G8 Playlist: Finding Roots of Perfect Squares and Perfect Cubes

Aligns with *CCSS.MATH.CONTENT.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.

Related Standards

- 6.EE.1 - Write and evaluate numerical expressions involving whole-number exponents.
- 6.EE.A.2C - Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).
- N-RN.1Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

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Objectives

In this module, you will learn and practice the following skills:

- Find square roots of numbers in the form $x^2 = p$.
- Find cube roots of numbers in the form $x^3 = p$.
- Know that $\sqrt{2}$ is irrational.

Let's get started!

Key Terms

- A **radical** is the symbol we place over a number to show we are finding its square or cube root.
- A **radicand** is the name of the number inside the radical.
- The **index** is the small number that denotes whether we are dealing with a square root or cube root.
- A **perfect square** is the result of multiplying a number by itself. For example, 4 is a perfect square because 2 multiplied by itself equals 4.
- A **perfect cube** is the result of multiplying a number as a factor 3 times. For example, 8 is a perfect cube because 2 • 2 • 2 = 8.
- The **square root** of a number, x, is the number that, when multiplied by itself, equals x. For example, the square root of 16 is 4, because 4 • 4 = 16. Finding the square root of a number is the inverse operation of squaring a number.
- The **cube root** of a number, x, is the number that, when multiplied as a factor three times, equals x. For example, the cube root of 27 is 3, because 3 • 3 • 3 = 27. Finding the cube root of a number is the inverse operation of cubing a number.
- An **integer** is a whole number that is positive, negative, or zero.

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Welcome

When solving algebraic problems, we are sometimes left with results that include perfect squares or perfect cubes. By this lesson, you will be able to identify perfect squares and perfect cubes and find the roots of perfect squares and perfect cubes. Here's a warm-up: what number multiplied by itself equals 49?

Watch!

For a quick overview of finding roots of perfect squares and perfect cubes, watch these videos:

- https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-roots/v/introduction-to-square-roots
- https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-roots/v/introduction-to-cube-roots

Focus: Determining if a Number is Rational or Irrational.

Rational numbers can be expressed as ratios (fractions). These include:

Fractions: $\frac{2}{5}$		
Integers: –5	400	–5
Terminating Decimals:	1.25	5.6
Repeating Decimals: $1.\overline{1}$		$2.\overline{28}$

Irrational numbers are non-terminating decimals. They don't repeat and don't end. You will see in this lesson that the roots of numbers that are not perfect squares or perfect cubes will end up being irrational.

For example: $\sqrt{2} = 1.41421356\ldots$

Answers

What number multiplied by itself equals 49?

7 • 7 = 49

You just found your first square root! Another way to ask this question is "what is the square root of 49?".

Watch!

For a quick overview of determining if a number is rational or irrational, watch this video:

- https://www.opened.com/video/32-irrational-numbers/116111

Is $\sqrt{15}$ rational or irrational?

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Explore

A **perfect square** is formed when you multiply a number by itself. A **perfect cube** is formed when you use a number as a factor three times. The best way to find the roots of **perfect squares** and **perfect cubes** is to memorize the perfect squares and cubes.

Squares	Cubes
$1^2 = 1$	$1^3 = 1$
$2^2 = 4$	$2^3 = 8$
$3^2 = 9$	$3^3 = 27$
$4^2 = 16$	$4^3 = 64$
$5^2 = 25$	$5^3 = 125$
$6^2 = 36$	$6^3 = 216$
$7^2 = 49$	$7^3 = 343$
$8^2 = 64$	$8^3 = 512$
$9^2 = 81$	$9^3 = 729$
$10^2 = 100$	$10^3 = 1000$
$11^2 = 121$	
$12^2 = 144$	
$13^2 = 169$	
$14^2 = 196$	
$15^2 = 225$	

To find the square root of 25, you know that $5^2 = 25$, so the square root of 25 is 5.

> You can write this as $\sqrt{25} = 5$. The check-mark looking symbol is called a **radical** and the number inside the radical is called the radicand.

To find the cube root of 27, you know that $3^3 = 27$, so the cube root of 27 must be 3.

> You can write a cube root as $\sqrt[3]{27} = 3$. Notice the small 3, called the **index** that tells us this is a cube root instead of a square root.

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To find higher perfect squares and cubes, guess and check. For example, if you need to find the square root of 324, you know it is bigger than 15 because 15 squared is 225. You also know the square root is smaller than 20 because 20 squared is 400. Try 17 squared and you get 289. Try 18 squared and you get 324. So the square root of 324 is 18.

When you have a number that is not a perfect square, you are left with an **irrational** number. For example, if you take the square root of 2, you will find no number that multiplies by itself to make 2. In decimal form, $\sqrt{2}$ is close to 1.414213562…, but this decimal goes on forever and never repeats, which is how we know it is irrational.

Watch!

For a more information about finding roots of perfect squares and perfect cubes, watch these videos:

- https://www.youtube.com/watch?v=-Tgqhhkd-BA
- https://www.youtube.com/watch?v=8UnqUToS2DY
- https://www.youtube.com/watch?v=lZDAd_YzwfE
- https://www.youtube.com/watch?v=w6ILmBtwYCg
- https://www.youtube.com/watch?v=sNWidbBJ5Ro end 3:55
- https://www.youtube.com/watch?v=h_LE1wzMx-0

Practice!

You can practice finding roots of perfect squares and perfect cubes by completing these activities:

- https://www.khanacademy.org/math/pre-algebra/exponents-radicals/cube-root-tutorial/e/cube_roots
- https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-roots/e/equations-w-square-and-cube-roots
- https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-numbers-operations/cc-8th-roots/e/more-square-and-cube-root-problems
- https://www.khanacademy.org/math/pre-algebra/exponents-radicals/radical-radicals/e/square_roots

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