
<th>25 x 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 x 10</td>
<td>43 x 10</td>
</tr>
<tr>
<td>55 x 10</td>
<td>62 x 10</td>
</tr>
<tr>
<td>71 x 10</td>
<td>80 x 10</td>
</tr>
<tr>
<td>99 x 10</td>
<td>13 x 10</td>
</tr>
</tbody>
</table>
Name:________________________

Practice With Tens!

Write a multiplication sentence and solve:

1) ________________  2) ________________

10 x 1 = 10

3) ________________  4) ________________

________________________

When multiplying by 10, add 0 to the number. 10 = 1 zero

Find the product:

1) \[ \begin{array}{c}
10 \\
\times 4
\end{array} \]  2) \[ \begin{array}{c}
10 \\
\times 7
\end{array} \]  3) \[ \begin{array}{c}
31 \\
\times 10
\end{array} \]  4) \[ \begin{array}{c}
137 \\
\times 10
\end{array} \]

5) \[ 11 \times 10 = \]  6) \[ 5 \times 10 = \]  7) \[ 234 \times 10 = \]

8) \[ 87 \times 10 = \]  9) \[ 49 \times 10 = \]  10) \[ 176 \times 10 = \]
Estimating Large Amounts
How Many Do You Think?

Use sampling to estimate how many are in each group. Count to find the exact number.

Estimate:______  Exact:______  Estimate:______  Exact:______

Estimate:______  Exact:______  Estimate:______  Exact:______

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Name:__________

Multiply by 10 or 100 or 1,000

Example: \[ 5 \times 10 = 50 \]
\[ 5 \times 100 = 500 \]
\[ 5 \times 1,000 = 5,000 \]

\[ 8 \times 10 = \quad \quad 23 \times 10 = \quad \quad \]
\[ 8 \times 100 = \quad \quad 23 \times 100 = \quad \quad \]
\[ 8 \times 1,000 = \quad \quad 23 \times 1,000 = \quad \quad \]

1) \[ 7 \times 10 = \quad \quad \]
6) \[ 19 \times 10 = \quad \quad \]

2) \[ 9 \times 100 = \quad \quad \]
7) \[ 100 \times 64 = \quad \quad \]

3) \[ 15 \times 1,000 = \quad \quad \]
8) \[ 3 \times 1,000 = \quad \quad \]

4) \[ 10 \times 33 = \quad \quad \]
9) \[ 10 \times 77 = \quad \quad \]

5) \[ 100 \times 11 = \quad \quad \]
10) \[ 1,000 \times 20 = \quad \quad \]

Find the products and compare. Write >, <, or =

1) \[ 40 \times 10 \quad \quad 100 \times 3 \]
2) \[ 100 \times 17 \quad \quad 1,000 \times 2 \]
3) \[ 20 \times 100 \quad \quad 100 \times 20 \]

4) \[ 1,000 \times 10 \quad \quad 100 \times 100 \]
5) \[ 780 \times 10 \quad \quad 100 \times 68 \]
6) \[ 10 \times 79 \quad \quad 100 \times 83 \]

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Operations Mutl. and Div. Obj. 6 p.12
Mental Math Shortcuts

40 \times 200

Here is how to multiply this quickly in your head.

\begin{itemize}
  \item Cut off the ending zeros.
  \item Multiply the other numbers.
  \item Count all the zeros and put them on your answer.
\end{itemize}

Let's try another one!

\begin{itemize}
  \item 500 \times 70 = 35,000
\end{itemize}

Now, you try to do these in your head.

1) \hspace{0.5cm} 30 \times 20 = \hspace{0.5cm} 4) \hspace{0.5cm} 70 \times 80 = \hspace{0.5cm}
2) \hspace{0.5cm} 400 \times 80 = \hspace{0.5cm} 5) \hspace{0.5cm} 2,000 \times 300 = \hspace{0.5cm}
3) \hspace{0.5cm} 500 \times 500 = \hspace{0.5cm} 6) \hspace{0.5cm} 90 \times 50 = \hspace{0.5cm}
Let’s Multiply With Zeros!

1) \(30 \times 30 = \) 6) \(90 \times 10 = \)
2) \(40 \times 20 = \) 7) \(700 \times 50 = \)
3) \(600 \times 800 = \) 8) \(20 \times 400 = \)
4) \(40 \times 4000 = \) 9) \(3,000 \times 70 = \)
5) \(500 \times 1,000 = \) 10) \(80 \times 60 = \)

11) \[
\begin{array}{c}
600 \\
\times \ 50
\end{array}
\]
12) \[
\begin{array}{c}
2,000 \\
\times \ 30
\end{array}
\]
13) \[
\begin{array}{c}
20 \\
\times \ 90
\end{array}
\]

14) \[
\begin{array}{c}
3,000 \\
\times \ 200
\end{array}
\]
15) \[
\begin{array}{c}
800 \\
\times \ 40
\end{array}
\]
16) \[
\begin{array}{c}
100 \\
\times \ 500
\end{array}
\]

There are 50 taco shells in a box. How many taco shells are there in 40 boxes?  
If each student has 10 toes, how many toes are there on 220 students?

[Image of taco shells]
Fun Factors

Use the numbers in the box to find pairs of factors for the product. (You can use the factors more than once.)

2 3 4 5 6 7 8 9
20 30 40 50 60 80 90
200 300 400 500
600 800 900

30 4 120

2,400

1,500

Now, make one of your own for your partner to solve!
**Objective 7:** Estimate, model, and multiply 2-digit numbers by 2-digit numbers.

**Vocabulary**
- horizontal
- vertical
- estimate
- digit
- about
- distributive
- product
- factor
- array
- actual
- round
- compare

**Language Foundation**

1. This lesson contains a lot of vocabulary which the students have previously studied. It might be helpful to review the words with them either before or during the lesson.

2. Tell students actual means real. Actual answer means the real answer or the correct answer.

3. Remind students that a round number is a number that ends in zero. Rounding means changing numbers to the nearest number that ends in zero. i.e. 345 would be rounded to 300. 57 would be rounded to 60.

4. Students may not remember how to write a word problem. Teacher may need to model this before asking students to do the Write-a-Problem activity sheet.

**Materials**
- base ten blocks
- index cards

**Student Copies:**
- Estimating Products Practice
- Break Them Up Multiplication
- Two-Digit Multiplication Practice
- More Two-Digit Multiplication Practice
- Practicing Multiplication Skills
- Find the Missing Digit
- Write-a-Problem
Mathematics Component

1. Estimate products.
   - Review multiplying with zeros. If necessary, use transparency Mental Math Shortcuts (Mult. and Div. Obj. 5).
   - Ask students to mentally solve a few problems. Write problems on the board. (30 x 70, 40 x 60, 80 x 50, 60 x 90, etc.) Ask students to give answers and write their responses on the board.
   - Write 23 x 13 on the board in horizontal format. Tell students mental math shortcuts will be used to estimate the product of these two numbers.
   - Ask students to round 23 to the nearest ten. (20) Write 20 on the board.  
     \[
     23 \quad \rightarrow \quad 20
     \]
   - Ask students to round 13 to the nearest ten. (10) Write 10 on the board.  
     \[
     13 \quad \rightarrow \quad 10
     \]
   - Ask students what 20 x 10 equals. (200) Write 200 on the board.  
     \[
     20 \times 10 = 200
     \]
   - Tell students the estimated product of 23 and 13 is 200.
   - Ask students if the estimated answer is more or less than the actual answer. (Less)
   - Ask students to explain why. (Both factors are rounded down so the estimated answer is less than the actual answer.)

   - Write 26 x 87 on the board in vertical format. Ask students to estimate the product.
   - Ask students to round 26 to the nearest ten. (30) Write 30 on the board.  
     \[
     26 \quad \rightarrow \quad 30
     \]
   - Ask students to round 87 to the nearest ten. (90) Write 90 on the board.  
     \[
     87 \quad \rightarrow \quad 90
     \]
   - Ask students what 30 x 90 equals. (2,700)
   - Tell students the estimated product of 26 and 87 is 2,700.
   - Ask students if the estimated answer is more or less than the actual answer. (More)
   - Ask students to explain why. (Both factors are rounded up so the estimated answer is more than the actual answer.)

   - Write 48 x 39 on the board in vertical format. Ask students to estimate the product.
   - Ask students to explain first step. (Round 48 to 50) Write 50 on the board.  
     \[
     48 \quad \rightarrow \quad 50
     \]
   - Ask students to explain next step. (Round 39 to 40) Write 40 on the board.  
     \[
     39 \quad \rightarrow \quad 40
     \]
   - Ask students to explain final step. (Multiply 50 x 40 to find estimated product of 2,000.)  
     \[
     50 \times 40 = 2,000
     \]
   - Ask students if the estimated answer is more or less than the actual answer. (More)
   - Ask students to explain why. (Both factors are rounded up so the estimated answer is more than the actual answer.)

Note: Some students might question how to determine if an estimated answer is more or less than an actual answer if one factor is rounded up and one factor is rounded down. Tell them it depends on the amount each factor was rounded either up or down. For example, in the problem 34 x 18, 34 rounds down to 30 and 18 rounds up to 20. 30 is 4 less than 34; 20 is 2 more than 18 so the amount rounded down is more than the amount rounded up. Therefore, the estimated product...
is less than the actual answer. It is not important for students to master the more/less relationship between the estimated answer and actual answer, but they do need to explore the concept.

- Do a few more examples on the board with the students. Make sure you use both vertical and horizontal formats. Have students verbalize as they complete each step. Remind students that the product is the estimated answer for the original multiplication problem. (23 x 13 is about 200; 34 x 87 is about 2,700, 48 x 39 is about 2,000)
- Distribute Estimating Products Practice. Go over the example with students. Have them complete the activity page.

2. Use base ten blocks to model multiplication of 2-digit numbers by 2-digit numbers.

- Put students into small groups (2 - 3 students per group)
- Distribute a bag of base ten blocks (27 tens and 69 ones) to each group of students.
- Tell students arrays will be used to solve multiplication problems involving 2-digit numbers.
- On an overhead transparency, write $23 \times 13$

- Ask students how to build an array to represent the problem. (An array with 23 rows of 13 in each row.)
- As the teacher builds the array on the overhead, students build the array at their desks.

- Ask students how the array might help them solve the problem. (Possible answers include counting all the units to find the product; trading smaller units to make larger units.)
- Since counting the units would take too much time, tell students the product will be determined by dividing the large array into smaller arrays and then finding the sum of all the areas of the smaller arrays.
Tell students the distributive property of multiplication will help determine the size of the smaller arrays.

Ask students to state the distributive property of multiplication (Mult and Div. Obj. 4). The distributive property says numbers can be broken apart to make them easier to multiply. For example, $6 \times 4$ can rewritten as $6 \times 2 + 6 \times 2$.

Ask students how to use the distributive property to rewrite the multiplication problem $23 \times 13$. Guide them to say $23 \times 10$ (tens blocks) and $23 \times 3$ (ones blocks). Write on the board. Make sure they understand and can verbalize why problem is $23 \times 10$ and not $23 \times 1$. (The digit 1 is in the tens place, making its value 1 ten or 10.)

Tell students the distributive property will be used again to break the new multiplication problems ($23 \times 10$ and $23 \times 3$) into problems that are easier to solve.

Ask students to rewrite $23 \times 10$ using the distributive property. Write on board $10 \times 20$ and $10 \times 3$.

Ask students to rewrite $23 \times 3$ using the distributive property. Write on board $20 \times 3$ and $3 \times 3$.

Ask students how many multiplication problems they have now. (4)

Instruct students to divide the large array into 4 smaller arrays that match the 4 multiplication problems. Allow students to work with their groups.

After students finish, have one student rearrange the overhead blocks to make the four smaller arrays. Write the multiplication problem next to the corresponding array.
- Have students use mental math to find the products of the 4 multiplication problems. Write the products on the board.

<table>
<thead>
<tr>
<th>10</th>
<th>10</th>
<th>20</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>x 20</td>
<td>x 3</td>
<td>x 3</td>
<td>x 3</td>
</tr>
<tr>
<td>200</td>
<td>30</td>
<td>60</td>
<td>9</td>
</tr>
</tbody>
</table>

- Ask students how to find the product of the original problem, 23 x 13. (Add together the areas/products of the 4 small arrays.)
- On the board, write 200 Find the sum (299) and write it on the board. 200

30 30
60 60

+ 9 + 9
299

- Review the steps in solving a 2-digit by 2-digit multiplication problem using the base ten blocks.
  a. Build an array.
  b. Use the distributive property to rewrite the problem into 2 new problems.
  c. Use the distributive property to rewrite the 2 new problems into 2 problems each.
     Now there are 4 problems.
  d. Divide the array into 4 smaller arrays representing the 4 new problems.
  e. Find the area of each new array.
  f. Add together the areas of the 4 small arrays to find the area of the original large array.
- Do another example together. On the board, write 24

x 12

- Make the array on the overhead as students make the array at their desks.
- Work together to use the distributive property to break the problem into 4 new problems.
(10 x 20; 10 x 4; 20 x 2; 4 x 2)
- Work together to break the array into the 4 smaller arrays, find the areas of the smaller arrays and add the areas together to find the total area, which is the product of the original problem. (24 x 12)
- Distribute Break Them Up Multiplication. Go over the example. Have students work in groups to complete activity sheet.

3. Multiply 2-digit numbers by 2-digit numbers without regrouping.
   - On the board, write
     \[
     \begin{array}{c}
     62 \\
     \times 43 \\
     \end{array}
     \]
   - Ask students how they could find the product. (Possible answers include building an array and counting the units, dividing the array into 4 smaller arrays and finding the sum of the areas of the arrays, using a calculator, etc.)
   - Ask students to evaluate the possible solutions. Is there always a calculator available? Are there enough base ten materials to make the array? Is there a quicker way to find the product than making an array and breaking it into four smaller arrays? How can the problem be solved with no tools other than paper and pencil?
   - Tell students the first step in solving the problem with just paper and pencil is to estimate the product. Ask them why estimating the product first is important. (To know if answer is reasonable.)
   - Ask a student volunteer to do the estimation on the board.
     \[
     \begin{array}{c}
     62 \rightarrow 60 \\
     \times 43 \rightarrow 40 \\
     \end{array}
     \]
     \[
     2,400
     \]
   - Tell students that since the estimated product is 2,400, then the actual product of 62 and 43 will be about 2,400.
   - Ask students if the estimated product is more or less than actual product. (Estimated product is less than actual product because both factors were rounded down.)
   - Ask students to verbalize how the product can be found using the arrays. Remind students that the original multiplication problem/array was broken down into 4 easier-to-solve problems/smaller arrays.
   - Ask students to break down the problem into the 4 easier-to-solve problems. Write the 4 problems on the board. (See diagram below.)
   - Solve the problems with students. Write the answers on the board.
   - Ask students how to find product of 62 and 43. (Add 2,400, 80, 180 and 6) Have students complete the addition. (2,666)
Refer students back to original estimation. Is 2,666 about 2,400? (Yes) Is 2,666 a reasonable answer? (Yes)

Leave the above problem on board so students can use it for comparison after the computational method is demonstrated.

Draw this pattern of arrows on the board.
Make sure to place numbers under arrows.

Tell students that this pattern can be used to make sure the four areas, or small arrays, are computed and added together to find the product.

On the board, again write the problem 62
\[ \times 43 \]

Ask students if they can see a pattern involving the original problem and the four easier-to-solve problems. To assist in the connection, use a large index card to cover up the 6 and 4 so only the 2 and 3 show. Ask students what problem is showing. (2 \( \times \) 3) Ask them the product of 2 \( \times \) 3 and place product (6) in ones place.

Use two index cards to cover the 2 and the 4 so only the 6 and the 3 show. Ask students which problem is showing. (6 \( \times \) 3) Ask them the product of 6 \( \times \) 3 and place the product (18) in the answer with the 8 in the tens place.

Use 2 index cards to cover the 6 and the 3 so only the 2 and the 4 show. Ask students which problem is showing. (4 \( \times \) 2) Ask them the product of 4 \( \times \) 2 and place the product (8) in the tens place under the 8. Tell students the product must be placed in the tens place since the 4 is in the tens place. The value of the 4 is 40; 40 \( \times \) 2 = 80. Tell students that since there isn't any number
under the 6, put a 0 there.

- Use an index card to cover the 2 and the 3 so only the 6 and the 4 show. Ask students which problem is showing. (4 x 6) Ask them the product of 6 x 4 and place the product (24) in the answer with the 4 directly under the 1.

- Tell students that the two partial products (186 and 2480) must be added together to find the product of 62 x 43.

- Compare the array method of finding the product and the computational problem. Make sure students see the product is the same.

- Do a few more examples (33 x 13; 82 x 21; 51 x 36) on the board. Have the students estimate first. You may have to use the index cards to assist some students in following the pattern. Emphasize the placement of the 0 in the second partial product.

- Distribute Two-Digit Multiplication Practice. Go over the example. Have students complete the activity sheet independently. If students are having difficulty with the pattern, have them use the tips of their fingers to cover up the numbers so they are only seeing 2 numbers at a time.

4. Multiply 2-digit numbers by 2-digit numbers with regrouping.

- On the board, write 46

  \[
  \begin{array}{c}
  \times 28 \\
  \end{array}
  \]

- Have students estimate the product. 46 \rightarrow 50

  \[
  \begin{array}{c}
  \times 28 \\
  \end{array}
  \]

  \[
  \begin{array}{c}
  \rightarrow 30 \\
  \end{array}
  \]

  \[
  \begin{array}{c}
  \rightarrow 1,500 \\
  \end{array}
  \]

- Ask students to explain the first step in solving this problem. (Multiply 6 x 8) Ask them the product of 6 x 8. (48) Ask students where we should place the 48. Allow time for students to make suggestions.

- Tell students that 48 is 8 ones and 4 tens. The 8 should be placed in the ones column and the 4 tens need to be regrouped and placed over the tens column in the original problem.
• Ask students the next step. (Multiply 8 x 5) Ask students the product of 8 x 5. (40) Tell students the 4 that was placed above the 5 must be added to the product of 8 x 5 before the answer is recorded. Say it as you write on the board: 8 x 5 = 40 + 4 = 44.

\[
\begin{array}{c}
4 \\
56 \\
\times 26 \\
\_448
\end{array}
\]
• Tell students we are done with the 4 so we need to mark it off as it has been used. Cross out the 4 that was regrouped so it will not confuse the students.

\[
\begin{array}{c}
4 \\
56 \\
\times 26 \\
\_448
\end{array}
\]
• Ask students the next step. (Multiply 6 x 2) Ask students the product of 6 x 2. (12) Remind students that you are really multiplying by 20 since the 2 is in the tens place so the answer must be in the tens place. The 2 should be in the tens column and the 1 should be placed over the crossed-out 4. Remind them to place a 0 under the 8.

\[
\begin{array}{c}
1 \\
\_4 \\
56 \\
\times 28 \\
\_448 \\
\_20
\end{array}
\]
• Ask students the next step. (Multiply 2 x 5) Ask students the product of 2 x 5. (10) Tell students that the 1 that was placed above the 5 must be added to the product before the answer is recorded. Say it as you write on the board: 2 x 5 = 10 + 1 = 11.

\[
\begin{array}{c}
1 \\
\_4 \\
56 \\
\times 28 \\
\_448 \\
\_20
\end{array}
\]
• Ask students the next step. (Add the 2 partial products together to get the answer.) Complete the problem on the board. Remind students to compare the answer to the estimate to check for reasonableness.
56
x 26
---
4 48
+ 1120
---
1,578

- Do a few more examples (43 x 27; 32 x 19; 85 x 46) on the board. Have students estimate first and compare the estimate to the final answer to check for reasonableness. Make sure students cross out the first number that is placed over the tens column so they will not get it confused with the second number. Continue to check for the placement of the 0 in the second partial product.
- Distribute More Two-Digit Multiplication Practice. Go over the example. Have students complete the activity sheet independently.
- Practicing Multiplication Skills, Find the Missing Digit and Write-a-Problem are included for further practice.
ESTIMATING PRODUCTS PRACTICE

Round each factor to the nearest ten. Then estimate the product.

Example:  \[46 \rightarrow 50\]
\[\times 31 \rightarrow 30\]
\[= 1,500\]

1. 74 \[\rightarrow \] 2. 68 \[\rightarrow \] 3. 12 \[\rightarrow \]
\[\times 52 \rightarrow \] \[\times 29 \rightarrow \] \[\times 35 \rightarrow \]

4. 46 \[\rightarrow \] 5. 89 \[\rightarrow \] 6. 83 \[\rightarrow \]
\[\times 8 \rightarrow \] \[\times 58 \rightarrow \] \[\times 41 \rightarrow \]

7. 76 \[\rightarrow \] 8. 57 \[\rightarrow \] 9. 64 \[\rightarrow \]
\[\times 23 \rightarrow \] \[\times 44 \rightarrow \] \[\times 61 \rightarrow \]

10. There are about 27 students in each class at Kennedy Middle School. There are 49 classroom teachers. Estimate the number of students in the school.
Break Them Up Multiplication

1. Use the arrays to solve the multiplication problem.
2. Rewrite the multiplication problem using the distributive property.
3. Use lines to divide the array into four smaller arrays.
4. Find the area of each smaller array.
5. Add the smaller arrays to find the area of the original array.

**EXAMPLE:**

\[
\begin{array}{c}
\text{26} \\
\times 13
\end{array}
\]

\[
\begin{array}{c}
\text{26} \\
\times 10
\end{array}
\]

\[
\begin{array}{c}
\text{10} \\
\times 20
\end{array}
\]

\[
\text{10} \left(200 + 60\right)
\]

\[
\begin{array}{c}
\text{26} \\
\times 3
\end{array}
\]

\[
\begin{array}{c}
\text{20} \\
\times 6
\end{array}
\]

\[
\text{6} \left(60 + 18\right)
\]

\[
\text{26} \times 13 = 338
\]
Two-Digit Multiplication Practice

Estimate, then solve.

Example:

\[
\frac{41}{\text{☆}} \rightarrow \frac{40}{\text{☆}}
\]

\[
\times \frac{71}{\text{☆}} \rightarrow \times \frac{70}{\text{☆}}
\]

\[
\frac{41}{\text{☆}}
\]

\[
+ \frac{2870}{\text{☆}}
\]

\[
\frac{2,911}{\text{☆}}
\]

1. \[
\frac{71}{\text{☆}} \rightarrow \frac{70}{\text{☆}}
\]

\[
\times \frac{71}{\text{☆}} \rightarrow \times \frac{70}{\text{☆}}
\]

\[
\frac{71}{\text{☆}}
\]

\[
+ \frac{2870}{\text{☆}}
\]

\[
\frac{2,911}{\text{☆}}
\]

2. \[
\frac{42}{\text{☆}} \rightarrow \frac{40}{\text{☆}}
\]

\[
\times \frac{43}{\text{☆}} \rightarrow \times \frac{40}{\text{☆}}
\]

\[
\frac{42}{\text{☆}}
\]

\[
+ \frac{2870}{\text{☆}}
\]

\[
\frac{2,911}{\text{☆}}
\]

3. \[
\frac{36}{\text{☆}} \rightarrow \frac{30}{\text{☆}}
\]

\[
\times \frac{21}{\text{☆}} \rightarrow \times \frac{30}{\text{☆}}
\]

\[
\frac{36}{\text{☆}}
\]

\[
\frac{30}{\text{☆}}
\]

\[
+ \frac{2870}{\text{☆}}
\]

\[
\frac{2,911}{\text{☆}}
\]

4. \[
\frac{94}{\text{☆}} \rightarrow \frac{90}{\text{☆}}
\]

\[
\times \frac{22}{\text{☆}} \rightarrow \times \frac{90}{\text{☆}}
\]

\[
\frac{94}{\text{☆}}
\]

\[
\frac{90}{\text{☆}}
\]

\[
+ \frac{2870}{\text{☆}}
\]

\[
\frac{2,911}{\text{☆}}
\]

5. \[
\frac{81}{\text{☆}} \rightarrow \frac{80}{\text{☆}}
\]

\[
\times \frac{72}{\text{☆}} \rightarrow \times \frac{80}{\text{☆}}
\]

\[
\frac{81}{\text{☆}}
\]

\[
\frac{80}{\text{☆}}
\]

\[
+ \frac{2870}{\text{☆}}
\]

\[
\frac{2,911}{\text{☆}}
\]

6. \[
\frac{53}{\text{☆}} \rightarrow \frac{50}{\text{☆}}
\]

\[
\times \frac{33}{\text{☆}} \rightarrow \times \frac{50}{\text{☆}}
\]

\[
\frac{53}{\text{☆}}
\]

\[
\frac{50}{\text{☆}}
\]

\[
+ \frac{2870}{\text{☆}}
\]

\[
\frac{2,911}{\text{☆}}
\]
More Two-Digit Multiplication Practice

Estimate, then solve.

1. \[ \begin{array}{c}
4 \\
4 \\
\downarrow \\
38 \rightarrow 40 \\
\downarrow \\
x 62 \rightarrow x 60 \\
\downarrow \\
76 \rightarrow 2,400 \\
\downarrow \\
+ 2280 \\
\downarrow \\
2,356 \\
\end{array} \]

2. \[ \begin{array}{c}
62 \rightarrow 372 \\
\downarrow \\
x 46 \rightarrow \\
\downarrow \\
+ 2480 \\
\downarrow \\
2,852 \\
\end{array} \]

3. \[ \begin{array}{c}
66 \rightarrow \\
\downarrow \\
x 37 \rightarrow \\
\downarrow \\
+ \\
\downarrow \\
\end{array} \]

4. \[ \begin{array}{c}
87 \rightarrow \\
\downarrow \\
x 43 \rightarrow \\
\downarrow \\
+ \\
\downarrow \\
\end{array} \]

5. \[ \begin{array}{c}
49 \rightarrow \\
\downarrow \\
x 24 \rightarrow \\
\downarrow \\
+ \\
\downarrow \\
\end{array} \]

6. \[ \begin{array}{c}
73 \rightarrow \\
\downarrow \\
x 65 \rightarrow \\
\downarrow \\
+ \\
\downarrow \\
\end{array} \]
9. If there are 12 rosebushes in each row of a garden, how many rosebushes are in 25 rows?

10. Mrs. Rams has 28 students in her reading class. If each student reads 15 books a year, how many total books does the class read?

11. Rosa's father is going on a trip. The gas tank in his car holds 19 gallons. The car can travel 22 miles on one gallon of gas. Estimate how far Rosa's father can travel using one tank of gas.
Practicing Multiplication Skills

Estimate, then solve.

1) $\frac{51}{24}$
2) $\frac{44}{22}$
3) $\frac{81}{34}$

4) $\frac{57}{23}$
5) $\frac{67}{38}$
6) $\frac{49}{34}$

7) $46 \times 61$
8) $75 \times 25$
9) $94 \times 45$

10) There are 29 students in Roberto’s class. Each student puts 14 pieces of paper in a box on the table. How many pieces of paper are in the box?
11) Each school can have about 68 students in the summer program. There are 17 schools. About how many students can be in the summer program?

12) David’s soccer team is selling candy bars. If each of the 14 boys on the team sells 28 candy bars, how many candy bars will the team sell?

14) The movie theater has 35 rows of seats. Each row has 16 seats. What is the total number of seats in the movie theater?

Estimate the products. Then compare the products. Use < or >.

Example:  
<table>
<thead>
<tr>
<th>93 x 42</th>
<th>&lt;</th>
<th>64 x 78</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ ▼</td>
<td></td>
<td>▼ ▼ ▼</td>
</tr>
<tr>
<td>90 x 40</td>
<td>▲</td>
<td>60 x 80</td>
</tr>
<tr>
<td>3600</td>
<td>&lt;</td>
<td>4800</td>
</tr>
</tbody>
</table>

15) 37 x 81 □ 52 x 41  

16) 45 x 66 □ 78 x 39

17) 44 x 93 □ 58 x 84  

18) 74 x 34 □ 63 x 28
Find the Missing Digit

Fill in the missing digit to complete each problem.

1) \[
\begin{array}{c}
\square 0 \\
x 3\square \\
\hline
1,800
\end{array}
\]

2) \[
\begin{array}{c}
6 \square \\
x 70 \\
\hline \square, \square 0 \square
\end{array}
\]

3) \[
\begin{array}{c}
\square \square \\
x 8\square \\
\hline 7,200
\end{array}
\]

4) \[
\begin{array}{c}
33 \square \\
x 2\square \\
\hline 66
\end{array}
\]

\[
\begin{array}{c}
+ 6 \square \square \\
\hline 726
\end{array}
\]

5) \[
\begin{array}{c}
\square 7 \\
x 42 \\
\hline 74
\end{array}
\]

\[
\begin{array}{c}
+ \square 28\square \\
\hline 13\square\square
\end{array}
\]

6) \[
\begin{array}{c}
24 \square \\
x 5\square \\
\hline 144
\end{array}
\]

\[
\begin{array}{c}
+ 1\square 0\square \\
\hline 13\square\square
\end{array}
\]

7) \[
\begin{array}{c}
62 \square \\
x \square 9 \\
\hline \square 58
\end{array}
\]

\[
\begin{array}{c}
+ \square 0\square \square \\
\hline \square, 6\square\square
\end{array}
\]

8) \[
\begin{array}{c}
\square \square \\
x 71 \\
\hline 84
\end{array}
\]

\[
\begin{array}{c}
+ \square 8\square\square \\
\hline 5,\square 6\square
\end{array}
\]

9) \[
\begin{array}{c}
\square 8 \\
x 45 \\
\hline \square 9\square
\end{array}
\]

\[
\begin{array}{c}
+ 31\square\square \\
\hline 3,\square 10
\end{array}
\]
Write-a-Problem

1. Write a multiplication word problem that uses estimation. Use two-digit numbers. Label and circle your answer.

2. Using the numbers 55 and 22, make up a multiplication word problem. Label and circle your answer.
### Answer Key
**Mult. and Div. - Obj. 7**

#### Estimating Products Practice

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 70</td>
<td>2) 70</td>
<td>3) 10</td>
</tr>
<tr>
<td>x 50</td>
<td>x 30</td>
<td>x 40</td>
</tr>
<tr>
<td>3,500</td>
<td>2,100</td>
<td>400</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4) 50</td>
<td>5) 90</td>
<td>6) 80</td>
</tr>
<tr>
<td>x 10</td>
<td>x 60</td>
<td>x 40</td>
</tr>
<tr>
<td>500</td>
<td>5,400</td>
<td>3,200</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7) 80</td>
<td>8) 60</td>
<td>9) 60</td>
</tr>
<tr>
<td>x 20</td>
<td>x 40</td>
<td>x 60</td>
</tr>
<tr>
<td>1,600</td>
<td>2,400</td>
<td>3,600</td>
</tr>
</tbody>
</table>

10) $30 \times 50 = 1,500$ students

#### Break Them Up Multiplication

1) [Diagram of a grid divided into sections, with numbers and arrows indicating multiplication operations.]

#### Break Them Up Multiplication

19
\[\times 18\]

19
\[\times 10\]

19
\[\times 8\]

10
\[\times 10\]

10
\[\times 9\]

10
\[\times 8\]

9
\[\times 8\]

100
\[+\]

90
\[+\]

80
\[+\]

72 = 342

---

**DRAFT FAST Math Vol. 1 OEIAS - ESL, 2000**  
**Operations**  
**Mult. and Div.**  
**Obj. 7**  
p.21
Two-Digit Multiplication Practice

1) \[ \begin{align*} 71 & \rightarrow 70 \\ \times 71 & \rightarrow 70 \\ 71 & \quad 4,900 \\ \hline & \quad 4970 \\ & \quad 5,041 \end{align*} \]

2) \[ \begin{align*} 42 & \rightarrow 40 \\ \times 43 & \rightarrow 40 \\ & \quad 126 \quad 1,600 \\ \hline & \quad 1680 \\ & \quad 1,806 \end{align*} \]

3) \[ \begin{align*} 36 & \rightarrow 40 \\ \times 21 & \rightarrow 20 \\ 36 & \quad 800 \\ \hline & \quad 720 \\ & \quad 756 \end{align*} \]

4) \[ \begin{align*} 94 & \rightarrow 90 \\ \times 22 & \rightarrow 20 \\ & \quad 188 \quad 1,800 \\ \hline & \quad 1880 \\ & \quad 2,068 \end{align*} \]

5) \[ \begin{align*} 8 & \rightarrow 80 \\ \times 72 & \rightarrow 70 \\ 162 & \quad 5,600 \\ \hline & \quad 5670 \\ & \quad 5,832 \end{align*} \]

6) \[ \begin{align*} 53 & \rightarrow 50 \\ \times 33 & \rightarrow 30 \\ & \quad 159 \quad 1,500 \\ \hline & \quad 1590 \\ & \quad 1,749 \end{align*} \]

More Two-Digit Multiplication Practice

1) \[ \begin{align*} 24 & \rightarrow 20 \\ \times 56 & \rightarrow x60 \\ 144 & \quad 1,200 \\ \hline & \quad 1200 \\ & \quad 1,344 \end{align*} \]

2) \[ \begin{align*} 47 & \rightarrow 50 \\ \times 34 & \rightarrow 30 \\ & \quad 188 \quad 1,500 \\ \hline & \quad 1410 \\ & \quad 1,598 \end{align*} \]

3) \[ \begin{align*} 66 & \rightarrow 70 \\ \times 37 & \rightarrow 40 \\ 462 & \quad 2,800 \\ \hline & \quad 1980 \\ & \quad 2,442 \end{align*} \]

4) \[ \begin{align*} 87 & \rightarrow 90 \\ \times 43 & \rightarrow 40 \\ & \quad 261 \quad 3,600 \\ \hline & \quad 3480 \\ & \quad 3,741 \end{align*} \]
5) 49 \[\times\] 24 = 1,176
6) 73 \[\times\] 65 = 4,745

7) 76 \[\times\] 48 = 3,648
8) 25 \[\times\] 69 = 1,725

9) 300 rosebushes
10) 420 books
11) 20 \times 20 = 400 miles

**Practicing Multiplication Skills**

<table>
<thead>
<tr>
<th>Answer</th>
<th>Estimate</th>
<th>Answer</th>
<th>Estimate</th>
<th>Answer</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 1,224</td>
<td>1,000</td>
<td>2) 958</td>
<td>800</td>
<td>3) 2,754</td>
<td>2,400</td>
</tr>
<tr>
<td>4) 1,311</td>
<td>1,200</td>
<td>5) 2,564</td>
<td>2,800</td>
<td>6) 1,666</td>
<td>1,500</td>
</tr>
<tr>
<td>7) 2,806</td>
<td>3,000</td>
<td>8) 1,875</td>
<td>2,400</td>
<td>9) 4,230</td>
<td>4,500</td>
</tr>
</tbody>
</table>

10) 406 pieces of paper
11) 70 \times 70 = 1,400 students
12) 392 candy bars
13) 560 seats
14) 40 \times 80 \geq 50 \times 40
15) 40 \times 90 < 60 \times 80
16) 50 \times 70 \geq 80 \times 40
17) 3,200 \geq 2,000
18) 70 \times 30 \geq 60 \times 30
19) 3,500 \geq 3,200
20) 3,600 \leq 4,800
21) 2,100 \geq 1,800

**Find the Missing Digit**

1) 6[6] 0 \[\times\] 3[0] = 1,800
2) 6[6] 0 \[\times\] 7[0] = 42,000
3) 9[9] 0 \[\times\] 8[0] = 7,200

DRAFT FAST Math Vol. 1 OElAS - ESL, 2000
4) \[3 \times 2 = 6, \quad 3 + 6 = 9\]
5) \[3 \times 4 = 12, \quad 7 + 14 = 21\]
6) \[2 \times 5 = 10, \quad 1 + 12 = 13\]

7) \[6 \times 5 = 30, \quad 5 + 31 = 36\]
8) \[8 \times 7 = 56, \quad 8 + 58 = 66\]
9) \[7 \times 4 = 28, \quad 3 + 31 = 34\]
Objective 8: Estimate and multiply 3-digit numbers by 2-digit numbers.

Vocabulary
horizontal
vertical
round
estimate
column

Materials
graph paper (optional)

Transparencies:
Multiplication/Columns - Problem 1
Multiplication/Columns - Problem 2

Student Copies:
Estimation Practice
Stay in Line
Name That Product
Multiplication Puzzle

Language Foundation

1. Review vocabulary previously learned in Obj.7.

2. Remind students that column is a word that has several meanings in English. It usually refers to an object with a vertical orientation.

- A column is a part of a building.

- A graph has columns.

- An array has columns.

When multiplying 3-digit numbers by 2-digit numbers, it is important to keep the numbers in the problem lined up in columns to avoid errors when adding up partial products.
Mathematics Component

Note: Students should have extensive practice multiplying 2-digit numbers by 2-digit numbers before moving on to 3-digit numbers. If the easier skill is mastered, then extending the skill with larger numbers should be less difficult for the students.

1. Estimate products.
   - Review multiplying with zeros.
   - Ask students to mentally solve a few problems. Write problems on the board. (50 x 70, 80 x 70, 300 x 20, 600 x 40, 900 x 20, etc.) Make sure some problems have 3-digit numbers in them. Ask students to give answers and write responses on the board.
   - Write 342 x 44 on the board in horizontal format. Tell students mental math shortcuts will be used to estimate the product of these two numbers.
   - Ask students to round 342 to the nearest hundred. (300) Write 300 on the board.
   - Ask students to round 44 to the nearest ten. (40) Write 40 on the board.
   - Ask students what 300 x 40 equals. (12,000) Write 12,000 on the board.
   - Tell students the estimated product of 342 and 44 is 12,000.  
     \[
     \begin{array}{c}
     342 \times 44 \\
     \downarrow \quad \downarrow \\
     300 \times 40 = 12,000
     \end{array}
     \]
   - Ask students if the estimated answer will be more or less than the actual answer. (Less)
   - Ask students to explain why. (Both factors were rounded down so the estimated answer will be less than the actual answer.)

   - Write 673 x 49 on the board in vertical format. Ask students to estimate the product.
   - Ask students to round 673 to the nearest hundred. (700) Write 700 on the board.
   - Ask students to round 49 to the nearest ten. (50) Write 50 on the board.
   - Ask students what 700 x 50 equals. (35,000) Write 35,000 on the board.
   - Tell students the estimated product of 700 and 50 is 35,000.
     \[
     \begin{array}{c}
     673 \rightarrow 700 \\
     \times 49 \rightarrow \times 50 \\
     35,000
     \end{array}
     \]
   - Ask students if the estimated product is more or less than the actual product. (More)
   - Ask students to explain why. (Both factors were rounded up so the estimated answer will be more than the actual answer.)

   - Write 432 x 18 on the board in horizontal format. Ask students to estimate the product.
   - Ask students to explain the first step. (Round 432 to 400) Write 400 on the board.
   - Ask students to explain the next step. (Round 18 to 20) Write 20 on the board.
   - Ask students to explain the final step. (Multiply 400 x 20 to find the estimated product of 8,000)
   Write 8,000 on the board.
     \[
     \begin{array}{c}
     432 \times 18 \\
     \downarrow \quad \downarrow \\
     400 \times 20 = 8,000
     \end{array}
     \]
• Ask students if the estimated product is more or less than the actual answer. (Less) This question might be difficult for students since one factor is rounded down and one factor is rounded up. Remind them to look at the amount each factor was rounded either up or down. (400 is 32 less than 432; 20 is only 2 more than 18 so the amount rounded down is more than amount rounded up. Therefore, the estimated sum is less than the actual answer.)

• Do a few more examples with the students. (658 x 46; 834 x 67; 324 x 51; etc.) Make sure you use both vertical and horizontal formats. Have students verbalize as they complete each step.

• Distribute Estimation Practice. Go over the example with the students. Have them complete the activity page.

2. Multiply 3-digit numbers by 2-digit numbers.

• Display the overhead transparency, Multiplication/Columns - Problem 1

• Ask students what should be the first step in solving this problem. (Estimate the product.)

• Ask students why estimating the product first is important. (To know if answer is reasonable.)

• Ask a student volunteer to do the estimation on the transparency.

\[
\begin{array}{c}
3 \ 2 \ 1 \\
\times \\
4 \ 2 \\
\hline
3 \ 0 \ 0 \\
4 \ 0 \\
\hline
12,000
\end{array}
\]

• Tell students that since the estimated product is 12,000, then the actual product will be about 12,000.

• Ask students if the estimated product is less or more than the actual product. (Estimated product is less than the actual product since both factors are rounded down.)

• Tell students that multiplying a 3-digit number by a 2-digit number is the same as multiplying a 2-digit number by a 2-digit number, only one step is added since there is one additional digit in the first factor. To help keep the columns straight, thin lines are placed between each place value column. Tell students that keeping the columns straight is the key to solving the problem correctly.

• Ask students what the first step is. (Multiply 2 x 1; the product is 2. Place the 2 in the ones column.) Write 2 on the transparency.

\[
\begin{array}{c}
3 \ 2 \ 1 \\
\times \\
4 \ 2 \\
\hline
2 \\
\end{array}
\]

• Ask the students the next step. (Multiply 2 x 2; the product is 4. Place the 4 in the tens column.) Write 4 on the transparency.

\[
\begin{array}{c}
3 \ 2 \ 1 \\
\times \\
4 \ 2 \\
\hline
4 \ 2 \\
\end{array}
\]

• Ask students the next step. (Multiply 2 x 3; the product is 6. Place the 6 in the hundreds column.)
Write 6 on the transparency.

\[
\begin{array}{c}
321 \\
\times 42 \\
\hline
642 \\
\end{array}
\]

• Ask students the next step. (Multiply 4 x 1; the product is 4. Place the 4 in the tens column. Put a 0 in the ones column.) Write 4 and 0 on the transparency.

\[
\begin{array}{c}
321 \\
\times 42 \\
\hline
642 \\
40 \\
\end{array}
\]

• Ask students the next step. (Multiply 4 x 2; the product is 8. Place the 8 in the hundreds place.) Write 8 on the transparency.

\[
\begin{array}{c}
321 \\
\times 42 \\
\hline
642 \\
840 \\
\end{array}
\]

• Ask students the next step. (Multiply 4 x 3; the product is 12. Place the 2 in the hundreds place and the 1 in the thousands place.) Write 12 on the transparency.

\[
\begin{array}{c}
321 \\
\times 42 \\
\hline
642 \\
12840 \\
\end{array}
\]

• Ask students the next step. (Add 642 and 12,840 to find the final product. Product is 13,482) Write 13,482 on the transparency.

\[
\begin{array}{c}
321 \\
\times 42 \\
\hline
642 \\
12840 \\
\hline
3482 \\
\end{array}
\]

• Ask students to compare estimated answer (12,000) to actual answer (13,482). Is it reasonable? (Yes) Some students may think that since there is almost a 1,500 difference between the estimated answer and the exact answer that the answer isn’t reasonable. Remind them that the 3-digit number is rounded to the nearest hundred which makes for an estimation that is not as close. Tell them that the larger the number, the less accurate the estimation is going to be when the number is rounded to the largest place in that number.

• Display the transparency, Multiplication/Columns - Problem 2
• Ask students the first step. (Estimate)
• Have a student volunteer do the estimation on the transparency.
Tell students that since the estimated product is 30,000, then the actual product will be about 30,000.

Ask students if the estimated product is less or more than the actual product. (Estimated product is more than the actual product since both factors are rounded up.)

Ask students why the lines are placed between the columns. (Helps keep the columns straight and the place value correct.)

Ask students the first step in solving the problem. (Multiply 6 x 3; the product is 18. Place the 8 in the ones column and regroup the 1 over the tens column.) Say as you write on the transparency: 6 x 3 = 18. Put the 8 in the ones column and regroup the 1 by placing it over the tens column.

Ask students what the next step is. (Multiply 6 x 7; the product is 42. Add the 1 to the product; now you have 43. Place the 3 in the tens column and regroup the 4 over the hundreds column.) It is important to cross out the 1 after it has been added to the product. Students may forget this important step. Failure to cross out the already regrouped number will lead to confusion when another number is regrouped in the next step. Say as you write on the transparency: 6 x 7 = 42 + 1 = 43. Cross out the 1. Put the 3 in the tens column and regroup the 4 by placing it over hundreds column.

Ask students what the next step is. (Multiply 6 x 4; the product is 24. Add the 4 to the product; now you have 28. Cross out the 4. Place the 8 in the hundreds column and the 2 in the thousands column.) Say as you write on the transparency: 6 x 4 = 24 + 4 = 28. Cross out the 4. Put 28 in the answer, with the 8 in the hundreds column and the 2 in the thousands column.
• Ask students the next step.  (Multiply 5 x 3; the product is 15.  Place the 5 in the tens column and regroup the 1 over the tens column.  Put a 0 in the ones column.)  Say as you write on the transparency: 5 x 3 = 15.  Put the 5 in the tens column and regroup the 1 by placing it over the tens column.  Put a 0 in the ones column.

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<td>x</td>
<td>5</td>
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<td>2</td>
<td>8</td>
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• Ask students the next step.  (Multiply 5 x 7; the product is 35.  Add the 1 that was regrouped; now the total is 36.  Cross out the 1.  Place the 6 in the hundreds column and regroup the 3 by placing it over the hundreds column.)  Say as you write on the transparency: 5 x 7 = 35 + 1 = 36.  Cross out the 1.  Put the 6 in the hundreds column and regroup the 3 by placing it over the hundreds column.

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<td>8</td>
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• Ask students the next step.  (Multiply 5 x 4; the product is 20.  Add the 3 that was regrouped; now the total is 23.  Cross out the 3.  Place the 3 in the thousands place and the 2 in the ten thousands place.)  Say as you write on the transparency: 5 x 4 = 20 + 3 = 23.  Cross out the 3.  Put the 23 in the answer, with the 3 in the thousands place and the 2 in the ten thousands place.

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<td>x</td>
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<td>2</td>
<td>8</td>
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<tr>
<td>2</td>
<td>3</td>
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</tbody>
</table>

• Ask students the next step.  (Add 2,838 and 23,650 to get the final answer.)  Work the addition problem out loud as you write on the transparency the final answer of 26,488.
Ask students to compare estimated answer (30,000) to actual answer (26,488). Is the estimate reasonable? (Yes) Why? (Estimated answer should be more than actual answer since both factors were rounded up before estimate was made.)

Do a few more examples (693 x 26; 844 x 52; 738 x 46) with the students. The product should be estimated first and the estimation compared to the final product to check for reasonableness. Make sure the numbers stay aligned in the proper columns. You may need to draw lines to separate the different place values or do some of the examples on the overhead using graph paper to keep the numbers lined up.

Distribute Stay in Line. Go over the example with students. Have students complete the activity sheet.

Monitor students' work for these common errors:
  a. numbers not lined up
  b. no placement of 0 in the ones place of the second partial product
  c. not adding the regrouped numbers
  d. not crossing off the regrouped numbers after using them

Distribute Name That Product. Go over the first problem with students. Have students complete the activity page. If students are having difficulty keeping the columns straight, have them work the problems on graph paper.

Multiplication Puzzle is included for further practice. Again, if students are having difficulty keeping the columns straight, have them work the problems on graph paper.
Estimation Practice

Use mental math to choose the best estimate. (Circle a, b, or c.)

1. 839 x 46
   a. 4,000  b. 40,000  c. 45,000

2. 452 x 67
   a. 35,000  b. 24,000  c. 28,000

3. 134 x 52
   a. 10,000  b. 500  c. 5,000

4. 773 x 26
   a. 16,000  b. 24,000  c. 32,000

5. 249 x 38
   a. 1,200  b. 600  c. 8,000

Estimate to compare. Use < or >.

6. 376 x 44  ○ 18,000
7. 564 x 31  ○ 15,000

8. 138 x 26  ○ 4,000
9. 762 x 59  ○ 42,000

10. The school cafeteria has 142 boxes of cookies. Each box holds 24 cookies. About how many cookies does the cafeteria have?
Multiplication/Columns - Problem 1

\[
\begin{array}{ccc}
3 & 2 & 1 \\
4 & 2 & \\
\end{array}
\]
Multiplication/Columns - Problem 2

<p>| | | | | |</p>
<table>
<thead>
<tr>
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<td>4</td>
<td>7</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

x

---

---
Stay in Line

Estimate, then solve.

1) \[ \begin{array}{c}
3 & 8 & 1 \\
\times & 4 & 2
\end{array} \]

2) \[ \begin{array}{c}
6 & 4 & 5 \\
\times & 3 & 3
\end{array} \]

3) \[ \begin{array}{c}
4 & 8 & 6 \\
\times & 5 & 7
\end{array} \]

4) \[ \begin{array}{c}
7 & 3 & 4 \\
\times & 2 & 9
\end{array} \]
Name That Product

Estimate, then solve.

1) 416
   x 78

2) 635
   x 44

3) 270
   x 65

4) 914
   x 57

5) 479
   x 83

6) 827
   x 39
7) Mrs. Chavez is buying sections of fencing so she can fence her yard. Each section of fencing is 12 feet long. Mrs. Chavez buys 110 sections. How many feet of fencing does she buy?

8) There are 36 inches in a yard. How many inches are there in 245 yards?

9) An airplane travels 625 miles an hour. How many miles will the plane travel in 47 hours?

10) How many days old are you? Multiply your age (in years) by 365 (number of days in a year).
MULTIPLICATION PUZZLE

Solve each problem.
Put the answer in the puzzle.

Across →

2. 389 x 66
3. 147 x 92
5. 49 x 36
6. 98 x 55
7. 183 x 27
11. 326 x 44
12. 176 x 49

Down ↓

1. 631 x 63
2. 122 x 22
4. 652 x 85
5. 268 x 43
8. 687 x 72
9. 54 x 42
10. 859 x 63
Answer Key
Mult. and Div. - Obj. 8

Estimation Practice

1) 800 x 50 = 40,000 (c)
2) 500 x 70 = 35,000 (a)
3) 100 x 50 = 5,000 (c)
4) 800 x 30 = 24,000 (b)
5) 200 x 40 = 8,000 (c)
6) 400 x 40 < 18,000
    16,000 < 18,000
7) 600 x 30 > 15,000
    18,000 > 15,000
8) 100 x 30 < 4,000
    3,000 < 4,000
9) 800 x 60 > 42,000
    48,000 > 42,000
10) 100 x 20 = 2,000 cookies

Stay in Line

```
  3
 /\ 1
 381 400
  x 42 40
   762 16,000
  15240
 16,002

  645 600
   x 33 30
  19350
 18,000

  486 500
   x 57 60
  3402 30,000
 24300
 27,702

  734 700
   x 28 30
  6606 21,000
 14680
 21,286
```
**Name That Product**

<table>
<thead>
<tr>
<th>Answer</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 32,448</td>
<td>32,000</td>
</tr>
<tr>
<td>2) 27,940</td>
<td>24,000</td>
</tr>
<tr>
<td>3) 17,550</td>
<td>21,000</td>
</tr>
<tr>
<td>4) 52,098</td>
<td>54,000</td>
</tr>
<tr>
<td>5) 39,757</td>
<td>40,000</td>
</tr>
<tr>
<td>6) 32,253</td>
<td>32,000</td>
</tr>
<tr>
<td>7) 1,320 feet</td>
<td></td>
</tr>
<tr>
<td>8) 8,820 inches</td>
<td></td>
</tr>
<tr>
<td>9) 29,375 miles</td>
<td></td>
</tr>
<tr>
<td>10) answers will vary</td>
<td></td>
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</table>

**Multiplication Puzzle**

**Across**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>2) 25674</td>
<td></td>
</tr>
<tr>
<td>3) 13524</td>
<td></td>
</tr>
<tr>
<td>5) 1764</td>
<td></td>
</tr>
<tr>
<td>6) 5390</td>
<td></td>
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<tr>
<td>7) 4941</td>
<td></td>
</tr>
<tr>
<td>11) 14344</td>
<td></td>
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<tr>
<td>12) 8624</td>
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**Down**

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<tbody>
<tr>
<td>1) 39753</td>
<td></td>
</tr>
<tr>
<td>2) 2684</td>
<td></td>
</tr>
<tr>
<td>4) 55420</td>
<td></td>
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<tr>
<td>5) 11524</td>
<td></td>
</tr>
<tr>
<td>8) 49464</td>
<td></td>
</tr>
<tr>
<td>9) 2268</td>
<td></td>
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<tr>
<td>10) 54117</td>
<td></td>
</tr>
</tbody>
</table>
Objective 9: Multiply whole numbers with 3 digits in each factor.

Vocabulary

round trip

Language Foundation

1. Students should be familiar with all the vocabulary in this lesson.

Materials

graph paper (optional)
index cards or small tiles

Transparencies:

Multiplying Large Numbers
Multiplication Madness

Student Copies:

Multiplication Madness
Solve That Problem
Mathematics Component

1. Multiply 3-digit numbers by 3-digit numbers.
   • Display the overhead transparency, Multiplying Large Numbers.
   • Tell students multiplication of a 3-digit number by a 3-digit number is an extension of multiplying a 3-digit number by a 2-digit number. The process is the same but an extra step is added.
   • Ask students the first step. (Estimation)
   • Ask students why estimation is important. (To check for reasonableness)
   • Ask students to round 268 to the nearest hundred. (300) Write 300 on the transparency.
   • Ask students to round 345 to the nearest hundred. (300) Write 300 on the transparency.
   • Ask students to estimate the product of 300 and 300. (90,000) Write 90,000 on the transparency.

\[
\begin{array}{c}
\phantom{0}2\phantom{6}6\phantom{8} \\
\times \phantom{0}3\phantom{4}\phantom{5}
\end{array}
\]

\[
\begin{array}{c}
\phantom{0}300 \\
\phantom{0}300 \\
\phantom{0}90,000
\end{array}
\]

• Tell students that the estimated product of 268 and 345 is 90,000. The estimate for a 3-digit number multiplied by a 3-digit number will not be extremely close to the actual answer since the rounding is to the largest place value (hundreds). However, the estimated answer is still important as it indicates the number of digits in the actual answer.

• Tell students that the actual product will have 5 digits in the answer. Tell students that since the actual product is a large number, it will be extremely important to keep the columns straight.

• Cover the 3 and the 4 in the second factor with a small piece of index card or a small tile.

• Ask students what the first step is. (Multiply 5 x 8; the product is 40. Place the 0 in the ones column and regroup the 4 by placing it over the tens column.) As you write on the transparency say, “5 x 8 = 40. Put the 0 in the ones column and regroup the 4 by placing it over the tens column.”

\[
\begin{array}{c}
\phantom{0}4 \\
\phantom{0}2\phantom{6}\phantom{8} \\
\times \phantom{0}5
\end{array}
\]

You are multiplying by 5 ones - the answer must start in the ones column.

• Ask students the next step. (Multiply 5 x 6; the product is 30. Add the 4 to the product; now the total is 34. Cross out the 4. Place the 4 in the tens column and regroup the 3 by placing it over the hundreds column.) Say as you write on the transparency, “5 x 6 = 30 + 4 = 34. Cross out the 4. Put the 4 in the tens column and regroup the 3 by placing it over the hundreds column.”

\[
\begin{array}{c}
\phantom{0}3\phantom{4} \\
\phantom{0}2\phantom{6}\phantom{8} \\
\times \phantom{0}5
\end{array}
\]

\[
\begin{array}{c}
\phantom{0}4 \\
\phantom{0}2\phantom{6}\phantom{8} \\
\phantom{0}0
\end{array}
\]
- Ask students the next step. (Multiply 5 x 2; the product is 10. Add the 3 that was regrouped; the total is 13. Cross out the 3. Place the 3 in the hundreds column and the 1 in the thousands column.) Say as you write on the transparency, "5 x 2 = 10 + 3 = 13. Cross out the 3. Put the 3 in the hundreds column and the 1 in the thousands column."

\[
\begin{array}{c}
4 \\
2 \\
6 \\
8 \\
\hline
1 \\
3 \\
4 \\
0 \\
\end{array}
\]

- Cover the 3 and 5 in the second factor with small pieces of index cards or small tiles.
- Ask students the next step. (Multiply 4 x 8; product is 32. Place the 2 in the tens column and regroup the 3 over the tens column.) Ask students what number goes in the ones column. (0) Say as you write on the transparency, "4 x 8 = 32. Put the 2 in the tens column and regroup the 3 over the tens column. Place a 0 in the ones column."

\[
\begin{array}{c}
3 \\
2 \\
6 \\
8 \\
\hline
1 \\
3 \\
4 \\
0 \\
\end{array}
\]

You are multiplying by 4 tens - the answer must start in the tens column

- Ask students the next step. (Multiply 4 x 6; the product is 24. Add the 3 that was regrouped; now the total is 27. Cross out the 3. Place the 7 in the hundreds column and regroup the 2 in the hundreds column.) Say as you write on the transparency, "4 x 6 = 24 + 3 = 27. Cross out the 3. Put the 7 in the hundreds column and regroup the 2 over the hundreds column."

\[
\begin{array}{c}
2 \\
2 \\
6 \\
8 \\
\hline
1 \\
3 \\
4 \\
0 \\
\end{array}
\]

- Ask students the next step. (Multiply 4 x 2; the product is 8. Add the 2 that was regrouped; now the total is 10. Cross out the 2. Place the 0 in the thousands column and the 1 in the ten thousands column.) Say as you write on the transparency, "4 x 5 = 20 + 2 = 22. Cross out the 2. Put the 0 in the thousands place and the 1 in the ten thousands place."
• Cover the 4 and the 5 in the second factor with small pieces of index cards or small tiles.
• Ask students what the next step is. (Multiply 3 x 8; the product is 24. Place the 4 in the hundreds column and regroup the 2 over the tens column. Put a 0 in both the ones column and the tens column.) Say as you write on the transparency, “3 x 8 = 24. Put the 4 in the hundreds column and regroup the 2 by placing it over the tens column. Put a 0 in both the ones column and the tens column.”

You are multiplying by 3 hundreds - the answer must start in the hundreds column.

• Ask students what the next step is. (Multiply 3 x 6; the product is 18. Add the 2 that was regrouped; now the total is 20. Cross out the 2. Place the 0 in the thousands column and regroup the 2 over the hundreds column.) Say as you write on the transparency, “3 x 6 = 18 + 2 = 20. Cross out the 2. Put the 0 in the thousands column and regroup the 2 by placing it over the hundreds column.”

• Ask students what the next step is. (Multiply 3 x 2; the product is 6. Add the 2 that was regrouped; the total is 8. Place the 8 in the ten thousands column.) Say as you write on the transparency, “3 x 2 = 6 + 2 = 8. Cross out the 2. Put the 8 in the ten thousands column.”
- Ask the students what the next step is. (Add together the three partial products.) Do the addition out loud as you write on the transparency the final answer of 92,460.

- Ask students to compare the estimated answer (90,000) to the actual answer (92,460). Is the estimate reasonable? (Yes) Why? (The estimated answer and actual answer both have 5 digits.) Remind students that estimated answers involving 3-digit numbers will not be as close to the actual answer as estimated answers involving 2-digit numbers since the rounding is to a greater place value. (Rounding to the hundreds place as opposed to rounding to the tens place)

- Do a few more examples (764 x 321; 492 x 564; 753 x 284) with the students. The product should be estimated first and the estimated answer compared to the final answer to check for reasonableness. Make sure the numbers stay aligned in the proper columns. You will need to draw lines to keep the columns straight or do the problems on the overhead using a graph paper transparency.

- Distribute Multiplication Madness. Use the transparency to complete the first problem with students. Have students finish the activity sheet.

- Solve That Problem is included for further practice. The problems on this activity sheet use a variety of multiplication skills (2-digit, 3-digit, estimation). Numbers are expressed in digits and in word names. There are some 2-step problems; #10 (marked with an asterisk) is more difficult and might require some language explanation (round trip). If students have difficulty keeping the columns straight while doing multiplication, have them work the problems on graph paper.
Multiplying Large Numbers

\[ \begin{array}{c|c|c|c} 
\hline
2 & 6 & 8 \\
\hline
\times & 3 & 4 & 5 \\
\hline
\end{array} \]
Multiplication Madness

Estimate, then solve.

1) \[ \begin{array}{c}
\boxed{4} \boxed{6} \boxed{3} \\
\times \boxed{2} \boxed{7} \boxed{6}
\end{array} \]

2) \[ \begin{array}{c}
\boxed{3} \boxed{7} \boxed{4} \\
\times \boxed{5} \boxed{8} \boxed{5}
\end{array} \]

3) \[ \begin{array}{c}
\boxed{2} \boxed{3} \boxed{7} \\
\times \boxed{2} \boxed{4} \boxed{6}
\end{array} \]

4) \[ \begin{array}{c}
\boxed{5} \boxed{7} \boxed{3} \\
\times \boxed{4} \boxed{3} \boxed{4}
\end{array} \]

Cross out the regrouped number after adding it to the product.
Solve That Problem!

1. The workers at the Pepsi plant can fill about 27 boxes of soda in one minute. Estimate the number of boxes they can fill in 90 minutes.

2. David has been collecting stamps for 13 years. Each year he collects 134 stamps. Find the total number of stamps David has.

3. The train from Washington to New York has 64 cars. Each car holds 178 people. How many people can the train hold?

4. There are 162 boxes of lollipops at the grocery store. Each box holds 144 lollipops. How many lollipops are there at the grocery store?

5. There are 264 apples in a large box. How many apples are in 65 boxes?
6. The school prints 125 copies of the school newspaper. Each paper has 54 sheets of paper. Will 6,000 sheets of paper be enough? If not, how many more sheets are needed?

7. Each bookcase in the library holds about 475 books. There are 89 bookcases in the library. About how many books does the library hold?

8. Mr. Tran is 48 years old. How many weeks old is Mr. Tran? (Hint: There are 52 weeks in one year.)

9. How many days are there in twenty-five years if there are 365 days in each year?

10. The distance from Washington to New York is 242 miles. The distance from New York to Washington is the same. (242 miles) The train makes a round trip from Washington to New York and back to Washington 18 times a week. Find the total miles the train travels in one week.
Answer Key
Mult. and Div. - Obj. 9

Multiplication Madness

1)  
\[
\begin{array}{cccc}
1 & 4 & 2 & 3 \\
3 & 1 & 2 & 7 \\
\hline
2 & 7 & 7 & 8 \\
3 & 2 & 4 & 1 \\
9 & 2 & 6 & 0 \ \\
1 & 2 & 7, 7, 7 \ \\
\end{array}
\]

4 x 6 = 500 
2 x 7 = 300 

2)  
\[
\begin{array}{cccc}
3 & 2 & 2 & 3 \\
5 & 3 & 3 & 2 \\
\hline
1 & 8 & 7 & 0 \\
2 & 9 & 9 & 2 \\
1 & 8 & 7 & 0 \ \\
2 & 1 & 8, 7, 9 \ \\
\end{array}
\]

3 x 8 = 400 

3)  
\[
\begin{array}{cccc}
1 & 1 & 3 & 2 \\
2 & 4 & 2 & 3 \ \\
\hline
1 & 4 & 2 & 2 \\
9 & 4 & 8 & 0 \\
4 & 7 & 4 & 0 \ \\
5 & 8, 3, 0 \ \\
\end{array}
\]

2 x 4 = 200 

2 x 4 = 200 

40,000

4)  
\[
\begin{array}{cccc}
2 & 1 & 2 \\
2 & 1 & 2 \\
\hline
2 & 2 & 9 & 2 \\
1 & 7 & 1 & 9 \ \\
2 & 2 & 9 & 0 \ \\
2 & 4 & 8, 6 \ \\
\end{array}
\]

4 x 3 = 600 

x 4 = 400 

240,000

Solve That Problem

1) 30 x 90 = 2700 boxes
2) 1,742 stamps
3) 11,392 people
4) 23,328 lollipops
5) 17,160 apples
6) No. 125 x 54 = 6,750. 6,750 - 6,000 = 750 more sheets
7) 500 x 90 = 45,000 books
8) 2,496 weeks
9) 9,125 days
10) 242 + 242 = 484. 484 x 18 = 8,712 miles
Objective 10: Write and evaluate numbers in exponential form.

Vocabulary

- exponent
- base
- exponential form
- factor
- squared
- cubed
- to the power of
- value

Language Foundation

1. Tell students that the word base has several meanings in English. Students might be familiar with first base, second base, base hit, etc. from the game of baseball. The base of an object is the bottom part or foundation of an object. The Statue of Liberty sits on a brick base. In this lesson, the term base refers to part of an exponential expression.

2. Show students the cube shape from a set of geometric solids. Ask them if they can name any objects with the shape of a cube. (ice cube, sugar cube, number cube) Explain to students that they will study about cubes in geometry, and that in this lesson they will learn the word cubed when they study exponents.

3. Explain to students the word value means how much something is worth. When shopping, an item on sale is a good value. The adjective valuable means something is worth a lot. Gold and diamonds are valuable.
Mathematics Component

1. Explore relationships between multiples of ten.
   - Place the transparency Multiplying by Ten on the overhead. Cover the chart on the bottom, leaving only the base ten blocks showing.
   - Distribute calculators to students. Tell students that calculators will be used later in the lesson.
   - Ask a student volunteer to point to the block on the transparency that shows 10 x 1. (ten block) Point to the corresponding sides of the block as you say, “10 x 1.”
   - Ask a student volunteer to point to the block that shows 10 x 10. (hundred block) Point to the corresponding sides of the flat as you say, “10 x 10.”
   - Ask a student volunteer to point to the block that shows 10 x 10 x 10. (thousand cube) Point to the corresponding sides of the cube as you say, “10 x 10 x 10.”
   - Point out to students that as you go from 10 to 100 to 1,000, each number is 10 times more than the previous number.
   - Uncover the chart at the bottom of the transparency. Tell students they may use their calculators.
   - Ask students the product of 10 x 1. (10) Write 10 on the chart.
   - Ask students the product of 10 x 10. (100) Write 100 on the chart.
   - Ask students the product of 10 x 10 x 10. (1,000) Write 1,000 on the chart.
   - Ask students the product of 10 x 10 x 10 x 10. (10,000) Write 10,000 on the chart.
   - Ask students the product of 10 x 10 x 10 x 10 x 10. (100,000) Write 100,000 on the chart.
   - Ask students the product of 10 x 10 x 10 x 10 x 10 x 10. (1,000,000) Write 1,000,000 on the chart.
   - Ask students if they can see a pattern in the products. (When multiplying 10 by 10, the product is a 1 followed by 2 zeros; when multiplying 10 by 10 by 10, the product is a 1 followed by 3 zeros; etc.) Tell students that when 10 is used repeatedly as the factor in a multiplication problem, the product is a 1 followed by zeros equal to the number of tens in the problem.

2. Define the terms exponent, base, and exponential form.
   - Tell students that a shorter way can be used to write problems in which all factors are the same. Tell them exponents are used.
   - Display Exponential Form transparency.
   - Tell students that 10 x 10 x 10 x 10 can be written as $10^4$. Tell students that this is read as 10 to the fourth power. Have students repeat “ten to the fourth power” several times. The 10 is called the base. The base is the factor or the number to be multiplied. Have students repeat the word base as you point to it on the transparency. The 4 is the exponent. The exponent tells how many times the base is used as a factor. Have the students repeat the word exponent as you point to it on the transparency. As you point to it on the transparency, say, “$10^4$ (10 to the fourth power) means 10 x 10 x 10 x 10.”
• Tell students that a number written with a **base** and an **exponent** is written in **exponential form**. Point to $10^4$ as you tell students that $10^4$ is an example of **exponential form**. Have the students repeat the words **exponential form** as you circle $10^4$ with your finger on the transparency.

3. Practice with powers of ten.

• Display **Ten Chart** transparency. Use a cover sheet so only the first line of the chart is visible to students.

• Tell students the calculators are **not** to be used during this part of the activity.

• Ask a student volunteer to read the first number. (100)

• Ask a student volunteer to read the multiplication or factor form. (10 x 10)

• Tell students that this number, 100, or $10 \times 10$, will be written using an **exponent**.

• Point out the 10 which is already on the chart. Ask students if anyone remembers what it is called. (base)

• Ask students what the **exponent** is or what number goes in the empty box. (2) Write the 2 on the chart. You might have to remind students that the exponent tells how many times the base is used as a factor.

• Uncover the next line on the chart. Tell students that only the multiplication (factor form) is given. The number and the exponent need to be found.

• Ask a student volunteer to read the multiplication. (10 x 10 x 10)

• Ask students how many times 10 is used as a factor. (3)

• Ask students how to write the exponential form. ($10^3$) You might have to prompt students by saying the exponential form is the base and the exponent. Write $10^3$ on the chart.

• Ask students what the number is. (1,000) Write 1,000 on the chart. Ask students to explain how they got 1,000. (If 10 is the base, the exponent names the number of zeros in the product. $10^3$ is a 1 followed by 3 zeros or 1,000.)

• Uncover the next line on the chart. Ask a student to read the multiplication. (10 x 10 x 10 x 10)

• Ask students how many times 10 is used as a factor. (4)

• Ask students how to write the exponential form. ($10^4$) Write $10^4$ on the chart.

• Ask students what the number is. (10,000) Write 10,000 on the chart. Ask students to explain how they got 10,000. (If 10 is the base, the exponent names the number of zeros in the product. $10^4$ is a 1 followed by 4 zeros or 10,000.)

• Uncover the next line on the chart. Ask a student to read the multiplication. (10 x 10 x 10 x 10 x 10)

• Ask students how many times 10 is used as a factor. (5)

• Ask students how to write the exponential form. ($10^5$) Write $10^5$ on the chart.
• Ask students what the number is. (100,000) Write 100,000 on the chart. Ask students to explain how they got 100,000. (If 10 is the base, the exponent names the number of zeros in the product. 10^5 is a 1 followed by 5 zeros.)

• Continue in the same manner until the chart is completed. See completed chart below.

<table>
<thead>
<tr>
<th>Number</th>
<th>Multiplication (Factor Form)</th>
<th>Exponential Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>10 x 10</td>
<td>10^2</td>
</tr>
<tr>
<td>1,000</td>
<td>10 X 10 X 10</td>
<td>10^3</td>
</tr>
<tr>
<td>10,000</td>
<td>10 X 10 X 10 X 10</td>
<td>10^4</td>
</tr>
<tr>
<td>100,000</td>
<td>10 X 10 X 10 X 10 X 10</td>
<td>10^5</td>
</tr>
<tr>
<td>1,000,000</td>
<td>10 x 10 x 10 x 10 x 10 x 10</td>
<td>10^6</td>
</tr>
<tr>
<td>10,000,000</td>
<td>10 x 10 x 10 x 10 x 10 x 10 x 10</td>
<td>10^7</td>
</tr>
<tr>
<td>100,000,000</td>
<td>10 x 10 x 10 x 10 x 10 x 10 x 10 x 10</td>
<td>10^8</td>
</tr>
</tbody>
</table>

• Ask students if the pattern could be extended - if we had 10 used as a factor 10 times, what would the exponential form be? (10^10)

• Ask students why we use exponential form. (Answers may vary but should include the observation that the exponential form is a much shorter and often less confusing way of writing large numbers)

• Review the vocabulary by pointing to each exponential form on the completed chart and having the students identify the base and the exponent. (10^2; the 10 is the base the 2 is the exponent, etc.) Have students read each exponential form out loud to practice the language. (10 to the second power, 10 to the third power, etc.)

• Distribute Take Ten activity sheet. Go over the directions with students and complete the first problem together. Have students finish independently. Calculators should not be used.

4. Extend the concept of exponents.

• Display the Exponential Form - Example Two transparency with only the title showing. Tell students that other numbers besides 10 can be written in exponential form.

• Tell students calculators can be used.

• Uncover the transparency so only 3^4 shows. Ask students how to read this. (3 to the fourth power.) Ask students what number is the base. (3) Ask students what number is the exponent.
• Ask students what \(3^4\) means. (3 is used as a factor 4 times or \(3 \times 3 \times 3 \times 3\)) Uncover the next line on the transparency, \(3 \times 3 \times 3 \times 3\), as you say, "\(3^4\) means \(3 \times 3 \times 3 \times 3\)."

• Ask students to use their calculators to find the product of \(3 \times 3 \times 3 \times 3\). (81) Uncover the 81 on the transparency.

• Uncover problem #2, \(4^5\). Ask students how to read this. (4 to the fifth power) Ask students what number is the exponent. (5) Ask students what number is the base. (4)

• Ask students what \(4^5\) means. (4 is used as a factor 5 times or \(4 \times 4 \times 4 \times 4 \times 4\)) Uncover the next line on the transparency as you say, "\(4^5\) means \(4 \times 4 \times 4 \times 4 \times 4\)."

• Ask students to use their calculators to find the product of \(4 \times 4 \times 4 \times 4 \times 4\). (1024) Uncover the 1024 on the transparency.

• Uncover problem #3, \(8^2\). Tell the students that when the exponent is 2, it is commonly read as squared instead of to the second power. Have the students repeat out loud, \(8^2\) squared. Ask students why they think the term squared is used. (Responses may vary. Let students speculate and tell them that the reason will be shown in the next step.)

• Ask students what \(8^2\) means. (8 used as a factor 2 times or \(8 \times 8\)) Uncover the 8 \(\times\) 8 on the transparency as you say, "\(8^2\) means \(8 \times 8\)."

• Ask students what kind of shape an 8 by 8 array makes. (a square) If students have difficulty recalling the word array or visualizing the 8 by 8 arrangement, make an 8 by 8 array using overhead counters or tiles. Remind them that if there are two factors that are the same, the array will have an equal number of rows and columns. The shape will be a square; thus the term squared describes the exponent 2. A squared number (any number with 2 as an exponent) is the product of the number times itself.

• Ask students to find the product of \(8 \times 8\). (64) Uncover the 64 on the transparency.

• Display page 2 of the transparency, Exponential Form - Example Two.

• Uncover problem # 4, \(7^2\). Ask a student to read the problem out loud. (7 to the second or 7 squared. Make sure you get both responses and the students understand that either way is correct.)

• Ask students what \(7^2\) means. (7 used as a factor 2 times or \(7 \times 7\)) Uncover the 7 \(\times\) 7 on the transparency as you say, "\(7^2\) means \(7 \times 7\)."

• Ask students to find the product of \(7 \times 7\). (49) Uncover the 49 on the transparency.

• Uncover problem # 5, \(6^3\). Tell students that when the exponent is 3, it is sometimes read as cubed instead of to the third power. Show students a cube (a thousands base ten cube or any cube you have in the classroom) Show that the cube has 3 dimensions (point to them) and say that cubed means 3.

• Ask students what \(6^3\) means. (6 used as a factor 3 times or \(6 \times 6 \times 6\)) Uncover the \(6 \times 6 \times 6\) on the
transparency as you say, "$6^3$ means $6 \times 6 \times 6$.”

- Ask students to use their calculators to find the product of $6 \times 6 \times 6$. (216) Uncover the 216 on the transparency.

- Uncover problem # 6, $5^3$. Ask a student to read the problem out loud. (5 to the third or 5 cubed. Make sure you get both responses and the students understand that either way is correct.)

- Ask students what $5^3$ means. (5 used as a factor 3 times or $5 \times 5 \times 5$) Uncover the $5 \times 5 \times 5$ on the transparency as you say, "$5^3$ means $5 \times 5 \times 5$.”

- Ask students to use their calculators to find the product of $5 \times 5 \times 5$. (125) Uncover the 125 on the transparency.

- Distribute Exponent Extravaganza. Tell students calculators can be used. Go over the directions and examples. Have students complete the activity sheet independently.

**Note:** If the calculators used by the students have exponent keys, it would be appropriate to teach the students how to use the key before beginning Exponent Extravaganza. The use of the exponent key enables the students to find values of larger exponents quickly and lessens the chance of making an error by multiplying too many or too few factors.

On the Texas Instruments Math Explorer calculator, the exponent key is marked $y^x$.

To find the value of $8^4$:

* press the 8 key
* press the exponent key ($y^x$)
* press the 4 key
* press the equals sign

The number displayed (4,096) is the value of $8^4$. 
## Multiplying by Ten

<table>
<thead>
<tr>
<th>Thousands</th>
<th>Hundreds</th>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thousand</td>
<td>Hundred</td>
<td>Ten</td>
<td>One</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expression</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 x 1</td>
<td>10</td>
</tr>
<tr>
<td>10 x 10</td>
<td>100</td>
</tr>
<tr>
<td>10 x 10 x 10</td>
<td>1000</td>
</tr>
<tr>
<td>10 x 10 x 10 x 10</td>
<td>10,000</td>
</tr>
<tr>
<td>10 x 10 x 10 x 10 x 10</td>
<td>100,000</td>
</tr>
<tr>
<td>10 x 10 x 10 x 10 x 10 x 10</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>
Exponential Form

**Exponent** - tells how many times the base is used as a factor

$$10^4$$

**Base** - factor in multiplication problem

$$10 \times 10 \times 10 \times 10 = 10^4$$
## Ten Chart

<table>
<thead>
<tr>
<th>Number</th>
<th>Multiplication</th>
<th>Exponential Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>10 × 10</td>
<td>10 x 10 x 10</td>
</tr>
<tr>
<td></td>
<td>10 × 10 × 10</td>
<td>10 x 10 x 10 x 10</td>
</tr>
<tr>
<td></td>
<td>10 × 10 × 10 × 10</td>
<td>10 x 10 x 10 x 10 x 10</td>
</tr>
</tbody>
</table>
## Take Ten

Fill in the bank boxes in the chart below.

<table>
<thead>
<tr>
<th>Exponential Form</th>
<th>Multiplication (Factor Form)</th>
<th>Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>$10 \times 10$</td>
<td>one thousand</td>
</tr>
<tr>
<td>103</td>
<td>$10 \times 10 \times 10$</td>
<td>ten thousand</td>
</tr>
<tr>
<td>105</td>
<td>$10 \times 10 \times 10 \times 10 \times 10$</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Name __________________________
Exponential Form - Example Two

1. \(3^4\)
   \[3 \times 3 \times 3 \times 3\]
   \[81\]

2. \(4^5\)
   \[4 \times 4 \times 4 \times 4 \times 4\]
   \[1024\]

3. \(8^2\)
   \[8 \times 8\]
   \[64\]