Break Apart and Multiply Big Numbers

Teacher		**Class**	Grade 4
Subject	Math	**Topic**	Multi-digit multiplication
Date		**Room**	
Lesson length	60 minutes	**Country**	United States

Students learn to break numbers by place value and multiply each part. They draw area models to solve 2-digit by 2-digit and 4-digit by 1-digit problems.

Curriculum links

- Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.
- Apply strategies (like rounding, place value, properties of multiplication and/or addition) and algorithms, including the standard algorithm, to estimate and determine the product of two whole numbers when given: A two-digit factor and a two-digit factor [1]
- Estimate, represent, solve, and explain solutions to single-step and multistep real-life problems that involve multiplication with whole numbers [1]

Learning objectives

- Students will multiply up to four digits by one digit using place-value breakup.
- Students will multiply two two-digit numbers using area models and partial products.
- Students will illustrate and explain steps with equations, arrays and area models.

Success criteria

- I can break numbers apart and multiply each part correctly.
- I can draw an area model and add the four parts.
- I can explain why multiplying by tens adds a zero.

What students already know

Show 6 x 4 array of dots. Ask: How many rows? How many columns? How many in all? Listen for 6 rows, 4 columns, 24 total.

Key words

place value	what a digit is worth depends on where it sits in the number [1]
rectangular array	rows of dots or blocks lined up to make a box shape [22]
area model	a rectangle drawing split into smaller parts to show each multiply step [22][7]
partial products	answers to the small multiplications that you add to get the total [22]
estimate	a close guess found by using round numbers to check [1]

Materials

- large graph paper
- colored markers

Before the lesson

- Print Worksheet Task C and Task D for pairs and exit tickets for each student

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- child-safe scissors
- glue sticks
- whiteboard, markers and rulers
- projector and Slides 1-12
- printed Worksheet Task C and Task D
- exit tickets
- Test Video clip 1 (0:00–2:48) and Video clip 3 (0:00–5:00) with sound and captions
- Tape large graph paper sheets and set out markers, child-safe scissors and glue sticks
- Draw a floor sample of 16 by 13 split into 10+6 and 10+3 for modeling

Lesson outline

0–8 min **Starter** 8 min · Whole class

Hook interest with the reading corner problem and recall rows-times-columns.

YOU DO

1. Show the title that says break numbers apart, multiply, then add.
2. Show the photo of pencils in neat rows that make a rectangle.
3. Read the reading corner hook and ask students to turn and talk about how rows help.
4. Take 2-3 quick ideas and link rows times columns to finding a total.

STUDENTS DO

1. Look at the rows photo and count rows and columns aloud.
2. Turn to a partner and share where they see rows in the classroom.
3. Predict how splitting 16 by 13 into smaller boxes could help.

Say: We are planning a reading corner that is 16 feet by 13 feet. How many square feet is that? Look at the pencils in neat rows. Rows times columns tells how many in all, so we can break big numbers apart, multiply, then add.

Worked example: 4 rows x 6 columns: Step 1 count rows = 4. Step 2 count columns = 6. Step 3 multiply 4 x 6 = 24 in all.

Ask: If we have 4 rows with 6 in each row, how many in all? (24, because 4 x 6 = 24.) · Why does rows times columns tell how many in all? (Each row has the same number, so it is equal groups in a rectangle.)

Check understanding: Show thumbs up if rows-times-columns makes sense; if not, point to rows and columns on the photo again and count together.

Support: Let students build 4 x 6 with cubes and count rows aloud before writing the equation. **Stretch:** Ask students to split a 12 x 4 array into 10 x 4 and 2 x 4 and say both products.

Use: Slides 1–2

8–20 min **Teaching** 12 min · Whole class

Model multiplying up to four digits by one digit with place-value parts.

YOU DO

1. Show the compare of two kinds of big jobs: up to 4 digits x 1 digit and two 2-digit numbers.
2. Play the video that shows how numbers split into tens and ones and small parts add to total.
3. Model 1,212 x 3 on the board by splitting into thousands, hundreds, tens and ones.
4. Add the four partial products in place-value columns and estimate to check if close.

STUDENTS DO

1. Watch how the rectangle splits into tens and ones and small parts add to total.
2. Choral respond with each small product: 3,000, 600, 30, 6.
3. Copy the four equations and total lined up by place value.

Say: We break apart by place value, multiply each small part, then add parts to get the total. Splitting uses the distributive property, so 1,212 x 3 is the same as 1,000 x 3 plus 200 x 3 plus 10 x 3 plus 2 x 3 [4]. We estimate first to check if our exact answer is close [1].

Worked example: 1,212 x 3: 1,000 x 3 = 3,000; 200 x 3 = 600; 10 x 3 = 30; 2 x 3 = 6; 3,000 + 600 + 30 + 6 = 3,636. Estimate 1,200 x 3 = 3,600, so 3,636 is close.

Ask: Why do we multiply 1,000 x 3 and not just 1 x 3? (The 1 means 1,000 by place value, so its worth is 1,000 [1].) · How does 1,200 x 3 help us check 1,212 x 3? (1,200 x 3 = 3,600, so the exact answer should be a little more than 3,600.)

Check understanding: All students write 3,636 on whiteboards; reteach splitting 1,212 = 1,000 + 200 + 10 + 2 if many are off.

Support: Provide a place-value chart with the splits already written, like 1,213 = 1,000 + 200 + 10 + 3, for students to multiply step by step. **Stretch:** Challenge students to solve 4,527 x 9 with the same split-and-add method.

Use: Slides 3–4, Slide 6, Video clip 1 (0:00–2:48)

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20–32 min **Guided practice** 12 min · Whole class

Connect base-ten thinking to the four-part area model for two 2-digit numbers.

YOU DO

1. Show the word cards for place value, break apart and answers to small multiplications.
2. Play the video that shows tens times tens and ones separately and how four parts add up.
3. Draw 16 x 13 split into 10 + 6 and 10 + 3 and label the four smaller boxes.
4. Think aloud while multiplying and adding: 100 + 30 + 60 + 18 = 208 square feet.

STUDENTS DO

1. Call out the four small multiplications as the teacher labels each box.
2. Add the four parts with the teacher and state the unit: square feet.
3. Explain to a partner why 6 x 10 is 60 and not 6.

Say: An area model is a picture of the base-ten blocks, and partial products are a way to write the same thinking [22][7]. We split both numbers, multiply each small part, then add. The second row counts as 20, not 2, because that digit means 2 tens [11].

Worked example: 16 x 13: 10 x 10 = 100; 10 x 3 = 30; 6 x 10 = 60; 6 x 3 = 18; 100 + 30 + 60 + 18 = 208 square feet.

Ask: Why do we have four small boxes for 16 x 13? (Each part of 10+6 multiplies each part of 10+3, so 4 products.) · What does the 60 stand for? (6 ones times 1 ten = 60, or 6 x 10.)

Check understanding: Point to a box at random and have all students call the product; revisit expanded form 16 = 10 + 6 if errors.

Support: Give students the four equations with one number missing to fill in before adding. **Stretch:** Ask students to prove with equations why 47 x 8 = 40 x 8 + 7 x 8 = 376.

Use: Slides 7–8, Video clip 3 (0:00–5:00)

32–50 min **Main activity** 18 min · Pairs

Pairs solve 23 x 14 with an area model and 1,212 x 3 with equations.

YOU DO

1. Hand out large graph paper, colored markers, scissors and glue sticks for the reading corner design.
2. Direct pairs to draw a box split into 20+3 and 10+4, find four small areas, then add.
3. Direct pairs to solve 1,212 x 3 with four partial-product equations lined up by place value.
4. Circulate, check place-value alignment, and prompt pairs to color and label each part with its equation.

STUDENTS DO

1. Draw and color the area model for 23 x 14: 20 x 10 = 200, 20 x 4 = 80, 3 x 10 = 30, 3 x 4 = 12; total 322.
2. Solve 1,212 x 3 with equations: 3,000 + 600 + 30 + 6 = 3,636.
3. Cut, arrange and glue the four labeled parts and show estimate and exact total.

Say: Draw your design to scale on graph paper and color each small box. Label each part with its equation and total, then write the full addition. You are showing the same thinking three ways: box, equations and total.

Ask: How do you know 20 x 10 is 200? (2 x 1 = 2, then two zeros because 20 is 2 tens and 10 is 1 ten.) · How does your equation match your box? (Each equation is one small box, and adding them gives the whole area.)

Check understanding: Stop at 9 minutes: pairs hold up boxes; if boxes are not split into 20+3 and 10+4, model the split again on the board.

Support: Give students the four equations with one number missing to fill in before adding. **Stretch:** Have students design and solve a 24 x 18 space and compare whose area is larger.

Use: Slide 9, Worksheet Task C

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50–60 min **Plenary** 10 min · Whole class

Explain the shortcut method and the tens-zero and check understanding.

YOU DO

1. Share that the fast stacking method is just partial products in disguise.
2. Display 34 x 26 as 34 x 6 plus 34 x 20 and ask why the second row counts as 20.
3. Pose why we write a zero when we multiply by tens, like in 23 x 20, for think-pair-share.
4. Hand out exit tickets that ask for learning, a question, and solving 14 x 12 with any model.

STUDENTS DO

1. Turn and tell a partner why the second row needs a zero.
2. Share one sentence explaining the second row with the class.
3. Complete the exit ticket on their own.

Say: The fast stacking method is just partial products in disguise. It multiplies each place-value part, then adds, only written shorter. The placeholder zero shifts the product one place left for tens, because 23 x 20 means 23 x 2 tens [11].

Worked example: 14 x 12: 10 x 10 = 100; 10 x 2 = 20; 4 x 10 = 40; 4 x 2 = 8; 100 + 20 + 40 + 8 = 168.

Ask: Why do we write a zero when we multiply by tens, like in 23 x 20? (Because we are really multiplying by 20, not 2, so the product is ten times bigger.) · How is stacking the same as partial products? (Both multiply each place-value part and add; stacking just writes it shorter [22].)

Check understanding: Collect exit tickets solving 14 x 12; if many miss the zero shift, reteach 34 x 20 tomorrow with an area model.

Support: Provide sentence starters like The second row is really ___ x ___ because ___ and a facts chart for single-digit products. **Stretch:** Ask students to estimate 1,921 x 4 as 2,000 x 4 and explain if exact will be a little more or less.

Use: Slides 10–12

Common mistakes

Mistake	How to spot it	How to fix it
Missing placeholder zero in the tens row, so second product is too small by ten times	Second row is written one place too far right and total is far below estimate	Write a 0 first for the tens row, then multiply by the tens digit, because it means x20 not x2 [11]
Skipping zero inside the top number, like 508 x 3 written as 154	Product has too few digits and zero place was never multiplied	Multiply every digit including zeros, 3 x 0 = 0 plus any carry, to keep place value [12]
Reusing old carries in the next row	Second partial product is too large and carries are not crossed out	Cross out carries between rows and start each row fresh to avoid double-adding [12]

Support

- Give students the four equations with one number missing to fill in before adding.
- Start with 12 x 3 and 14 x 2 with a pre-split box and a multiplication chart for facts through 12 x 12 [1].

Stretch

- Have students design and solve a 24 x 18 space and compare whose area is larger.
- Challenge students with 4,527 x 9 using the same split-and-add method.

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- Provide a place-value chart with splits already written, like 1,213 = 1,000 + 200 + 10 + 3.
- Add a multistep order, like 15 boxes at $12 each plus 3 packs at $14 each, and find the combined total.

For the LSE or teaching assistant

Stay with target pairs in main activity: prompt split into tens and ones, check each small product, and help line up partial products by place value.

Safety

- Use child-safe scissors only, cut away from fingers, and clean up paper scraps to prevent slipping.

Check for understanding

Question	Answer
Solve 14 x 12 with any model and show your parts.	168. Example: 100 + 20 + 40 + 8 = 168.
Why do we write a zero when we multiply by tens, like in 23 x 20?	The 2 means 20, so we multiply by 20; the zero shifts the product into tens.
One thing I learned about area models is...	Example: they split numbers by place value and the small products add to the total.

Homework

Draw an area model for 24 x 18, label the four parts, and add to find the total.

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