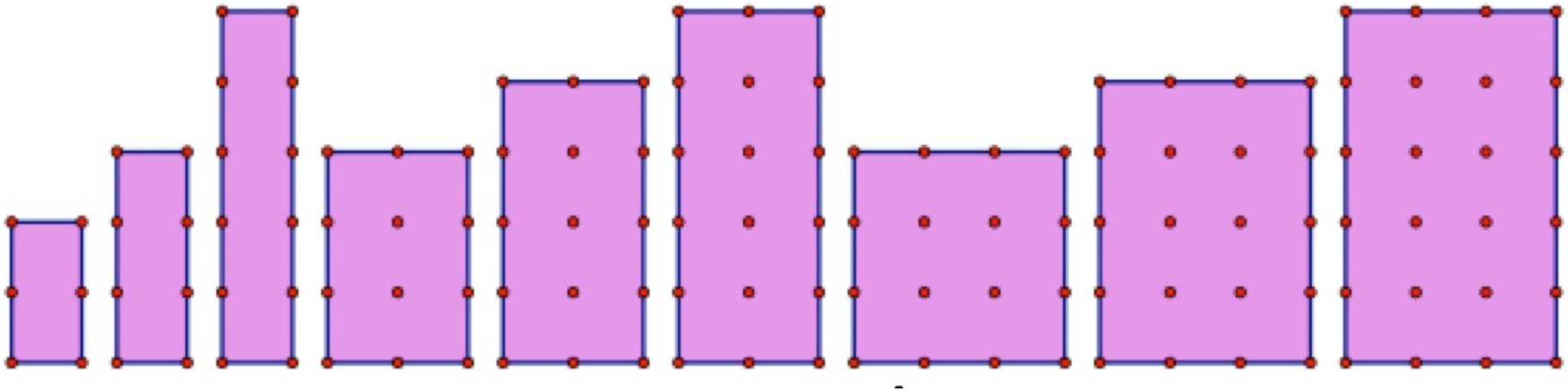


Rectangles

This lesson has been taught in several second-grade classes. It takes about forty-five to fifty-five minutes.

Children draw rectangles on one-inch grid paper (using a one-inch square cutout) by counting, and sometimes grouping and adding, the area of each rectangle in square inches. They then confirm their answers by using a calculator.

PROPS

- calculators
- scissors (one pair per child)
- rulers (one per child)
- pencils
- two or three sheets of one-inch grid paper (our paper was hot pink)
- a large number of square cutouts, one inch on a side, cut from paper colored to contrast with the grid paper (we used white)
- teacher’s calculator viewable by children

THE LESSON

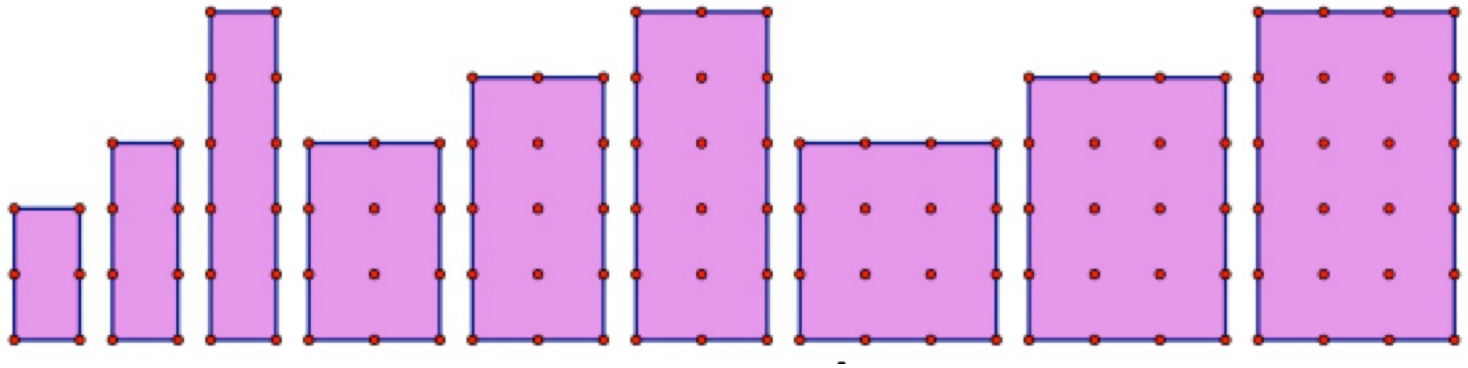
We prepared beforehand a collection of nine rectangles cut from hot pink paper. They were the following sizes: 1 in. by 2 in., 1 by 3, 1 by 5, 2 by 3, 2 by 4, 2 by 5, 3 by 3, 3 by 4, 3 by 5. We taped them to two sheets of white paper, as shown on the slide two ahead, and we posted them on the blackboard with magnets. We passed out all the materials except the white square inches.

Part 1. Drawing and cutting out several rectangles

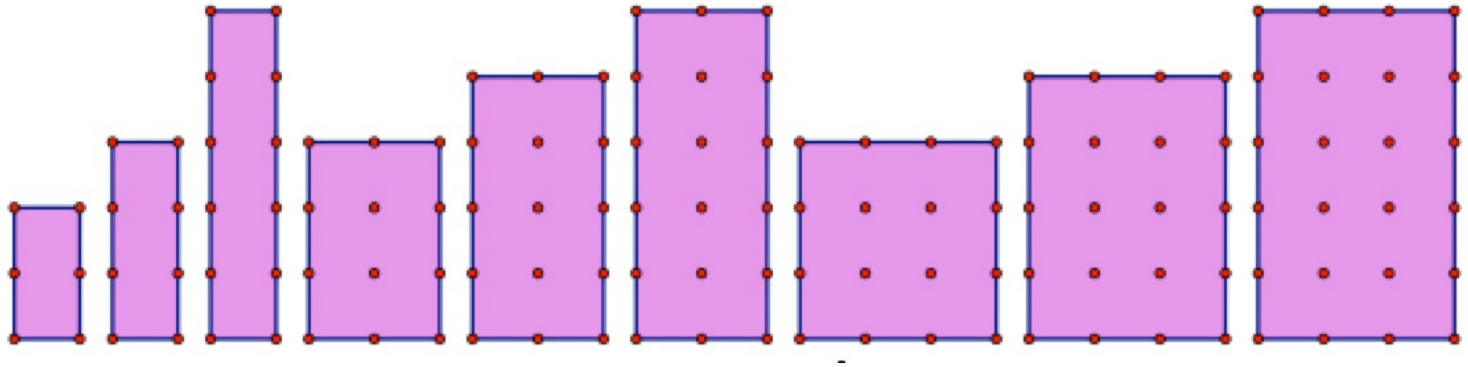
Below we give part of the dialog and interaction that occurred in the classroom.

“Today we are going to start by drawing some rectangles. Does anybody know what a rectangle is?”
Children made a sort of rectangle shape with their fingers. One child said, “It is a shape.” Another said, “It is like a square, only squished.” Another said, “It has four corners.”

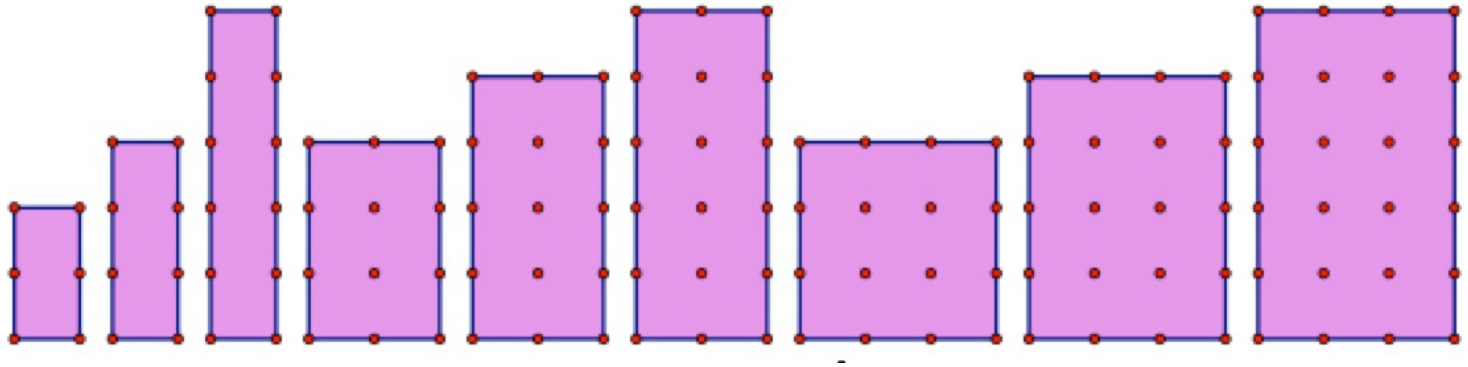
The teacher said, “So, a rectangle is shaped like a window.” The children agreed.



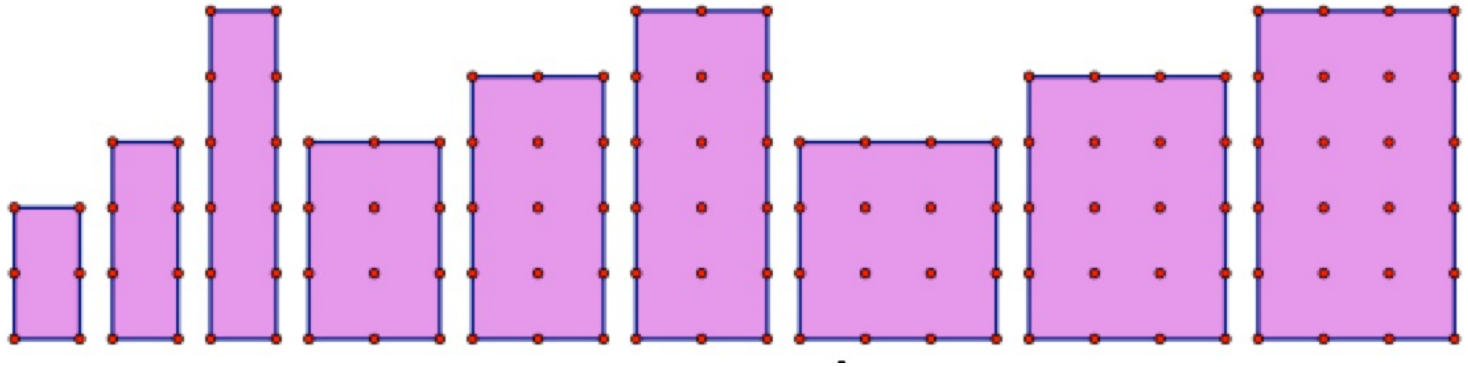
Pointing to the picture, the teacher said, “Here are some rectangles. See how I have sorted them. Here is a skinny bunch, then a medium-sized bunch, and then a fat bunch. Each rectangle has a bottom, a top, and two sides. Now, you take your rulers and pencils and draw some rectangles on your pink paper. Draw a bunch of sizes. There is one rule. Each rectangle must have its four corners on dots. And each rectangle needs to have a bottom, a top, and two sides.”



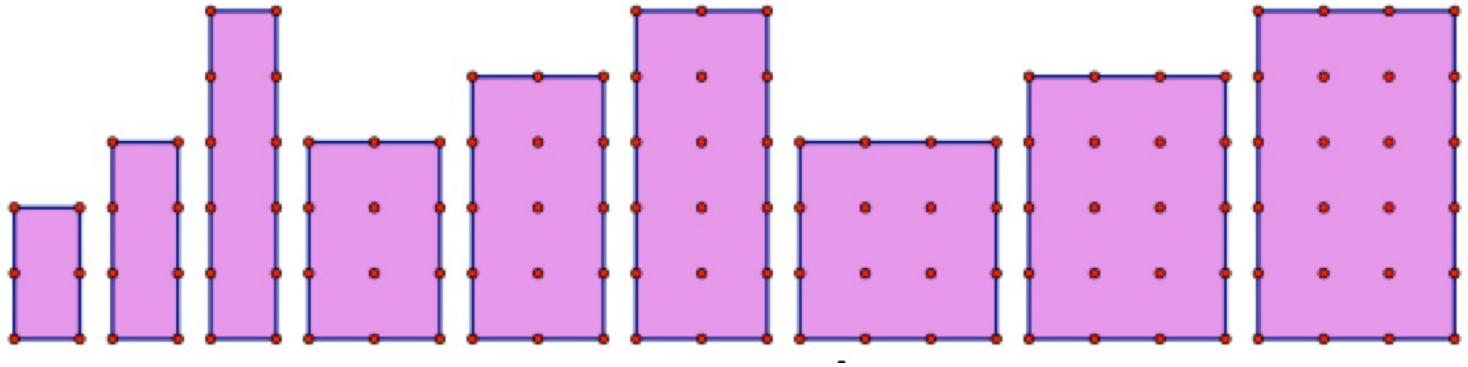
Using a piece of pink grid paper that was propped onto the blackboard, the teacher demonstrated how to draw a rectangle that is five inches high and three inches wide. She counted steps as she pointed to and darkened the dots on her paper. “I start at a corner and I count one step, two steps, three steps. Then I count down, one step, two steps, …” Using a ruler, she drew lines through the darkened dots.



The children began to draw. Many drew free hand and did not even try to use a ruler. Their lines were not very straight. They drew quite a few different sizes.
“Now cut them out!” The children did so,but it was not an easy exercise. They did not cut very straight, and some of the scissors were stiff and not very usable, and had to be exchanged for different ones. The teacher waited until every child had at least two rectangles cut out.



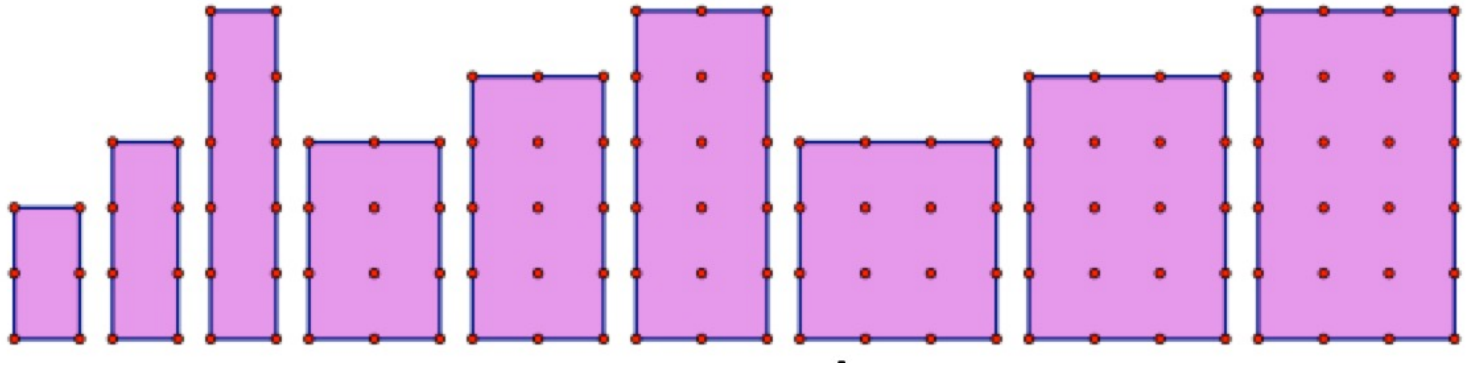
“Can you figure out, using your ruler, how long your rectangle’s bottom is? How tall it is?”
Several children had difficulty determining how tall and how wide their rectangles were, because they would put a corner on the “1” on the ruler, and then count one too many inches. The teacher explained that to do it correctly, you need to count the number of STEPS you would take (as she had demonstrated earlier). So you line up the end of the ruler with the corner, and then you count steps (inches).



Part 2. Finding the areas of the rectangles

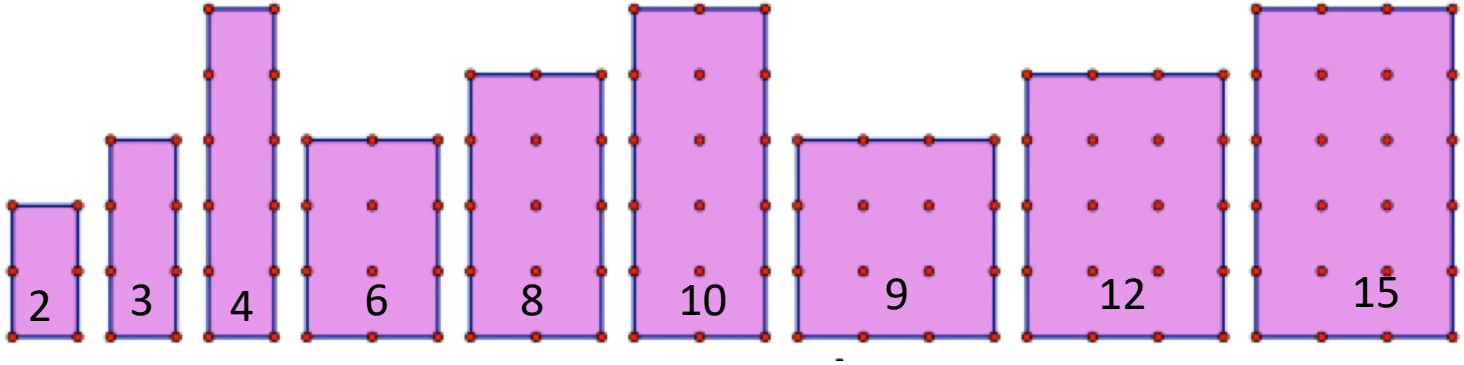
We will now summarize activity in the classroom.

“What’s the smallest rectangle you can make? Remember the rule that every corner has to be on a dot.”
(The children knew, and many cut out one square inch!)
“Measure its sides.”…”We call the square, one square inch….See how it just fits one square inch.” She gave each child one square inch, white in color.

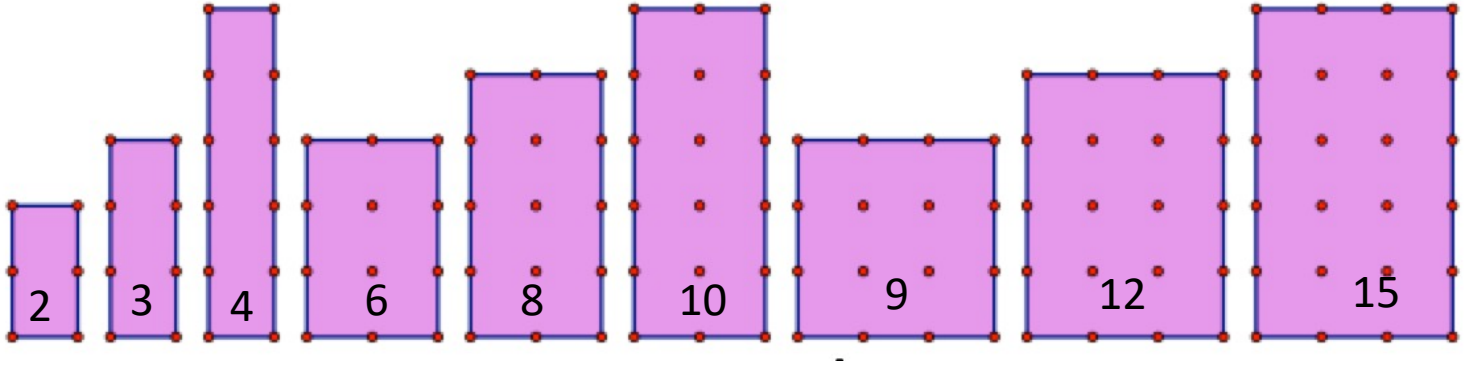


“Now we want to give a name to each rectangle that you have cut out. The name that we give it is its area. It will be a number… the number of square inches that will fit into it. Let me show you how to count.” She demonstrated by moving the white square inch along the 3 by 5 rectangle on the board, carefully counting. “Now I am going to write the rectangle’s name on it: 15. Its area is 15 square inches.”

This was a successful exercise. In counting, each square inch had to have a corner on a dot.

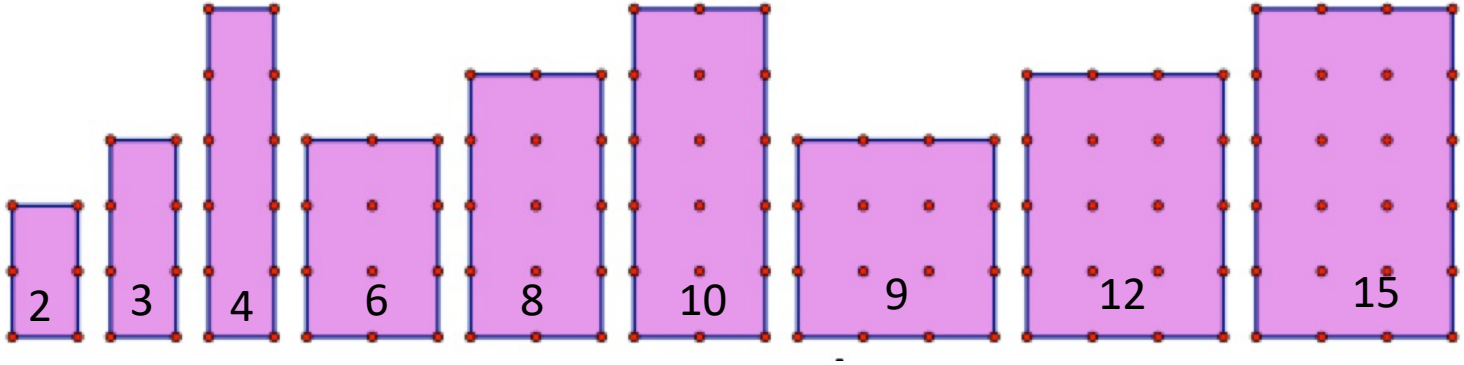


Children were shown how to group and add. For a 3 inch by 4 inch rectangle, they could count 4 + 4 + 4, or 3 + 3 + 3. Eventually children had written a name on each of their rectangles.

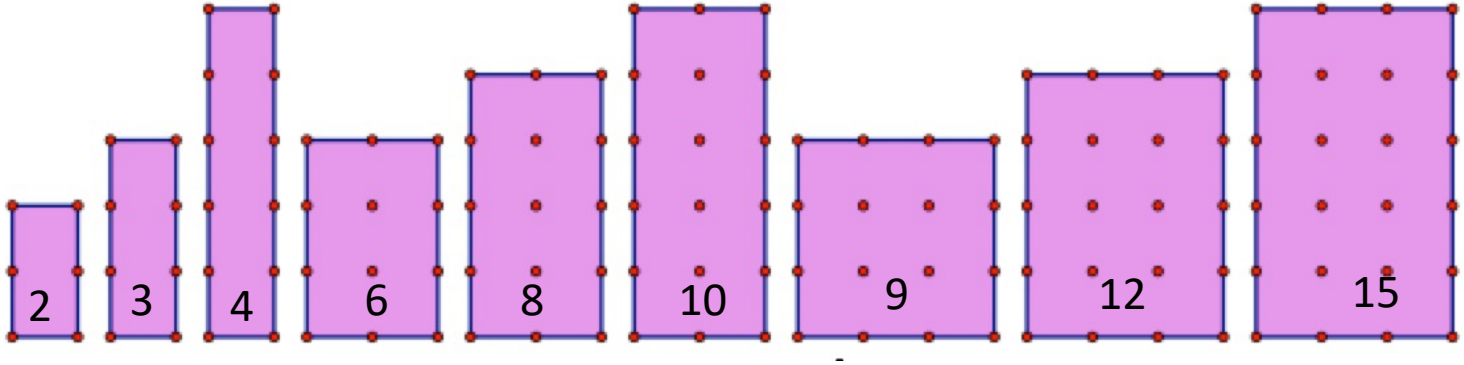


Part 3. Computing areas using ruler and calculator

"Now we are going to see if we gave our rectangles the right names." The teacher asked about the rectangle with 15 written on it. Is it really 15 square inches? She showed, using a ruler, how to measure its bottom and side (3 inches and 5 inches). How to check with a calculator? Children suggested 3 + 3 + 3 + 3+ 3 =. Yes! Is there another way to show it? 5 + 5 + 5 =. And some children suggested, you can "times" it! Three times five equals 15!
"Now, you can check your names!"

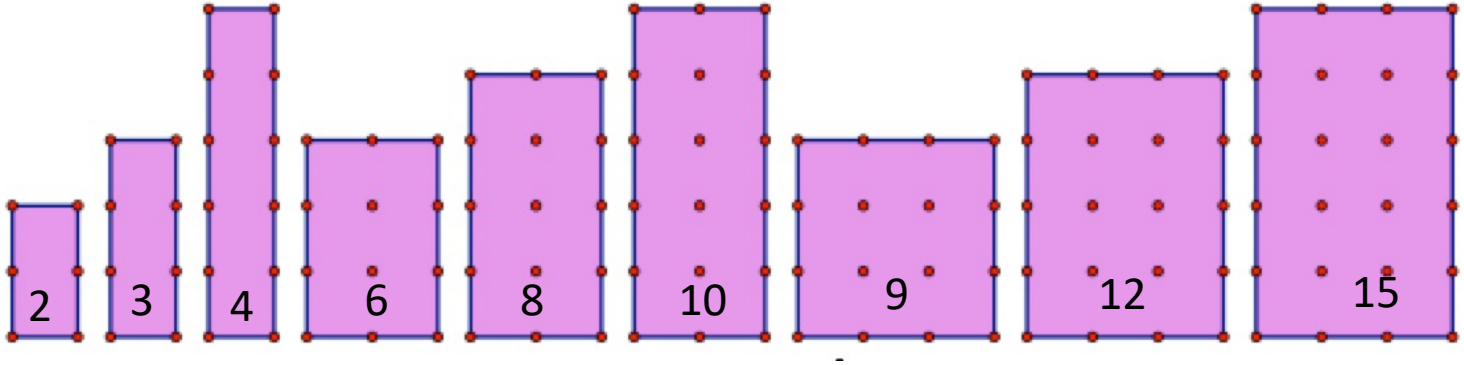


Some children who had made the biggest possible rectangle knew that it had 11 dots on one side and 8 on another, and a few thought that 11 times 8 would give the area in square inches. They said they got 88 instead of 70, which they had counted before. The teacher helped them, by putting the corner of the rectangle at the zero-end of the ruler and counting to seven (not eight) and ten (not eleven).



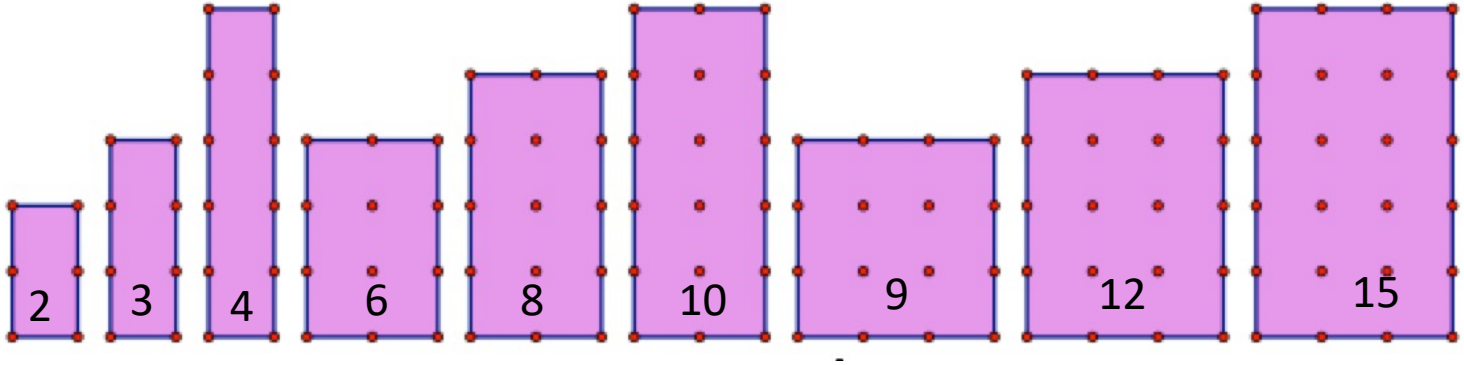
Part 4. Finding the area of a right triangle made from half of a rectangle

Class time was running out, so we did one more quick activity. The teacher held up her 5 by 3 rectangle. “Here is my rectangle named 15. Its area is 15 square inches. I am going to draw a straight line on the rectangle from one corner to the opposite corner. And now I’m going to cut along the line. What do I get?” She showed how to fit the two indentical halves one on top of the other. “Two triangles! And they are alike!”

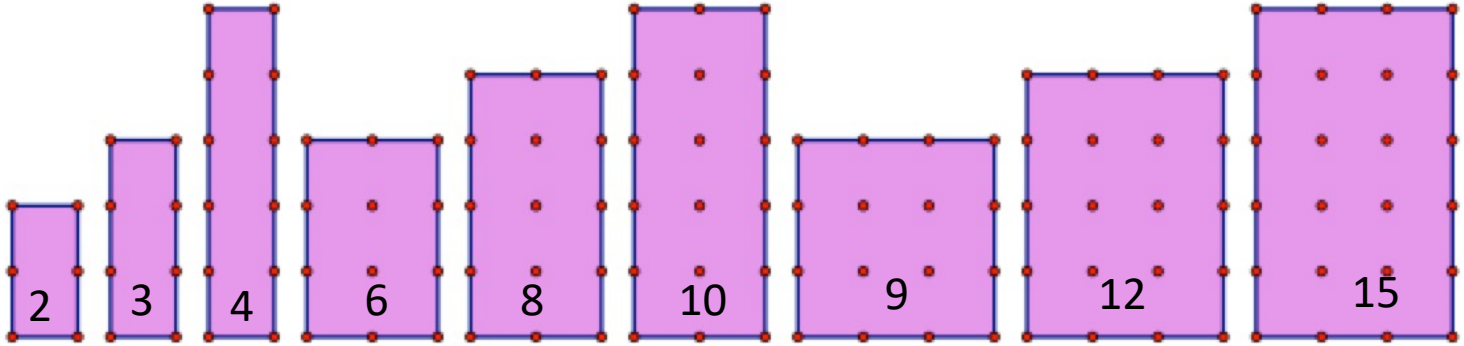


The big question: How many square inches are in each triangle? What name should we give to each triangle?

Some children shouted, “You take half!” “Half of what?” “Half of 15.”
How to do it using the calculator?
You divide.
What do you divide?
Eventually, some children figured that you must divide by 2.



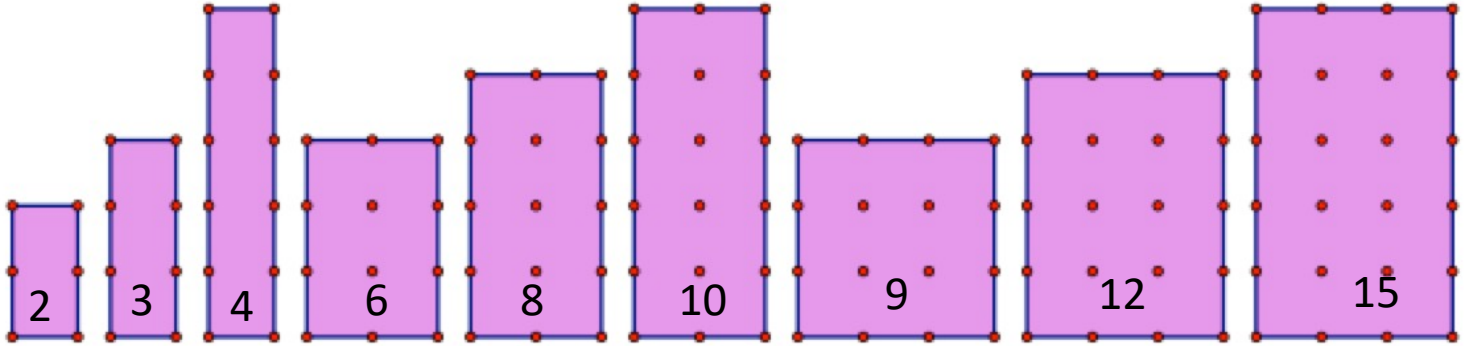
Try it on your calculator. The teacher wrote on the board,
15 ÷ 2 =
They tried it, and they got 7.5. Several read this as seventy-five. "It is seven point five. That is half way between seven and eight square inches. We will learn more about it in another lesson!"
Several children asked to take their rectangles home. We provided envelopes for this activity!



REMARKS

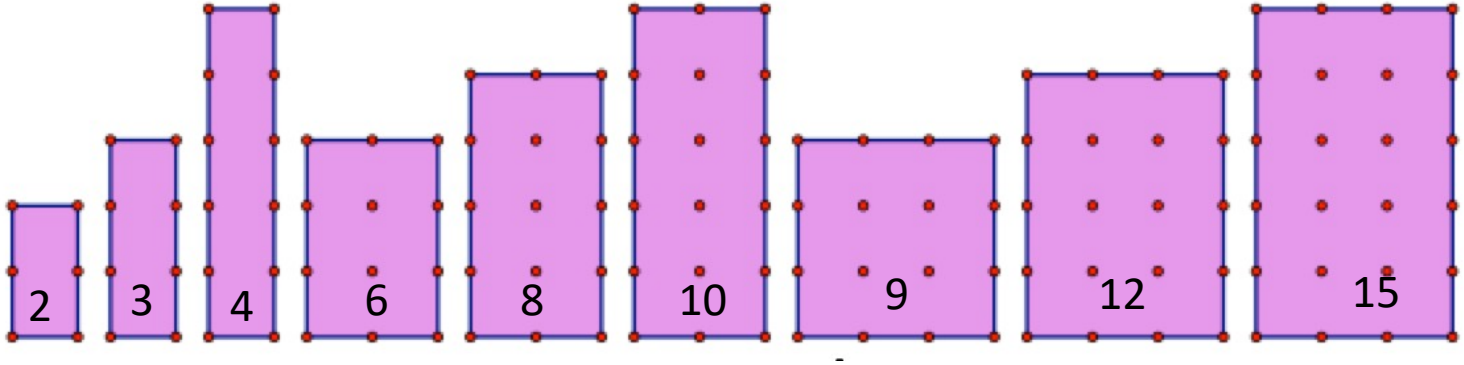
Possible extensions

1. After children have named their rectangles by their areas, have them line them up according to size. Here they can see that a one-inch by ten-inch rectangle has the same name (area) as a two-inch by five-inch.
2. Have children draw diagonals on some of their rectangles and find the area of each half. Because each triangle is one-half of a rectangle, we can compute its area by dividing the area of the rectangle by two!



3. What if you made an rectangle twenty-three inches by fifty-seven inches and cut it into two triangles? (Show about how big that would be!) What would the area of each triangle be?

4. (Hard problem for extra credit) If I want to make two triangles, each with an area of twelve square inches, how can I do it? I can start by making a rectangle. How big does the rectangle need to be? (Answer: 24 square inches.) Can you find more than one way to do it?

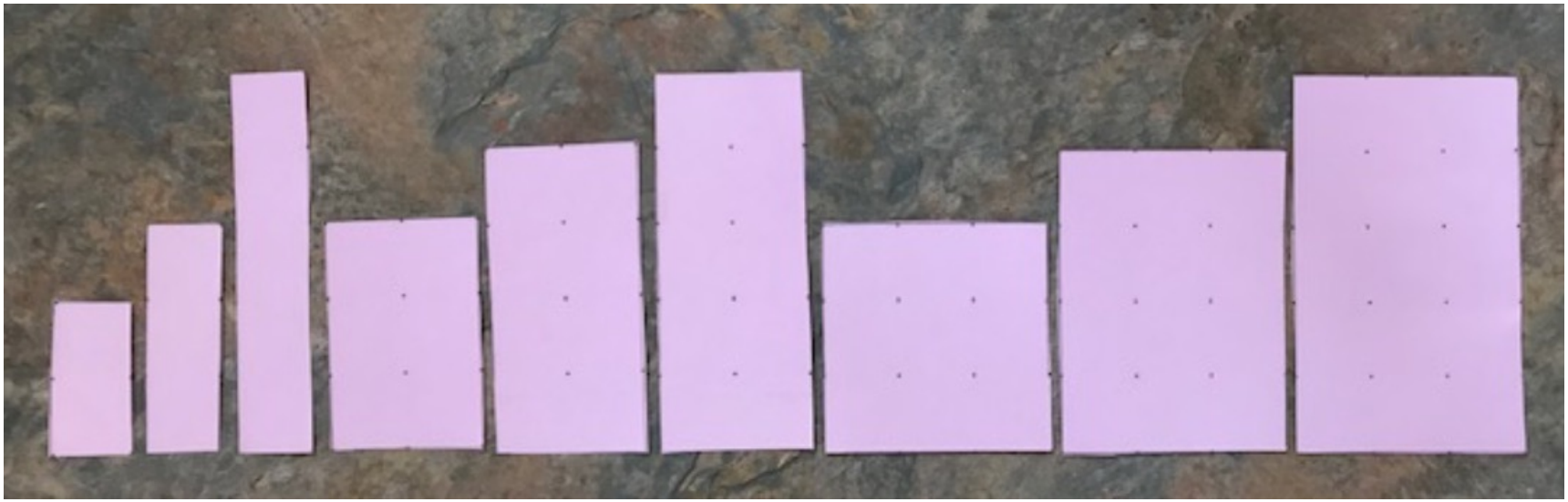


Notes

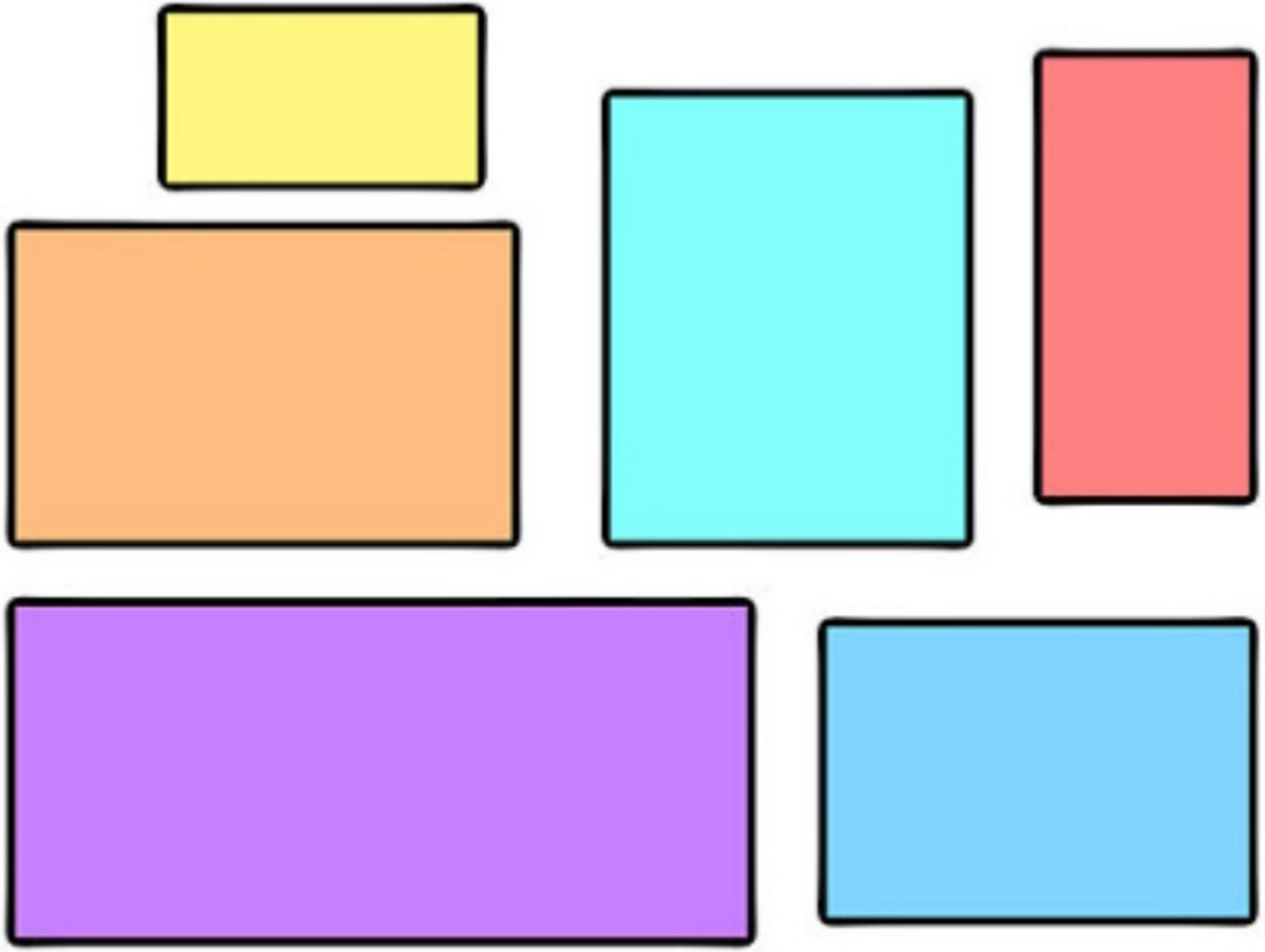
As mentioned before, giving each child a square inch cut out in paper of a contrasting color was key. It allowed children to count accurately.

It is important to say that we are finding the area (first of the rectangles and then of the triangles), and that we are naming the figures using the areas as names. Using mathematically correct terminology is important.

My rectangles, including the one square inch in a different color.



Here they are lined up. Don’t forget the one square inch square! How many square inches altogether?



The End