Math is going to the dogs

Two different solution contexts for the Math Is Going to the Dogs investigation are described this month: from Brenda Camaligan's fourth-grade students at Forked River School in Forked River, New Jersey; and from Walter Stark's fifth-grade class at Captain Vincent G. Fowler Elementary School in South Ozone Park, New York.

Getting started

In both cases, students were asked to create possible dog kennel designs with a rectangular floor consisting of forty-eight square tiles that snapped together. The students then determined the amount of fencing that would be needed to enclose their kennels. The task required students to consider the relationships among the side lengths of a rectangle, its area, and its perimeter.

Forked River Elementary School

Camaligan presented the task to her fourth graders as a problem she was trying to solve:

> I am thinking about getting a dog for Christmas. Before I get my dog, I need to design a kennel so that my dog has a safe place to play. For the floor, I purchased forty-eight square floor tiles that click together. Can you help me design a rectangular kennel that will use all the tiles? How many feet of fencing will I need to buy for my kennel? Can you design and find the required fencing for more than one kennel?

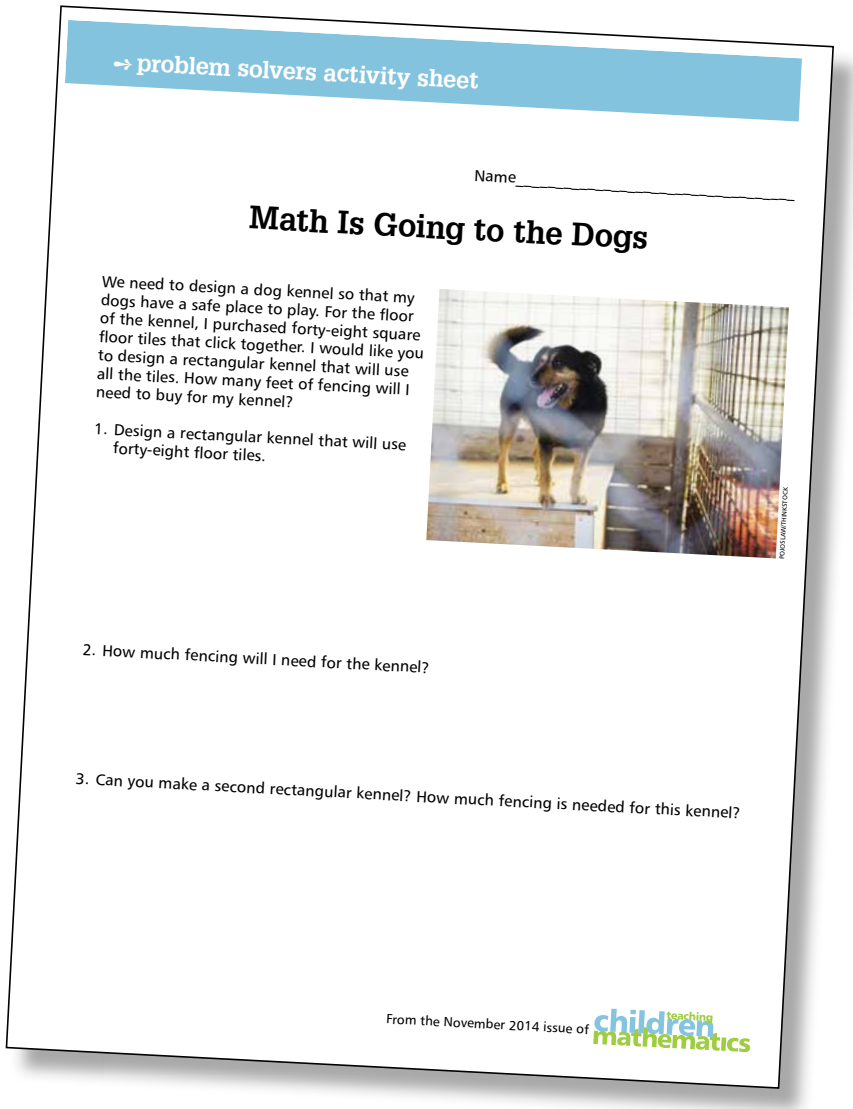
Vincent G. Fowler Elementary School

Stark distributed the Math Is Going to the Dogs activity sheets to his fifth graders and read through the problem with them.

In both classes, students were asked to restate the problem to ensure understanding of the task before they began. As usual, Camaligan and Stark had their students work in pairs. They also provided square tiles, and Stark gave his students grid paper.

MA_RISH/THINKSTOCK

The November 2014 problem offers students a chance to create rectangular dog kennel designs using square tiles and fencing. The investigation focuses on students' understanding of the meaning of area and perimeter and the relationships between them. To access the full-size activity sheet, go to **http://www.nctm.org/tcm**, All Issues.



problem solvers activity sheet

Name_____

Math Is Going to the Dogs

We need to design a dog kennel so that my dogs have a safe place to play. For the floor of the kennel, I purchased forty-eight square floor tiles that click together. I would like you to design a rectangular kennel that will use all the tiles. How many feet of fencing will I need to buy for my kennel?

1. Design a rectangular kennel that will use forty-eight floor tiles.

POSSLAR/THINKSTOCK

2. How much fencing will I need for the kennel?

3. Can you make a second rectangular kennel? How much fencing is needed for this kennel?

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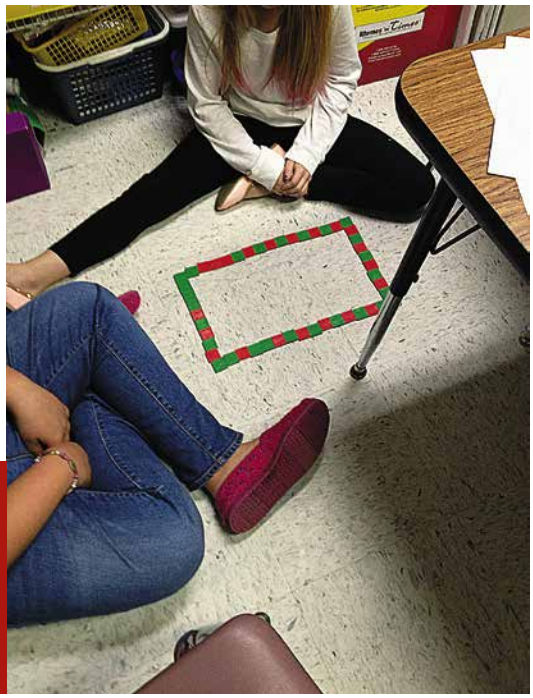
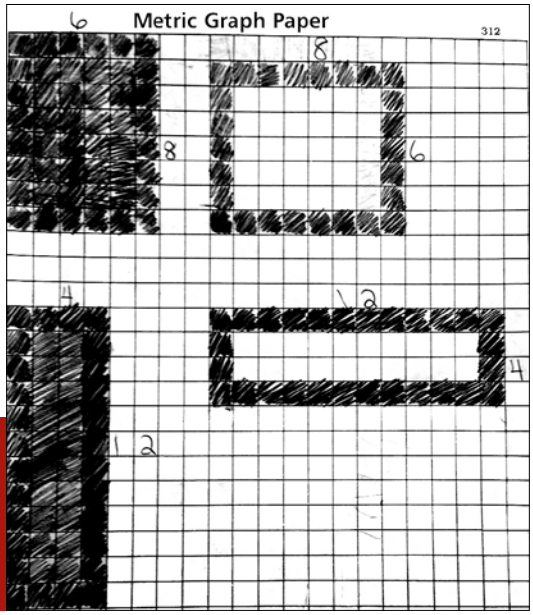


BRENDA CAMALIGAN

These students initially used forty-eight tiles to represent the perimeter of the kennel instead of representing the area or floor of the kennel.

Working on it

As pairs of students begin working, Stark and Camaligan circulated around their respective classrooms, observing students and recording their initial strategies. In both classes, the teachers noticed a number of students laying out forty-eight tiles as the perimeter instead of the area.



This student used the commutative property to determine paired rectangles by "flipping" the lengths and widths.

Instead of correcting students by telling them how to arrange the tiles, Camaligan and Stark asked questions to clarify student thinking, such as "What part of the kennel do the tiles represent?" and "Will there be spaces between the tiles or should they all be connected together?" Most students realized they were modeling the perimeter with the tiles and returned to the task to try to create a rectangular area using forty-eight tiles.

Student discussions

As students worked on determining the different rectangular areas, the teachers listened in on their discussions. Camaligan overheard two of her students discussing the dimensions of the floor area:

"I don't know how long to make it," stated Sarah.

"Wait!" exclaimed Bella. "What makes forty-eight? Four times seven is twenty-eight. Seven times eight is fifty-six. Six times eight—what's six times eight? What's six times eight?"

Sarah voiced her thoughts: "Six groups of eight. We could just count by eights. Wait—should we multiply? Yes, because the floor is the area and we multiply length times width."

These girls had made the important connection of multiplication to the area of a rectangle using the side lengths of the rectangle as factors. Some students in Stark's class made the same connection and concluded that they just needed to find all the factors of forty-eight to determine the different possible rectangles.

One student cautioned against counting the same kennel twice. "If I have a six-times-eight kennel, I don't need to have an eight-times-six kennel."

Another student disagreed and gave the example of a 16 × 3 kennel and a 3 × 16 kennel, describing the first as "long short" and the second as "short long" and explaining that you would need to choose differently, depending on the size of your yard.

Camaligan reports a similar conversation during which Olivia shared that she had built a kennel measuring 6 × 8 and now she was recording 8 × 6. When Camaligan asked her why that would work, she replied, "Because I just flipped the lengths." She then commented that it really was not a different kennel; it had just been turned.

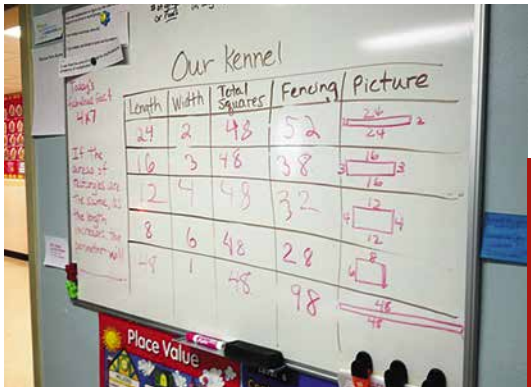
Both of these classes were exploring the commutative property of multiplication that can be seen visually in this context as lengths and widths of the rectangle that can be "turned" so a 6 × 8 kennel becomes a 8 × 6 kennel. Both teachers noticed some students using their understanding of the area of a rectangle as multiplication to determine side lengths as factors of forty-eight. Other students used different strategies based on number sense, such as halving the length and doubling the width. Some students arrived at solutions through guess and check. Camaligan and Stark both observed that although most students were successful in modeling the rectangular area, many students incorrectly assumed that the perimeter of different rectangles with the same areas would also have the same perimeter. A significant number of students experienced difficulty calculating the perimeter. Both teachers decided to focus on this concept during the class discussion of solutions.

Consolidating the learning

Stark and Camaligan decided to share student solutions through the creation of a class table on which they recorded the length, width, area, and perimeter of each rectangle for the class to consider. During this process, both teachers noted that some students had difficulty in determining the perimeter accurately. Camaligan shared one student's attempt to calculate the perimeter:

> She used her finger to trace the perimeter of the rectangle as she counted each tile—a common mistake, which often results in the miscalculation of perimeter. Her peers commented that she had forgotten to count both sides of the corner squares.

In both classrooms, students were surprised to learn that different rectangles with the same area would have different perimeters. To examine this concept more closely with tape and string, Camaligan took her class out to the hall to construct three of the kennels to scale. As a group, the fourth graders then calculated the amount of fencing required for each rectangle and noted that the rectangles with longer sides required more fencing.



This class recorded the different possible kennels in a table that included the length, width, area, perimeter, and a diagram.

Reflections and next steps

Stark and Camaligan both commented that this investigation provided their students with the opportunity to demonstrate their knowledge about perimeter and area while solving a problem in a real-life context. The results of this lesson revealed to Camaligan that her students would benefit from additional practice with rich mathematical tasks involving real-world scenarios to solidify their thinking about and further develop their understanding of the relationships between area and perimeter.

Edited by **Ralph Connelly**, **ralph.connelly@brocku.ca**, an elementary school learning services consultant with the Waterloo Region District School Board in Kitchener, Ontario, Canada. Each month, this section of the department showcases classroom results of using problems presented in previous issues of *Teaching Children Mathematics*. Find detailed submission guidelines for all departments at **http://www.nctm.org/WriteForTCM**.

Students used tape to model the dog kennels to scale.