LESSON 1

Expressions and Equations

Squares and Square Roots

Objective

Find the square of a number and the square root of a perfect square.

Common Core State Standards

- **8.EE.2** Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

Building squares helps students identify the relationship between squares and square roots. Students who can find the square roots of perfect squares are better prepared to estimate the square roots of other numbers. Learning these skills enables students to understand and use the Pythagorean relationship, the quadratic formula, and the distance formula.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *Why is a number written with an exponent of 2 often read as that number squared?*
- **Ask:** *What is the relationship between a square and its square root?*
- **Ask:** *How can you find the square root of a number if you do not have tiles to make a square?*

Solve It

Reread the problem with students. Discuss how the questions relate to finding squares and square roots. Have students write a paragraph using the terms *square* and *square root* to answer the Try It! questions.

More Ideas

For other ways to teach the relationship between squares and square roots—

- Have students use Centimeter Cubes to make square arrays and record their observations in a table. One row of the table will be side length, or square root, and the second row will be the total number of cubes, or square. Encourage pairs to combine their cubes to make squares for larger numbers.
- Use Cuisenaire® Rods to have students model squares with side lengths up to 10 units. Have students group rods of equal length to make each square. The number of rods used equals the side length, or square root.
- Use Geoboards to make four of the square designs in the problem. Instruct students to consider the space between pegs as one unit when making squares.

Formative Assessment

Have students try the following problem.

What is the square root of 100?

A. 1 **B.** 10 **C.** 1,000 **D.** 10,000

Try It!

25 minutes | Groups of 4

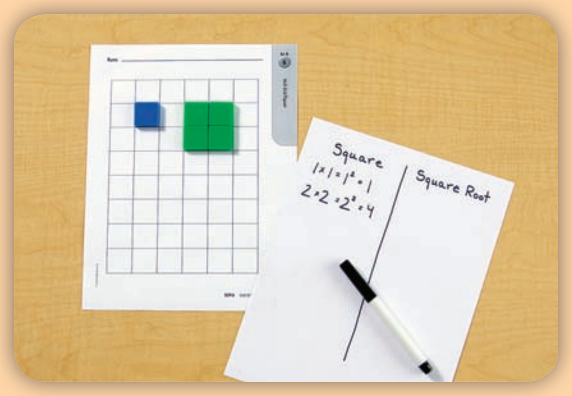
Here is a problem about squares and square roots.

Kayla uses 91 square tiles to make 6 designs. Each design is a square and all are different sizes. How many tiles are used in each square? What is the length of the sides in each square?

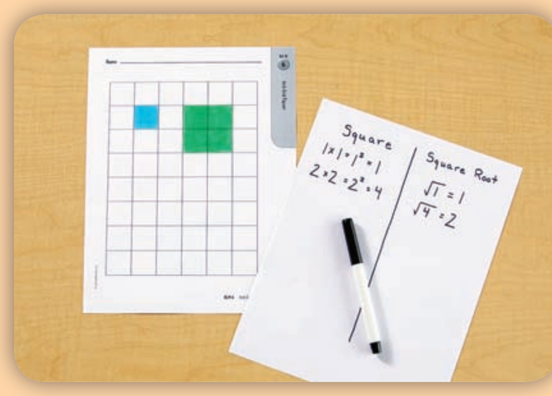
Introduce the problem. Then have students do the activity to solve the problem. Define the terms *square* and *square root.* Ask students to label one side of their papers "Square" and the other side "Square Root". Distribute the materials.

Materials

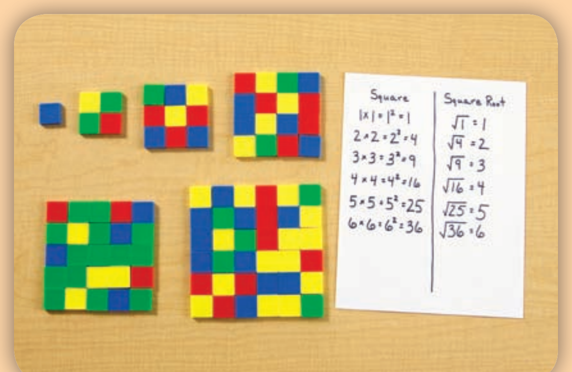
- Color Tiles (91 per group)
- Inch Grid Paper (BLM 1; 1 per group)
- paper (1 sheet per group)
- pencils (1 per group)
- colored pencils (2 per group)



1. On the grid paper, have students build a 1 × 1 and a 2 × 2 square. **Ask:** *How can you find the number of tiles in each square?* Write $1 \times 1 = 1^2 = ?$ and $2 \times 2 = 2^2 = ?$ on the board. Review the meaning of the exponent 2. Have students write equations to show each square number.



2. **Ask:** *Which part of the square represents the square root?* Write $\sqrt{4} = 2$ on the board. Explain that the radical sign means "find the square root." Have students copy the equation and write an equation showing the square root of 1 on their papers.



3. Have students use tiles to make the other squares. Remind them to include a one-tile square in their list and to use the appropriate symbols when writing equations for the square and the square root.

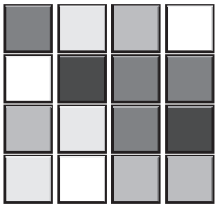
Look Out!

If students have difficulty finding the 6 smallest perfect squares, suggest that they start with one tile, add one tile to the row, and then add a tile to each column to make a square. Encourage them to continue this method to build larger squares. If students confuse the square and square root, point out that in mathematics *root* means "the answer." For a given number of tiles, the square root of that number gives the dimensions of the square that can be built with the tiles.

Use Color Tiles to model each number. Write the perfect square under the radical symbol. Write the square root.

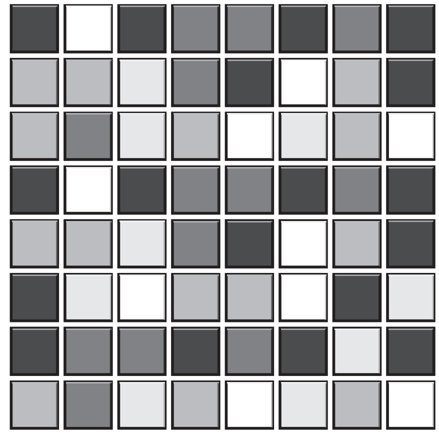
(Check students' work.)

1.



$\sqrt{16}$ = 4

2.



$\sqrt{64}$ = 8

Using Color Tiles, model each number to determine if it is a perfect square. Sketch the model. Write the perfect square under the radical. Write the square root.

(Check students' models.)

3. 36

$\sqrt{36}$ = 6

4. 100

$\sqrt{100}$ = 10

Find each square root.

5. $\sqrt{4}$ 2

6. $\sqrt{81}$ 9

7. $\sqrt{144}$ 12

8. $\sqrt{25}$ 5

9. $\sqrt{9}$ 3

10. $\sqrt{16}$ 4

11. $\sqrt{49}$ 7

12. $\sqrt{121}$ 11

13. $\sqrt{1}$ 1

Answer Key

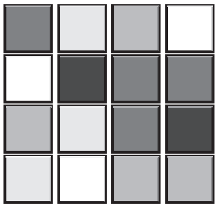
Challenge! Use the pattern that you noticed on the previous page to find the square root of 400. Explain.

Challenge: (Sample) Two identical numbers that can be multiplied to equal 400 are 20 and 20. So, $\sqrt{400} = 20$.

Name ______________________________

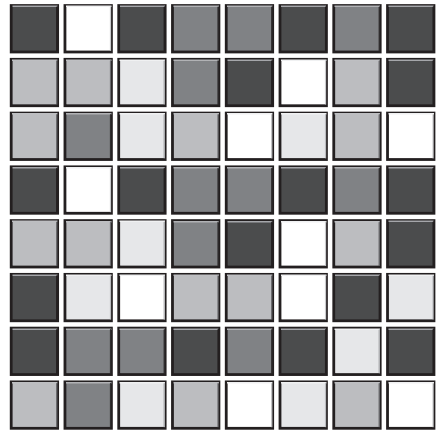
Use Color Tiles to model each number. Write the perfect square under the radical symbol. Write the square root.

1.



$\sqrt{}$ = ________

2.



$\sqrt{}$ = ________

Using Color Tiles, model each number to determine if it is a perfect square. Sketch the model. Write the perfect square under the radical. Write the square root.

3. 36

$\sqrt{}$ = ________

4. 100

$\sqrt{}$ = ________

Find each square root.

5. $\sqrt{4}$ ____________

6. $\sqrt{81}$ ____________

7. $\sqrt{144}$ ____________

8. $\sqrt{25}$ ____________

9. $\sqrt{9}$ ____________

10. $\sqrt{16}$ ____________

11. $\sqrt{49}$ ____________

12. $\sqrt{121}$ ____________

13. $\sqrt{1}$ ____________

Name ________________________________

Challenge! Use the pattern that you noticed on the previous page to find the square root of 400. Explain.

BLM 1

Inch Grid Paper

Name ____________________