BORDER TILES

NUMBER • PATTERNS/FUNCTIONS • GEOMETRY

• Pattern recognition
• Square numbers
• Predicting

Getting Ready

What You'll Need

Color Tiles, about 60 each of 2 different colors per pair

Color Tile grid paper, page 91

Crayons

Overhead Color Tiles and/or Color Tile grid paper transparency (optional)

Overview

Children use Color Tiles to model a series of squares and then figure out the number of border tiles and interior tiles in each square. In this activity, children have the opportunity to:

- identify and continue patterns
- explore square numbers
- make generalizations

The Activity

Introducing

- Discuss the concept of a *border*. Invite children to talk about where they have noticed borders.
- Ask children to use Color Tiles to make a square with a border of one color and inside tiles of a different color.
- Have children display or describe their squares.

On Their Own

What number patterns can you find by making Color Tile squares with borders?

- Working with a partner, use Color Tiles to make a 3-by-3 square. Use 1 color for the inside tile and a different color for the border tiles.
- Build 3 more squares with your Color Tiles, each 1 tile bigger on every side than the previous square. Again, use different colors for the border and for the inside.
- Record each of your squares. Also record the number of tiles inside the square, the number of tiles in the border, and the total number of tiles used to make the square.
- Look for patterns in your data. See if you can predict the number of inside tiles and the number of border tiles that you would need to build a 7-by-7 square and an 8-by-8 square. See if you can find a rule that can be used to find these numbers of tiles for any size square.

The Bigger Picture

Thinking and Sharing

Have children help you create a class chart displaying the data for the four squares they built.

Use prompts such as these to promote class discussion:

- How many border tiles and inside tiles did you use in your smallest square? How many in each of your next squares?
- Did you find any interesting relationships between the numbers? If so, what were they?
- What strategies did you use to find the number of inside and border tiles needed for the larger squares?
- Did you discover a rule for finding the number of inside and border tiles needed for any size square? If so, how? What is your rule?

Writing

Have children describe how they moved from building squares to making a rule.

Extending the Activity

Have children repeat the activity, making rectangles instead of squares. Tell one group to start with a 3-by-6 rectangle and increase both the width and the length by one tile for each subsequent rectangle in the sequence. Tell another group of children to begin with a 3-by-6 rectangle and increase the width by one tile and the length by two tiles for each subsequent rectangle in the sequence. Both groups should record their findings, look for patterns, and compare their results.

Teacher Talk

Where's the Mathematics?

The squares children build in this activity should produce the following data:

Dimensions	Number of inside tiles	Number of border tiles	Total number of tiles
3 by 3	1	8	9
4 by 4	4	12	16
5 by 5	9	16	25
6 by 6	16	20	36

Children may discover a number of patterns in the data. Some may notice that as the squares grow larger, the differences between the numbers of inside tiles are 3, 5, and 7, odd numbers increasing by two. Others may note that the numbers of inside tiles (1, 4, 9, and 16) are square numbers. They may decide that this is so because the inside tiles form a small square inside the larger one. In either case, children may continue their patterns to arrive at the number of inside tiles in a 7-by-7 square (25) and an 8-by-8 square (36).

Either of these patterns may start children thinking about a rule for the number of inside tiles. Children may notice that the inside tiles form a smaller square—a square whose sides are two tiles smaller than the original square. For example, the inside tiles of a 5-by-5 square form a 3-by-3 square. Many children may know that the product of these dimensions tells how many tiles are in the square. They may, therefore, generalize that to find the number of inside tiles needed to build a square of a certain size, they should subtract 2 from the number of tiles on a side and multiply that number by itself.

Some children may be able to represent this generalization algebraically, stating that the number of inside tiles in an S-by-S square is (S – 2) x (S – 2).

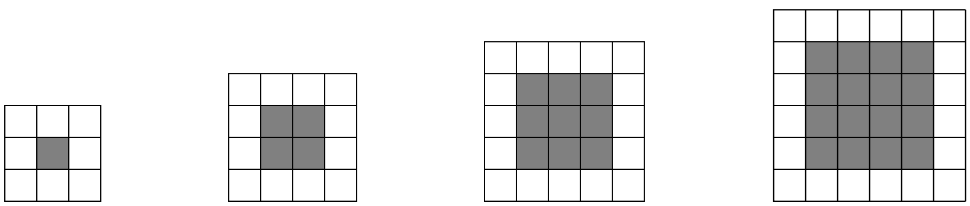
Children may also find patterns in the numbers of border tiles. For example, the number of tiles in the border of each successive square increases by 4.

Children may continue this pattern of adding 4 to determine the number of border tiles needed for successively larger squares. There will be 24 tiles in the border of a 7-by-7 square and 28 tiles in that of an 8-by-8 square.

Other children may use their square models to figure out the relationship between the number of tiles on a side of the square and the number of tiles in the border. They may generalize this relationship in different ways. They may say, for example, that the number of tiles needed in a border is four times the number of tiles on a side of the square minus 4 because the four corners are counted twice. Still other children may add the lengths of two of the sides of the original square and then add on the lengths of the other two sides, subtracting 2 from each of the second two sides first (the two corners having already been counted in the first two sides). Some might find the total number of border tiles by squaring the length of a side and then subtracting the number of tiles in the inner square.

Some children may try to represent these generalizations algebraically. Depending on the relationship they see, they might express the number of the tiles in the border of an S-by-S square as (4 x S) – 4, or S + S + (S – 2) + (S – 2), or $S^2 - (S - 2)^2$.

Children who have experience with number patterns may recognize a relationship between the number of tiles needed and the number of the square in the sequence of squares. For example, children may notice that the first square has 1 x 1 inside tiles; the second, 2 x 2 inside tiles; the third, 3 x 3 inside tiles, and so on. To find the number of tiles needed for a 7-by-7 square, these children may think: "This would be the fifth square in the sequence; therefore it would have 5 x 5, or 25, inside tiles. Subtracting this number from the total number of tiles in the square (7 x 7) tells me there would be 49 – 25, or 24, border tiles."



1st square 1 (1 x 1) inside tile — 2nd square 4 (2 x 2) inside tiles — 3rd square 9 (3 x 3) inside tiles — 4th square 16 (4 x 4) inside tiles

COLOR TILE GRID PAPER