Today's lesson continues our investigation of real numbers focusing on perfect cubes and cube roots.

Please gather your clicker and your notebook.

You will want to copy a table of the first ten perfect cube numbers into your notes, as well as any notes on vocabulary and procedures.

There are three clicker questions today.

1-3 Cube Roots

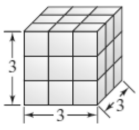
What You'll Learn

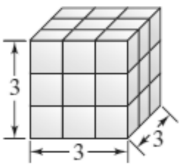
To find cube roots and to solve cube root equations

New Vocabulary perfect cube, cube root

Why Learn This?

The large cube at the right is made up of smaller unit cubes. You can use this type of model to help you understand perfect cubes and cube roots.





A cube number is a power with an exponent of 3. A number that is the cube of a whole number is a **perfect cube**. For example, $3 \cdot 3 \cdot 3$, or 3^3, is 27. So 27 is a perfect cube.

The **cube root** of a number is a number that, when used as a factor three times, is equal to the given number. Since 3^3, or $3 \cdot 3 \cdot 3$, is 27, 3 is the cube root of 27.

Perfect Cubes

n	n^3
0	0
1	1
2	8
3	27
4	64
5	125
6	216
7	343
8	512
9	729
10	1,000

EXAMPLE **Finding Cube Roots of Perfect Cubes**

1 Find the cube root of each number.

a. 8 $2 \cdot 2 \cdot 2 = 8$ ← The cube root of 8 is 2.

b. -125 $-5 \cdot -5 \cdot -5 = -125$ ← The cube root of -125 is -5.

c. $\frac{1}{64}$ $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} = \frac{1}{64}$ ← The cube root of $\frac{1}{64}$ is $\frac{1}{4}$.

Example

1 Finding Cube Roots of Perfect Cubes Find the cube roots of each number.

a. 27

$3 \cdot 3 \cdot 3 = 27$

So, the cube root of 27 is [redacted]

b. -343

$-7 \cdot -7 \cdot$ [redacted] -343

So, the cube root of -343 is [redacted]

c $\frac{1}{512}$

[redacted] $\cdot \frac{1}{8} \cdot \frac{1}{8} = \frac{1}{512}$

So, the cube root of $\frac{1}{512}$ is [redacted]

Quick Check

1. Find the cube root of each number.

a. 216 **b.** -1 **c.** $\frac{1}{27}$

[redacted] [redacted] [redacted]

The inverse of cubing a number is finding its cube root. The symbol $\sqrt[3]{\ }$ means the cube root of a number. For example, $\sqrt[3]{1{,}000}$ means the cube root of 1,000, or 10.

Vocabulary Tip

Volume is the number of unit cubes needed to fill a solid. Volume is measured in cubic units.

EXAMPLE Finding the Side Length of a Cube

2 **Measurement** A cube-shaped packing box has a volume of 64 cubic feet. What is the side length of the box?

The formula for the volume V of a cube is $V = s^3$, where s is the length of one side of the cube.

Method 1 Solve an Equation

$V = s^3$ ← Volume formula

$64 = s^3$ ← Substitute 64 for V.

$\sqrt[3]{64} = \sqrt[3]{s^3}$ ← Find the cube root of each side.

3 [$\sqrt[x]{\ }$] 64 [=] 4 ← Use a calculator.

$4 = s$

Method 2 Mental Math

The volume of the box is 64 cubic feet. Since $4^3 = 64$, $\sqrt[3]{64} = 4$.

The side length of the box is 4 feet.

Example

2 **Finding the Side Length of a Cube** A cube-shaped storage container has a volume of 1,728 cubic inches. What is the side length of the container?

$V = s^3$ ← Volume formula

1,728 $= s^3$ ← Substitute 1,728 for V.

$\sqrt[3]{1{,}728} = \sqrt[3]{s^3}$ ← Find the cube root of each side.

12 $= s$

The side length of the storage container is 12 inches.

Quick Check

2. A different cube-shaped packing box has a volume of 125 cubic feet. What is the side length of the box? [redacted]

$V = s^3$ ← Volume formula

Substitute 125 for V.

Find the cube root of each side.

To find the cube root of a fraction, find the cube root of the numerator and the cube root of the denominator.

EXAMPLE 3 Solving a Cube Root Equation

Solve $x^3 = \frac{8}{343}$.

$x^3 = \frac{8}{343}$

$\sqrt[3]{x^3} = \sqrt[3]{\frac{8}{343}}$ ← Find the cube root of each side.

$= \frac{\sqrt[3]{8}}{\sqrt[3]{343}}$ ← Find the cube root of the numerator. Find the cube root of the denominator.

$x = \frac{2}{7}$ ← Simplify. *Think:* $8 = 2 \cdot 2 \cdot 2$ and $343 = 7 \cdot 7 \cdot 7$.

Quick Check

3. Solve $x^3 = \frac{27}{216}$. [redacted]

What is the cube root of 27?

Text in your response

A cube-shaped package has a volume of 512 cubic inches. What are the dimensions of the package?

- (A) 5 inches by 5 inches by 5 inches
- (B) 6 inches by 6 inches by 6 inches
- (C) 7 inches by 7 inches by 7 inches
- (D) 8 inches by 8 inches by 8 inches
- (E) 9 inches by 9 inches by 9 inches

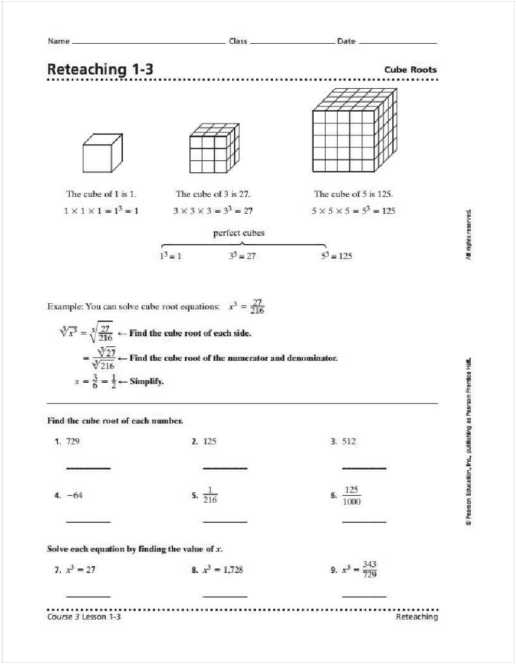
Solve: $x^3 = \frac{64}{729}$

- (A) 3/8
- (B) 4/9
- (C) 5/10
- (D) 2/3
- (E) 3/7

Power down your clickers and put them away.

You have an assignment worksheet, due tomorrow.

Calculators are allowed on this worksheet.



Name _____ Class _____ Date _____

Reteaching 1-3 **Cube Roots**

The cube of 1 is 1. $1 \times 1 \times 1 = 1^3 = 1$

The cube of 3 is 27. $3 \times 3 \times 3 = 3^3 = 27$

The cube of 5 is 125. $5 \times 5 \times 5 = 5^3 = 125$

perfect cubes

$1^3 = 1$ $3^3 = 27$ $5^3 = 125$

Example: You can solve cube root equations: $x^3 = \frac{27}{216}$

$\sqrt[3]{x^3} = \sqrt[3]{\frac{27}{216}}$ ← **Find the cube root of each side.**

$= \frac{\sqrt[3]{27}}{\sqrt[3]{216}}$ ← **Find the cube root of the numerator and denominator.**

$x = \frac{3}{6} = \frac{1}{2}$ ← **Simplify.**

Find the cube root of each number.

1. 729 _____
2. 125 _____
3. 512 _____
4. −64 _____
5. $\frac{1}{216}$ _____
6. $\frac{125}{1000}$ _____

Solve each equation by finding the value of x.

7. $x^3 = 27$ _____
8. $x^3 = 1{,}728$ _____
9. $x^3 = \frac{343}{729}$ _____