Lesson 1-5
Solve Equations Using Square Roots and Cube Roots

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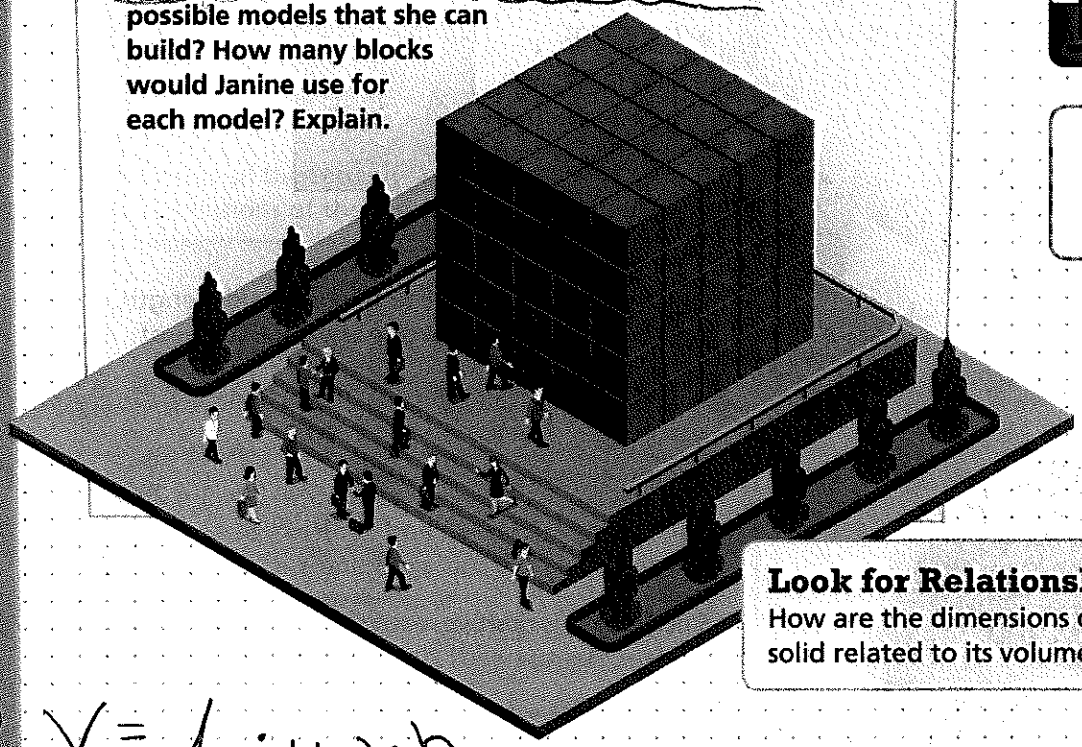
Solve & Discuss It!

ACTIVITY

Janine can use up to 150 one-inch blocks to build a solid, cube-shaped model. What are the dimensions of the possible models that she can build? How many blocks would Janine use for each model? Explain.



I can...
solve equations involving squares or cubes.

Common Core Content Standards
8.EE.A.2

Mathematical Practices
MP.2, MP.3, MP.6, MP.7, MP.8

Look for Relationships
How are the dimensions of a solid related to its volume? MP.7

$V = l \cdot w \cdot h$

$5 \times 5 \times 5$

$4 \times 4 \times 4$

$3 \times 3 \times 3$

$2 \times 2 \times 2$

$1 \times 1 \times 1$

Focus on math practices

Reasoning Janine wants to build a model using $\frac{1}{2}$-inch cubes. How many $\frac{1}{2}$-inch cubes would she use to build a solid, cube-shaped model with side lengths of 4 inches? Show your work. MP.2

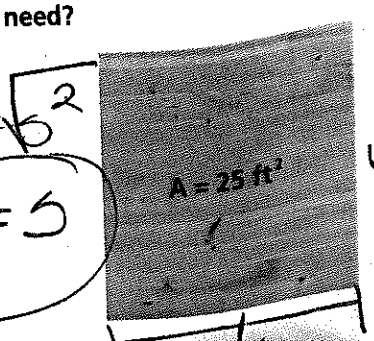
Essential Question How can you solve equations with squares and cubes?

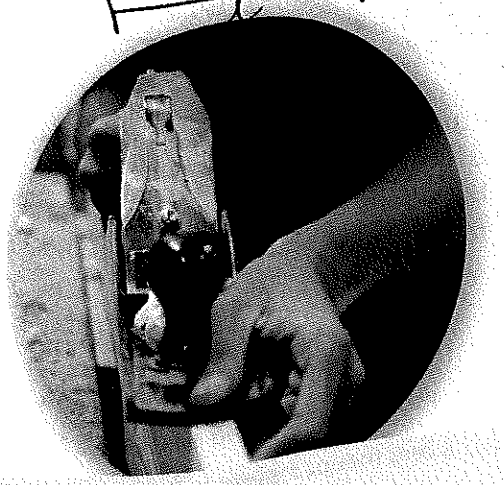
INTERACTIVE ANIMATION ASSESS

Scan for Multimedia

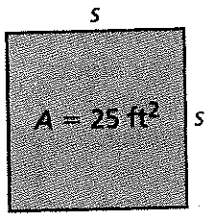
EXAMPLE 1 Solve Equations Involving Perfect Squares

Darius is restoring a square tabletop. He wants to finish the outside edges with a piece of decorative molding. What total length of molding will Darius need?





Draw a diagram to represent the tabletop.



Use the formula $A = s^2$ to find each side length. To solve, take the square root of both sides of the equation.

$$A = s^2$$
$$25 = s^2$$
$$\sqrt{25} = \sqrt{s^2}$$
$$\pm 5 = s$$

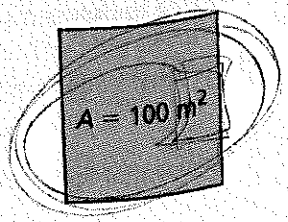
Because $5^2 = 5 \times 5 = 25$ and $(-5)^2 = -5 \times -5 = 25$, $s = 5$ and $s = -5$, or $s = \pm 5$.

Since length is positive, each side length of the tabletop is 5 feet. Darius needs 20 feet of decorative molding.

Generalize In general, an equation of the form $x^2 = p$, where p is a positive rational number, has two solutions, $x = \pm\sqrt{p}$. MP.8

Try It!

What is the side length, s, of the square below?



$A = s^2$

$\square = s^2$

$\square = \sqrt{s^2}$

$\pm\square = s$

Each side of the square measures $\square$ meters.

Convince Me! Why are there two possible solutions to the equation $s^2 = 100$? Explain why only one of the solutions is valid in this situation.

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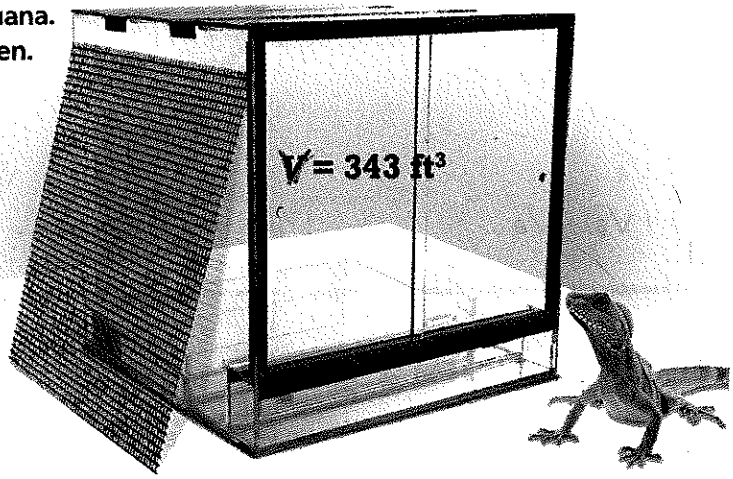
EXAMPLE 2 Solve Equations Involving Perfect Cubes

Kyle has a large, cube-shaped terrarium for his iguana. He wants to cover the opening with a square screen. What are the dimensions, *s*, for the screen?



$V = s^3$

$343 = s^3$

$\sqrt[3]{343} = \sqrt[3]{s^3}$

$7 = s$

The value of s is not $\pm\sqrt[3]{343}$ because $(-7)^3 = -7 \times -7 \times -7 = -343$.

Each edge of the terrarium is 7 feet, so the dimensions of the screen are 7 feet by 7 feet.

* an exponent of 3 is undone by the $\sqrt[3]{}$ (cube root

Try It!

Solve $x^3 = 64$.

$\sqrt[3]{x^3} = \sqrt[3]{64}$

$x = 4$

EXAMPLE 3 Solve Equations Involving Imperfect Squares and Cube

Solve for *x*.

A. $x^2 = 50$

$\sqrt{x^2} = \sqrt{50}$

$x = \pm\sqrt{50}$

Because 50 is not a perfect square, write the solution using the square root symbol.

There are two possible solutions, $x = +\sqrt{50}$ and $x = -\sqrt{50}$.

B. $x^3 = 37$

$\sqrt[3]{x^3} = \sqrt[3]{37}$

$x = \sqrt[3]{37}$

$x = \sqrt[3]{37}$ is an exact solution of the equation.

There is one possible solution, $x = \sqrt[3]{37}$.

If it says to estimate then find imperfect squares to the nearest tenth. If not leave with the radical

Try It!

a. Solve $a^3 = 11$.

$\sqrt[3]{a^3} = \sqrt[3]{11}$

$a = \sqrt[3]{11}$

b. Solve $c^2 = 27$.

$\sqrt{c^2} = \sqrt{27}$

$c = \pm\sqrt{27}$

Solving Algebraically

	$1.\overline{23}$	$5.4\overline{3}$
x = fraction of the original decimal	$x = 1.\overline{23}$	$x = 5.4\overline{3}$
	$100[x = 1.\overline{23}]$	$[x = 5.4\overline{3}]10$
	$100x = 123.\overline{23}$ $-x \quad -1.\overline{23}$	$10x = 54.\overline{33}$ $-x \quad -5.4\overline{3}$
	$\frac{99x}{99} = \frac{122}{99}$	$\frac{9x}{9} = \frac{48.9}{9}$
	$x = 1\frac{23}{99}$	$x = \frac{48.9}{9}\left(\frac{10}{10}\right)$
		$x = \frac{489}{90}$ $90\overline{)489}$
		$x = 5\frac{39}{90}$
		$x = 5\frac{13}{30}$

Solving $\sqrt{\ }$ + $\sqrt[3]{\ }$ algebraically

$\sqrt{a^2} = \sqrt{64}$

$a = 8 + -8$

$a = \pm 8$

$\sqrt[3]{x^3} = \sqrt[3]{512}$

$x = 8$

$\sqrt{b^2} = \sqrt{-9}$

$b =$ no solution

$\sqrt[3]{y^3} = \sqrt[3]{-27}$

$y = -3$

$\sqrt[3]{z^3} = \sqrt[3]{125}$

$z = 5$

$\sqrt{c^2} = \sqrt{4}$

$c = 2 + -2$

$c = \pm 2$