Number and Operations in Base Ten

Students in third grade continue developing place value understanding as they work within the base ten number system. They extend their knowledge of place value and number sense beyond procedures and algorithms as they work to explain and reason about the answers they get–for example, when they perform rounding and multi-digit arithmetic.

Students will apply their understanding of place value and algorithms to fluently add and subtract within 1,000. *Fluency* is applying accuracy, efficiency (using a reasonable number of steps and amount of time), and flexibility (adjusting strategy to suit the situation) to solve problems. Students will use strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

The Grade 3 Common Core State Standards for Number and Operations in Base Ten specify that students should–

- Use place value understanding and properties of operations to perform multi-digit arithmetic.

The following hands-on activities support students' understanding of place value. Tools and models, such as numbers lines and place value charts, will help students develop rich understanding of the base ten number system. Mathematically proficient third graders communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. They should be given opportunities to explain their thinking, show and explain their work by using strategies and algorithms, and verify that their answers are reasonable.

Number and Operations in Base Ten

Contents

Lesson 1 **Estimating the Sum or Difference** 46

Objective: Estimate the sum or difference in addition and subtraction problems.

Manipulative: Base Ten Blocks

Lesson 2 **Adding and Subtracting** 50

Objective: Add and subtract within 1,000.

Manipulative: Base Ten Blocks

Lesson 3 **Multiply by 10** 54

Objective: Identify the effect of multiplying by 10.

Manipulative: Base Ten Blocks

Lesson 4 **Multiplying with Multiples of 10** 58

Objective: Multiply a 1-digit whole number by a multiple of 10.

Manipulative: Base Ten Blocks

LESSON 1

Objective

Estimate the sum or difference in addition and subtraction problems.

Common Core State Standards

- **3.NBT.1** Use place value understanding to round whole numbers to the nearest 10 or 100.
- **3.NBT.2** Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

Number and Operations in Base Ten

Estimating the Sum or Difference

As students become more familiar with adding and subtracting, they come to understand that sometimes a situation calls for an estimate rather than an exact answer. Estimates are helpful when dealing with very large numbers and save time when an exact answer is not needed.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *When is an estimate enough information to solve a problem?* Guide students to understand that when a problem asks for "about" how many, they can use an estimate.
- **Ask:** *What number did you round 104 to? How did you know to round down instead of up? What about 328? How did you know to round up?*
- **Ask:** *Was your estimate close to the exact answer? Will rounding always give you an estimate that is close to the exact answer? What if you rounded the same numbers to the closest hundred?*

Solve It

With students, reread the problem. Have students write to describe how they used Base Ten Blocks to help them estimate 104 + 328. They should then write a sentence telling whether the class will have enough labels for a new computer.

More Ideas

For other ways to teach about estimating sums and differences—

- Have students use Base Ten Blocks to estimate differences. Give students a subtraction problem. Then ask them to round the numbers in the problem and subtract to find an estimate.
- Give students sample addition and subtraction word problems. Some problems should ask for an exact answer, while others should indicate that they require an estimate by using phrases such as "about how many." Have students decide for each problem whether an exact answer or an estimate is needed. For problems requiring an estimate, have students estimate using mental math first. Then have them use Base Ten Blocks to check their answers.

Formative Assessment

Have students try the following problem.

Estimate the difference between 812 and 489 by rounding each number to the nearest 100.

A. 300 **B.** 320 **C.** 420 **D.** 480

Try It! 25 minutes | Groups of 4

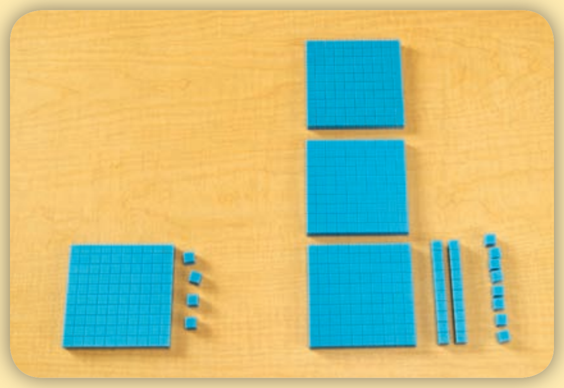
Here is a problem about estimating a sum.

Mrs. Vasquez's class is collecting box top labels for a new computer. The class collects 104 labels in September and 328 labels in October. They need 500 labels for a new computer. Can the students find out if they have enough labels without counting them or adding 104 + 328?

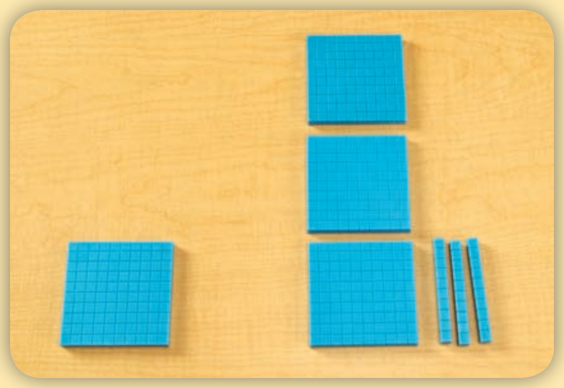
Introduce the problem. Then have students do the activity to solve the problem. Distribute Base Ten Blocks to students. Introduce the concept of rounding to students, and explain how they can use rounding to estimate sums and differences. With students, practice rounding one-, two-, three-, and four-digit numbers using 5 as the benchmark. Write the addition problem *104 + 328* on the board.

Materials

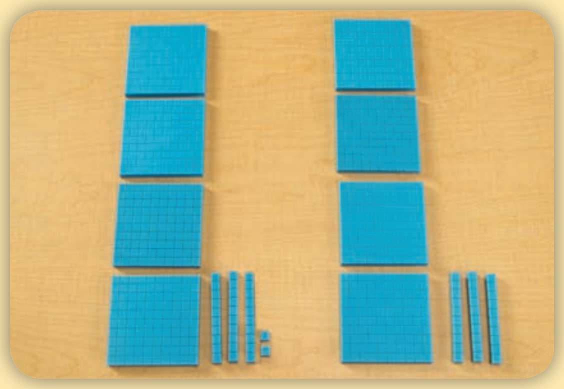
- Base Ten Blocks (10 flats, 10 rods, and 20 units per group)
- paper (1 sheet per group)
- pencils (1 per group)



1. Have students model the numbers 104 and 328 using blocks. Have students use these models to assist them in rounding to the tens place.



2. Students should then model the rounded numbers using blocks. Ask students to add the rounded numbers to find the sum. Have students write down the rounded sum.



3. Now ask students to find the exact answer using blocks. Have students write down their exact answer and compare it to their estimated answer.

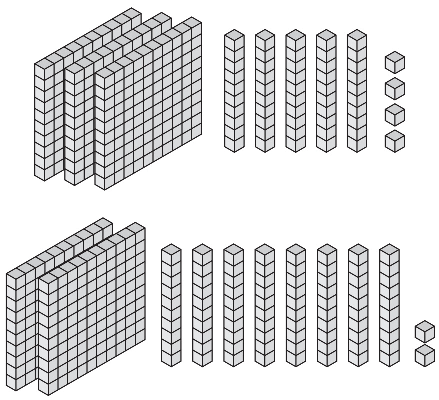
⚠ Look Out!

Students may feel compelled to find an exact answer every time. Brainstorm with students to identify situations in which they need an estimate rather than an exact answer. Also, for students who are confused about when to round up or down, you may wish to draw a blank ten frame on paper and use counters to illustrate the rule that numbers under 5 are rounded down, while numbers 5 and above are rounded up.

Answer Key

Use Base Ten Blocks to build each pair of numbers. Estimate each sum or difference to the nearest 100. (Check students' work.)

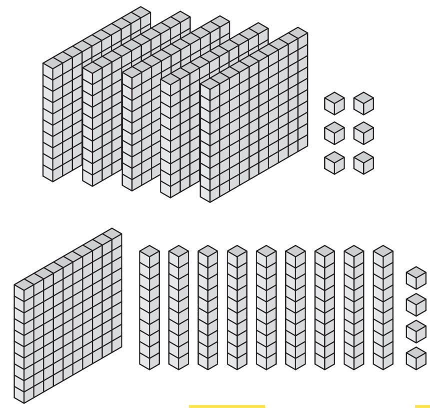
1.



Model: 354 + 282

Estimate: 400 + 300 = 700

2.



Model: 506 – 194

Estimate: 500 – 200 = 300

Build each problem using Base Ten Blocks. Sketch the model. Estimate each sum or difference to the nearest 10. (Check students' work.)

3. 77 + 42

80 + 40 = 120

4. 261 – 237

260 – 240 = 20

Estimate each sum or difference to the nearest 10.

5. 522 + 179

520 + 180 = 700

6. 85 – 53

90 – 50 = 40

7. 103 + 517

100 + 520 = 620

Estimate each sum or difference to the nearest 100.

8. 463 – 268

500 – 300 = 200

9. 145 + 827

100 + 800 = 900

10. 557 – 299

600 – 300 = 300

Answer Key

Challenge! Write rules for Base Ten Blocks that describe how to round numbers to the nearest 10, nearest 100, and nearest 1,000. Use examples or draw pictures to help.

Challenge: (Sample) For rounding to the nearest 10 when there are 5 or more units, replace the units with a rod. When there are fewer than 5 units, remove the units. For rounding to the nearest 100 when there are 5 or more rods, replace the rods with a flat and remove any units. When there are fewer than 5 rods, remove the rods and units. For rounding to the nearest 1,000 when there are 5 or more flats, replace the flats with a cube and remove any rods and units. When there are fewer than 5 flats, remove the flats, rods, and units.

LESSON 2

Number and Operations in Base Ten

Adding and Subtracting

Objective

Add and subtract within 1,000.

Common Core State Standards

- **3.NBT.2** Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

Learning how to add and subtract numbers up to four digits is an important skill both in mathematics and in everyday life. Addition and subtraction require students to be able to accurately represent numbers and understand the value of each. In this lesson, students will learn the fundamentals of adding and subtracting numbers up to four digits with and without regrouping.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Write *289* and *319* on the board. **Ask:** *How can you write these numbers as an addition problem?* Help students line up the numbers so that they are ready to be added. Emphasize the importance of aligning place-value columns. Then add the numbers together as a class.
- **Say:** *Sometimes when we add numbers we find that we need to regroup.* **Ask:** *How do you know when you need to regroup? Which numbers did you need to regroup to solve this problem? How did you do it? How did you show regrouping using the blocks?*
- As a class, write the problem *608 – 95*, lining up the place-value columns correctly. **Ask:** *How did you regroup numbers to solve this problem? How is regrouping for subtraction different from regrouping for addition?*

Solve It

With students, reread the problem. Have students write two sentences telling the total number of pages read by Peggy and Rahul and how they used addition and subtraction with regrouping to find the answer.

More Ideas

For other ways to teach about adding and subtracting—

- Have students put Centimeter Cubes in a paper bag and then draw out two handfuls. Students should count each handful of cubes separately and then add the two numbers together.
- Have students work in pairs to challenge each other to subtract two- and three-digit numbers. Each student makes up a subtraction problem. Then students use Base Ten Blocks to solve each other's subtraction problems.

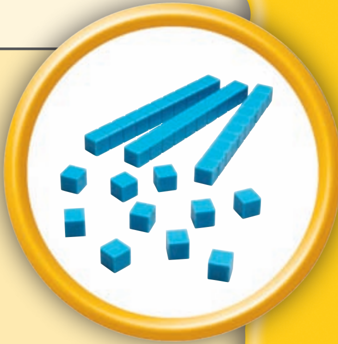
Formative Assessment

Have students try the following problem.

Circle the correct answer.

$$\begin{array}{r} 519 \\ +\ 411 \\ \hline \end{array}$$

A. 920 **B.** 928 **C.** 930 **D.** 938



Try It! 30 minutes | Groups of 4

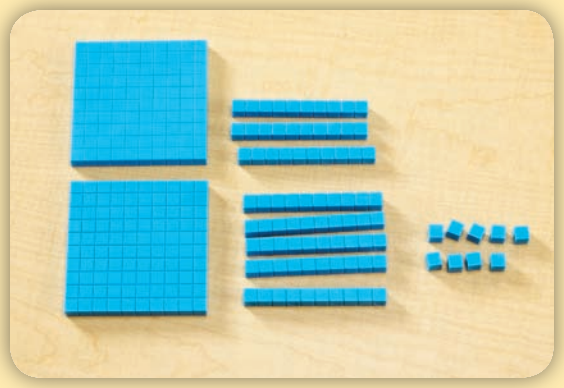
Here is a problem about adding and subtracting.

Claire, Tim, Peggy, and Rahul keep track of the number of pages they read each month. Claire read 289 pages. Tim read 319 pages. Claire and Tim added their pages together to see how much they read altogether. Peggy and Rahul read 95 fewer pages. How many pages did Peggy and Rahul read?

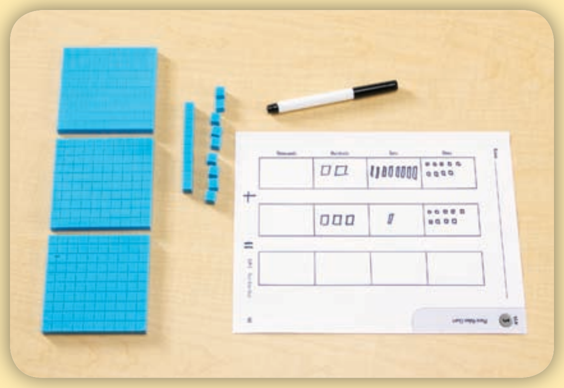
Introduce the problem. Then have students do the activity to solve the problem. Distribute Base Ten Blocks, charts, and pencils to students.

Materials

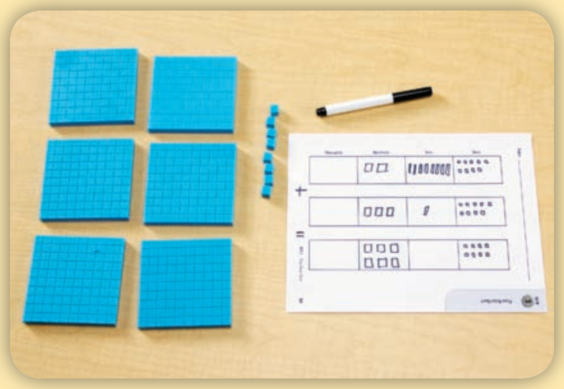
- Base Ten Blocks (10 flats, 10 rods, and 20 units per group)
- Place-Value Chart (BLM 3; 2 per student)
- pencils (1 per student)



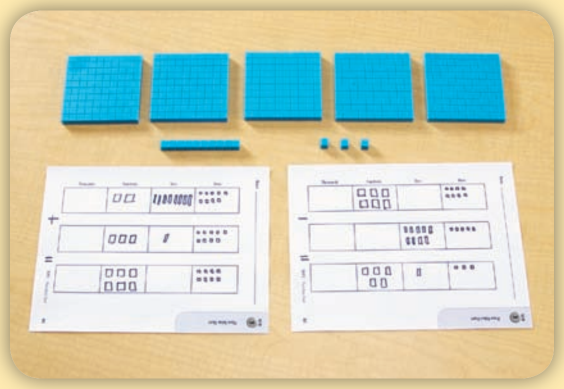
1. Say: *We are going to add together 289 and 319. First model 289 with blocks. Then draw the blocks you used on the chart and draw a plus sign below them.* Have students set the blocks they used to the side.



2. Say: *Now we will use new blocks to model 319.* Have students model the number and then draw the blocks they used in the second row on the chart. Students should draw an equal sign below the second addend.



3. Say: *Now we will put the blocks together to help us add.* Explain to students that they will need to regroup to solve the problem by exchanging units for rods and rods for flats. Then have them draw the blocks that show the sum (608) on their charts.



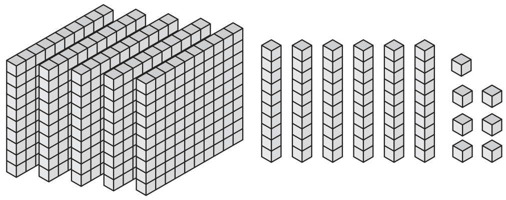
4. Say: *Transfer your sum to the second chart and subtract 95 from 608.* Assist students in exchanging blocks to regroup.

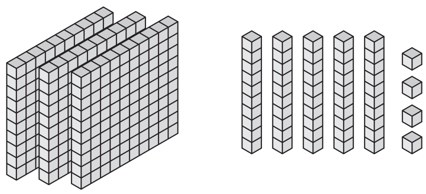
Answer Key

Use Base Ten Blocks to build each number. Find the sum or difference.

(Check students' work.)

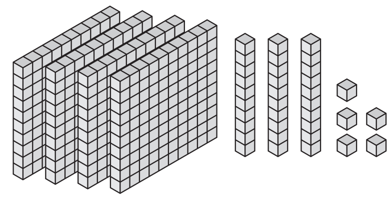
1.

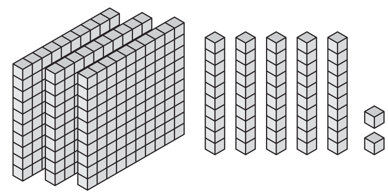


\+ 

Sum: 921

2.



– 

Difference: 83

Build each problem using Base Ten Blocks. Then sketch the model. Find the sum or difference. Name any regrouping needed.

(Check students' models.)

3. 628
\+ 259

887

4. 463
– 278

185

Find each sum or difference.

5. 356 + 288 = 644

6. 235 – 154 = 81

7. 416 + 378 = 794

8. 815 – 421 = 394

9. 81 + 425 = 506

10. 990 – 386 = 604

Answer Key

Challenge! Explain why when adding or subtracting two numbers, you work from right to left. Draw a picture to help.

Challenge: (Sample) You need to decide when to regroup. When adding, regrouping for a place value adds one to the place value to the left. When subtracting, if there is not enough in a place value, you have to look to the place value to the left to regroup.

LESSON 3

Objective

Identify the effect of multiplying by 10.

Common Core State Standards

- **3.NBT.3** Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60) using strategies based on place value and properties of operations.

Number and Operations in Base Ten

Multiply by 10

Multiplying by 10 will illustrate the patterns in multiplication in a more obvious way than multiplying by other numbers. Students need to know that multiplying by 10 will result in a 0 in the ones place in the product. Through using manipulatives such as Base Ten Blocks, students will understand the patterns involved in multiplication.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Display a Place-Value Chart (BLM 3) and show a 1 in the ones place. **Ask:** *What do we get when we multiply by 10?* Students should explain that the 1 moves to the tens place, and a 0 is placed in the ones place. **Ask:** *How can we use the Place-Value Chart to show 13 × 10 = 130?*
- **Say:** *When you multiply by a multiple of 10, your answer will always have a 0 in the ones place.* **Ask:** *Why do you think this is true?* Have students skip-count by 10 on a number line to reinforce this concept.
- **Ask:** *If you had 15 teams with 20 students on each team, how could you find the total number of students?*

Solve It

With students, reread the problem. Have students write a short paragraph to explain how they can use place value to multiply 13 × 10 by adding a 0 to 13.

More Ideas

For other ways to teach about multiplying by 10—

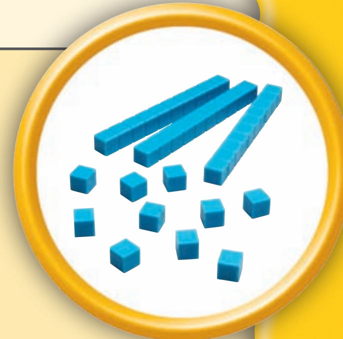
- Have groups of students make stacks of 10 Color Tiles and use them to multiply various numbers by 10. After multiplying, students can check their work by counting the tiles. Have them record their answers to reinforce the pattern and conclude that in each case they added a 0 to the number they multiplied by 10.
- Have students work in groups using Base Ten Blocks to multiply larger multiples of 10. Supply a series of problems, such as 4 × 40, 4 × 50, 4 × 60, and 4 × 70. Help students see the pattern of multiplying and then adding 0—for example, 4 × 40 is solved by multiplying 4 × 4 and adding 0.

Formative Assessment

Have students try the following problem.

Mrs. McMahon wants to prepare a copy of a test for each of the 20 students in her class. The test is 3 pages long. How many pages will she prepare altogether?

A. 6 **B.** 30 **C.** 60 **D.** 120



Try It! 30 minutes | Groups of 4

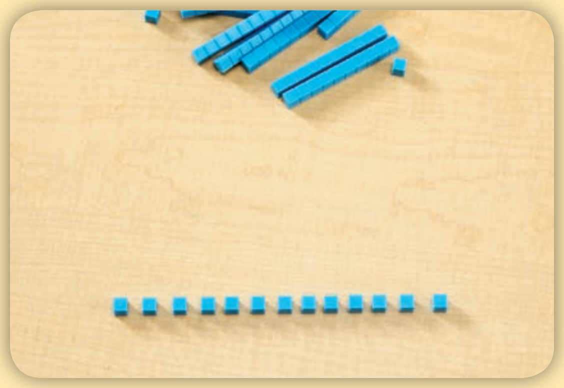
Here is a problem about multiplying by 10.

On Olympics Day at Baker Elementary School, students divide into 13 teams. Each team has 10 students. What is the total number of students?

Introduce the problem. Then have students do the activity to solve the problem. Distribute Base Ten Blocks to groups and explain that they will use them to multiply 13 × 10.

Materials

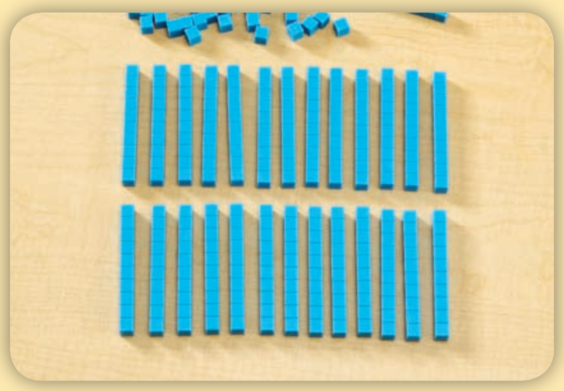
- Base Ten Blocks (30 rods and 30 units per group)



1. Write *13 × 10* on the board. Tell students to model 13 using 13 units.

2. Have students multiply 13 × 10 by replacing each unit with a rod. Have them count the rods to find the total. **Say:** *When you multiply by a 10, you can add a 0 to the other factor to find the product.*

Invite students to model other problems, such as 8 × 10 or 15 × 10.



3. Ask: *What if each team had 20 students? How can you multiply 13 × 20?* Guide students to line up 2 rows of 13 units each, then to replace each unit with a rod. Explain that this is the same as multiplying 13 × 2, then adding a 0 to the product.

⚠ Look Out!

Students may not understand why multiplying by 10 will automatically result in a product with a 0 in the ones place. Have them create arrays for 1 × 10, 2 × 10, and so on through 10 × 10 to show how the number in every new row adds 10. Have students map this pattern on a Hundred Chart (BLM 1) to reinforce.

Answer Key

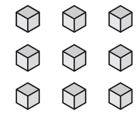
Use Base Ten Blocks to build each number. Use rods to find the product of each number modeled and 10. (Check students' work.)

1. 

5 × 10 = 50

2. 

7 × 10 = 70

3. 

9 × 10 = 90

Build each problem using Base Ten Blocks. Then sketch the model. Write each product. (Check students' models.)

4. 8 × 10 = 80

5. 15 × 10 = 150

6. 21 × 10 = 210

7. 8 × 20 = 160

8. 4 × 20 = 80

9. 7 × 20 = 140

Find the answer to each multiplication problem.

10. 3 × 10 = 30

11. 12 × 10 = 120

12. 24 × 10 = 240

13. 6 × 20 = 120

14. 9 × 20 = 180

15. 15 × 20 = 300

Answer Key

Challenge! Explain how Problems 11 and 13 have the same product when their factors are different.

Challenge: (Sample) The factors of Problem 11 are 12 and 10. The factors of Problem 13 are 6 and 20. You can work backward to rewrite $6 \times 20 = 6 \times 2 \times 10$. Then use the Associative Property: $(6 \times 2) \times 10 = 12 \times 10$.

LESSON 4

Number and Operations in Base Ten

Multiplying with Multiples of 10

Objective

Multiply a 1-digit whole number by a multiple of 10.

Common Core State Standards

- **3.NBT.3** Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60) using strategies based on place value and properties of operations.

This lesson builds on the previous lesson about multiplying by 10. Now students will multiply using a multiple of 10 in the range 10–90. For example, the product of 4 × 80 can be shown as 4 groups of 8 tens, or 32 tens, or 320. This is a representation of the Associative Property of Multiplication, because 4 × 80 = 4 × (8 × 10) = (4 × 8) × 10 = 320. Students will build on their understanding that 4 × 80 is the same as multiplying 4 × 8, then adding a 0 to the product.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Say:** *We needed to find 4 × 50. We thought of 4 × 50 as 4 × 5 × 10, or 20 × 10, which is easy to multiply. We also could think about it as finding 4 × 5 and adding a zero.* Elicit from students that breaking up the multiple of 10 allows them to find the smaller product first. **Say:** *We know that if 4 × 5 = 20, then 4 × 50 = 200.*
- **Ask:** *Why do you need to add the zero when you have found 4 × 5 = 20?* Elicit from students that adding the zero accounts for the fact that they really need to multiply by 50, not just 5.

Solve It

Reread the problem with students. Have students write a sentence or two explaining why 4 groups of 50 is the same as 20 groups of 10.

More Ideas

For other ways to teach multiplying single digits by multiples of 10—

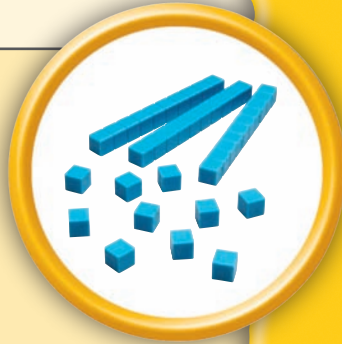
- Have students use Base Ten units and Place-Value Chart (BLM 3) to multiply 7 × 30, 6 × 20, and 3 × 90. For example, to find 7 × 30, have students make 7 groups of 3 units to get 21. Then have students write the product and add a zero to get 210.
- Have students use Color Tiles to make stacks of ten and use them to multiply various single-digit numbers by multiples of 10. After multiplying, students can check their work by counting the tiles.

Formative Assessment

Have students try the following problem.

Tasia is having a hard time solving the problem 8 × 90 = ?. Which shows a way to write the problem so it is easier to solve?

A. 8 × 9 × 10 = ? **B.** 2 × 4 × 90 = ? **C.** 8 × 45 × 2 = ? **D.** 80 × 9 = ?



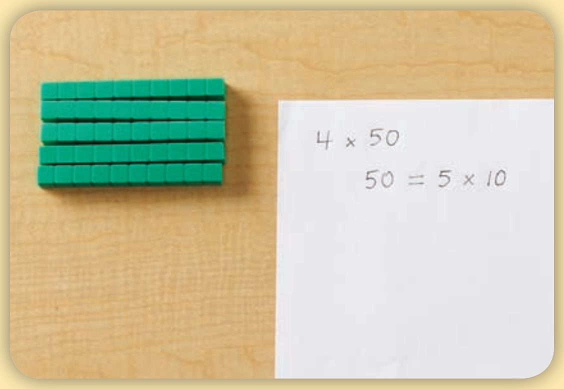
Try It! 25 minutes | Groups of 4

Here is a problem about multiplying single digits by multiples of 10.

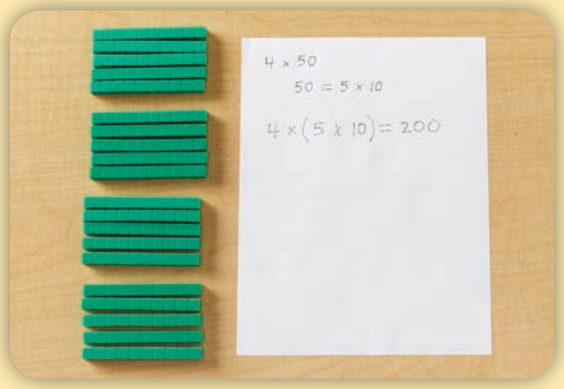
The third and fourth grade students are going on a field trip. There are 4 buses with 50 students on each bus. How many students are going in all?

Introduce the problem. Then have students do the activity to solve the problem. Distribute Base Ten Blocks, paper, and pencils to students.

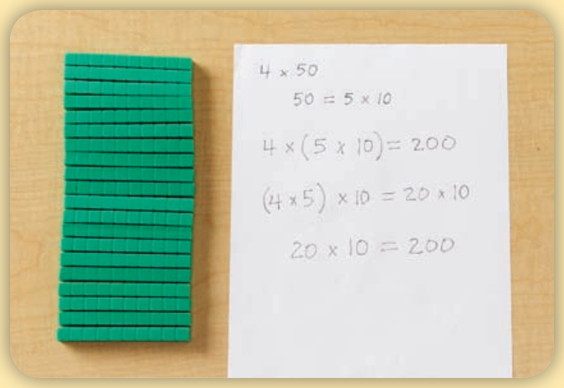
Materials
- Base Ten Blocks (30 rods per group)
- paper (1 sheet per group)
- pencils (1 per group)



1. Elicit that 4 × 50 students are going on the trip. Write *4 × 50* on the board and have students write it on their papers. **Say:** *Let's model the number of students on one bus.* **Ask:** *How can you make 50 using groups of 10?* Have students build the model using 5 rods. Write *50 = 5 × 10* on the board and have students write it on their papers.



2. Ask: *How many buses are there? How can you model all the students on the 4 buses?* Help students recognize that they can add 3 more groups of 5 rods to the model they built for one bus. Have them build the model. Ask them to count by tens, rod by rod, to determine the total number of students. Write the equation *4 × (5 × 10) = 200* on the board and have students write it on their papers.



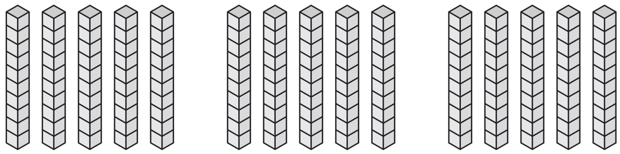
3. Have students push the rods together to form a 20 × 10 array. Elicit that 4 × (5 × 10) can be rewritten as (4 × 5) × 10, or 20 × 10. Write *(4 × 5) × 10 = 20 × 10* and *20 × 10 = 200* on the board and have students do the same on their papers.

⚠ Look Out!

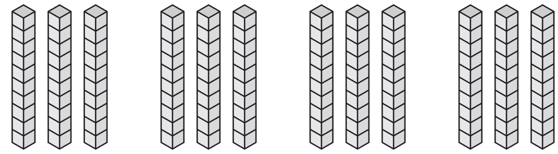
Stress that students break the multiple of 10 into a single digit times 10. **Say:** *When you see a multiple of ten, break that number into a single digit times 10 to make multiplication easier.*

Use Base Ten Blocks to build the model. Find the product. (Check students' work.)

1. 3 × 50 = 3 × 5 × 10 = 150



2. 4 × 30 = 4 × 3 × 10 = 120



Use Base Ten Blocks to model the product. Sketch the model. Complete the multiplication sentence.

3. 7 × 20

Sketch of 7 groups of 2 rods

7 × 2 × 10 = 140

4. 4 × 40

Sketch of 4 groups of 4 rods

4 × 4 × 10 = 160

Find the answer to each multiplication problem.

5. 8 × 40 = 320

6. 9 × 20 = 180

7. 6 × 70 = 420

8. 3 × 90 = 270

9. 8 × 50 = 400

10. 4 × 80 = 320

11. 9 × 60 = 540

12. 7 × 40 = 280

13. 6 × 60 = 360

Answer Key

Challenge! Marcus bought a box of cards. In the box there were 6 smaller boxes, and in each of those boxes there were 6 packs of 10 cards. To find the total number of cards he bought, Marcus wrote this equation: $6 \times 60 = 360$. Is he correct? Explain how you know.

Challenge: (Sample) Yes, Marcus is correct; 6×60 can be written as $6 \times (6 \times 10)$, and this can be rewritten as $(6 \times 6) \times 10$, or 36×10, which is 360.