Mystery Rug: Find the Missing Side

Teacher		**Class**	Grade 4
Subject	Math	**Topic**	Area and perimeter
Date		**Room**	
Lesson length	60 minutes	**Country**	United States

Students use rectangle area and perimeter formulas to solve real problems. They find a missing side by solving a multiplication or addition puzzle.

Curriculum links

- Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor [1]

Learning objectives

- Students will use the rectangle area formula to solve real-world problems.
- Students will use the rectangle perimeter formula to solve real-world problems.
- Students will find a missing width or length from known area or perimeter.

Success criteria

- I can find area with length times width.
- I can find perimeter by adding all sides.
- I can find a missing side from area or perimeter.

What students already know

Show a 4 by 3 rectangle on grid. Ask: How many square tiles fill it? How far is it all the way around? Listen for 12 tiles and 14 units.

Key words

area	the space inside a flat shape, counted by how many 1 unit by 1 unit squares fit inside [7]
perimeter	the total distance around the outside edge of a shape [19]
length	the distance from one end to the other along the longer side of a rectangle
width	the distance across a rectangle along the shorter side
square feet	units for surface that count how many 1-foot by 1-foot tiles would cover it [19]

Materials

- grid paper
- pencils
- rulers
- printed copies of Worksheet Task A for pairs
- Slides 1, 3-6, 8-11 ready to show

Before the lesson

- Print Worksheet Task A, one per pair, plus a few spare copies
- Test Slide 5 Video clip 1 (0:00–1:58) for sound and full-screen view
- Set out grid paper, pencils, rulers, and whiteboards

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- Video clip 1 Area and perimeter song (0:00–1:58) tested on Slide 5
- mini-whiteboards and markers
- Pre-make one support sheet with an 8-unit-long strip already shaded
- Write Slide 8 tasks on the board as backup if tech fails

Lesson outline

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

Recall the difference between area and perimeter and hook students with the rug mystery.

YOU DO

1. Show Slide 1 Fence It? Fill It? and read the hook: Our new reading rug covers 48 square feet and is 8 feet long, but the box does not say how wide it is. Can you solve the mystery?
2. Show Slide 3 New Floor, New Fence and ask how floor tiles and trim around the rug are different jobs.
3. Show Slide 4 Two Big Ideas cards and point to tile for inside space and string for walking around.
4. Ask pairs to turn and talk: Do tiles or trim match area? Do tiles or trim match perimeter?

STUDENTS DO

1. Listen to the rug mystery and look at Slides 1, 3-4.
2. Turn to a partner and say which job is area and which is perimeter.
3. Show thumbs up if trim means perimeter and tiles mean area.

Say: Our new reading rug covers 48 square feet and is 8 feet long, but the box does not say how wide it is. Can you solve the mystery? Floor tiles fill the inside space, that is area. Trim goes around the outside edge, that is perimeter, the total distance around the outside [19].

Ask: What does area tell us about the rug? (How much inside space it covers, how many square tiles fill it.) · What does perimeter tell us? (How far it is all the way around the outside edge.) · Will we use square feet for both? (No, square feet for area, feet for perimeter because area is square units and perimeter is linear units [19].)

Check understanding: Ask all to point to the carpet for area and trace the edge in the air for perimeter. If mixed, replay Slide 4 cards and repeat with a book cover.

Support: Hold up one paper square for inside and a string loop for around so students can see and touch the difference. **Stretch:** Ask: A rug needs 48 square feet of carpet. Would 48 feet of trim be the same? Why not?

Use: Slides 1, 3-4

8–20 min **Teach and model** 12 min · Whole class

Model how to write area and perimeter formulas with an unknown factor or addend.

YOU DO

1. Play Slide 5 Video clip 1 (0:00–1:58) and have class shout the formula when they hear it.
2. Show Slide 6 Area vs. Perimeter compare and stress area is length times width while perimeter adds all sides [7].
3. Model the rug on the board as 8 x ? = 48, viewing the area formula as a multiplication equation with an unknown factor [1].
4. Model Slide 9 steps for perimeter: write P = L + L + W + W [11], fill known numbers, try values until true.

STUDENTS DO

1. Sing along, then copy 8 x ? = 48 and 26 = L + L + 5 + 5.
2. Call out test facts: 8 x 5, 8 x 6 and 8 + 8 + 5 + 5.
3. Write the final widths and lengths with correct units on whiteboards.

Say: The area A of a rectangle with dimensions l and w is the product lw [2]. That means 8 times missing width equals 48. Perimeter adds every side, so P = L + L + W + W [11]. We can write the puzzle with a question mark and try numbers until it balances.

Worked example: Area: 8 x ? = 48. Try 6 because 8 x 6 = 48, so width = 6 feet. Check: area = 48 square feet, width = 6 feet. Perimeter: P = 26 feet, W = 5 feet. Write 26 = L + L + 5 + 5. So L + L = 16, L = 8 feet. Check: 8 + 8 + 5 + 5 = 26 feet [11].

Ask: How do we find the rug width without guessing blindly? (Write 8 x ? = 48 and find the factor that makes 48, which is 6.) · How do we find length from perimeter 26 feet and width 5 feet? (Add the two widths, subtract from 26, split the rest into two equal lengths.)

Check understanding: All hold up whiteboards showing 6 feet and 8 feet. If many show 48 feet for width, reteach feet for sides and square feet for covering [19].

Support: Let students use a multiplication table or count by 8s: 8, 16, 24, 32, 40, 48 to find the unknown factor [1]. **Stretch:** Ask what division equation also checks the rug, such as 48 divided by 8 = 6.

Use: Slides 5-6, 9, Video clip 1 (0:00–1:58)

20–45 min **Main activity** 25 min · Pairs

Build rectangles and solve for missing sides to prove area and perimeter answers.

YOU DO

1. Show Slide 8 Your task and assign: Find width for area 48 square feet, length 8 feet; find length for perimeter 26 feet, width 5 feet.
2. Hand out grid paper and rulers. Demo building an 8-feet-long strip and adding rows until you count 48 squares, showing area is squares that fit inside [7].
3. Give Worksheet Task A Use the bar to find the missing side and circulate to check equations and units.
4. Stop at 20 minutes and have two pairs show proofs: 8 x 6 = 48 and 8 + 8 + 5 + 5 = 26.

STUDENTS DO

1. In pairs, Student A builds the area rug on grid paper while Student B writes 8 x ? = 48.
2. Complete Worksheet Task A bars and Slide 8 perimeter puzzle, showing addition or multiplication proof.
3. Label every answer: square feet for area, feet for side or perimeter.

Say: Build the 8-foot strip first, then add rows until you have 48 squares. Write 8 times what equals 48. For the fence puzzle, write length plus length plus width plus width equals 26 and solve for the missing side.

Worked example: Student A shades 8 squares in one row, then adds rows: 8, 16, 24, 32, 40, 48. That is 6 rows, so width is 6 feet. Student B draws the bar for 26 feet, marks 5 + 5 on the ends, leaving 16 for the two long sides, so each long side is 8 feet.

Ask: How many rows gave 48 squares and what does that prove? (6 rows, proves width is 6 feet because 8 x 6 = 48.) · Why must perimeter answers be in feet, not square feet? (Perimeter is a length around, area is covering space measured in square units [19].)

Check understanding: Collect whiteboards or Task A bars and sort into correct 6 feet and 8 feet piles. Pull a small group for reteach if equations are missing.

Support: Give a sheet with an 8-unit-long strip already shaded and let students add one row at a time and skip-count by 8s to reach 48. **Stretch:** Try a larger rug with an area of 96 square feet and a length of 12 feet and find the missing width the same way.

Use: Slide 8, Worksheet Task A

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45–60 min **Plenary** 15 min · Whole class

Compare same-fence gardens and quiz to confirm use of both formulas.

YOU DO

1. Show Slide 10 Best Garden? vote with 24 feet of fence: 10 by 2, 8 by 4, 6 by 6.
2. Have class calculate each area with A = lw [2] and note different rectangles with the same perimeter can have different areas [18].
3. Run Slide 11 Quick quiz: 9 feet by 5 feet room area and perimeter, plus rug area 36 square feet problem.
4. Return to objectives and have students state which success line they can now do.

STUDENTS DO

1. Vote for a garden, then calculate its area and perimeter with a partner.
2. Answer Slide 11 quiz on whiteboards with units.
3. Point to the success line that matches each quiz answer.

Say: All three gardens use 24 feet of fence, but they do not hold the same space. Area calculations are needed when buying carpet or planning a garden [6]. Always check: did I cover inside or walk around?

Worked example: 10 x 2 garden: area = 20 square feet, perimeter = 24 feet. 8 x 4 garden: area = 32 square feet, perimeter = 24 feet. 6 x 6 garden: area = 36 square feet, perimeter = 24 feet. Same fence, most room is the square.

Ask: Which 24-foot fence garden holds the most soil? (The 6 by 6 square, 36 square feet, more than 32 or 20.) · Room is 9 feet by 5 feet. Area? Perimeter? (Area 45 square feet because 9 x 5 = 45; perimeter 28 feet because 9 + 9 + 5 + 5 = 28.)

Check understanding: Use Slide 11 as hinge: all show 45 square feet and 28 feet. If units or values are off, re-model one garden before exit tickets.

Support: Let students count tiles on pre-drawn 6 by 6 and 10 by 2 grids to see 36 is larger than 20 before multiplying. **Stretch:** Ask students to order the three 24-foot gardens from smallest to largest area and predict the pattern.

Use: Slides 10-11

Common mistakes

Mistake	How to spot it	How to fix it
Mixing units, writing perimeter in square feet or area in feet	See 26 square feet for fence length or 45 feet for floor covering	Sort jobs: paint or carpet to cover a surface needs square units, walking the edge needs linear units [19][6]. Require both labels every time.
Thinking same perimeter means same area	Claims 10 by 2 and 6 by 6 both hold 24 square feet because fence is 24 feet	Calculate both with A = lw [2] to show 20 vs 36, stressing different rectangles with the same perimeter can have different areas [18].
Adding instead of multiplying for area, or multiplying sides for perimeter	Says 8 by 6 rug area is 28, adding 8 + 6 + 8 + 6 for inside	Rebuild with tiles to count 48 squares inside [7], then contrast with adding sides for distance around [11].

Support

- Give a sheet with an 8-unit-long strip already shaded and let students add one row at a time and skip-

Stretch

- Try a larger rug with an area of 96 square feet and a length of 12 feet and find the missing width the same

count by 8s to reach 48.
- Provide multiplication table and pre-labeled length, length, width, width sides to add for perimeter [11].

way.
- Design three different rectangles with an area of 48 square feet and order them from smallest to largest perimeter.

For the LSE or teaching assistant

Stay with the two focus pairs during main activity. Prompt skip-counting by 8s, check that ? is in feet and total in square feet, and use the pre-shaded strip if counting stalls.

Check for understanding

Question	Answer
A bedroom floor is 9 feet by 5 feet. What is its area? Show the math.	45 square feet, 9 x 5 = 45
Same 9 feet by 5 feet room. How much baseboard goes around it?	28 feet, 9 + 9 + 5 + 5 = 28
A rug area is 48 square feet and length is 8 feet. What is the width? How do you know?	6 feet, because 8 x 6 = 48

Homework

At home, sketch a 10 feet by 4 feet rug, find its area and perimeter, and label units correctly.

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