

Computer Desk SMARTboard NRF 10

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4.1 Estimating Roots

MATH LAB

LESSON FOCUS Explore decimal representations of different roots of numbers.

Make Connections

Since $3^2 = 9$, 3 is a square root of 9.
 We write: $3 = \sqrt{9}$

Since $3^3 = 27$, 3 is the cube root of 27.
 We write: $3 = \sqrt[3]{27}$

Since $3^4 = 81$, 3 is a fourth root of 81.
 We write: $3 = \sqrt[4]{81}$

How would you write 5 as a square root? A cube root? A fourth root?

Introduction

What do you know???

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What do you know???

x^2

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Let's try some examples:

a) 3^2 b) 4^3

c) $\sqrt{81}$ d) $\sqrt{49}$

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1-25 Perfect Squares

(1)² = 1 x 1 = 1
 (2)² = 2 x 2 = 4
 (3)² = 3 x 3 = 9
 (4)² = 4 x 4 = 16
 (5)² = 5 x 5 = 25
 (6)² = 6 x 6 = 36
 (7)² = 7 x 7 = 49
 (8)² = 8 x 8 = 64
 (9)² = 9 x 9 = 81
 (10)² = 10 x 10 = 100
 (11)² = 11 x 11 = 121
 (12)² = 12 x 12 = 144
 (13)² = 13 x 13 = 169
 (14)² = 14 x 14 = 196
 (15)² = 15 x 15 = 225
 (16)² = 16 x 16 = 256
 (17)² = 17 x 17 = 289
 (18)² = 18 x 18 = 324
 (19)² = 19 x 19 = 361
 (20)² = 20 x 20 = 400
 (21)² = 21 x 21 = 441
 (22)² = 22 x 22 = 484
 (23)² = 23 x 23 = 529

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Perfect Cubes
1-12

$(1)^3 = 1 \times 1 \times 1 = 1$
 $(2)^3 = 2 \times 2 \times 2 = 8$
 $(3)^3 = 3 \times 3 \times 3 = 27$
 $(4)^3 = 4 \times 4 \times 4 = 64$
 $(5)^3 = 5 \times 5 \times 5 = 125$
 $(6)^3 = 6 \times 6 \times 6 = 216$
 $(7)^3 = 7 \times 7 \times 7 = 343$
 $(8)^3 = 8 \times 8 \times 8 = 512$
 $(9)^3 = 9 \times 9 \times 9 = 729$
 $(10)^3 = 10 \times 10 \times 10 = 1000$
 $(11)^3 = 11 \times 11 \times 11 = 1331$
 $(12)^3 = 12 \times 12 \times 12 = 1728$
 $(13)^3 = 13 \times 13 \times 13 = 2197$
 $(14)^3 = 14 \times 14 \times 14 = 2744$
 $(15)^3 = 15 \times 15 \times 15 = 3375$
 $(16)^3 = 16 \times 16 \times 16 = 4096$
 $(17)^3 = 17 \times 17 \times 17 = 4913$
 $(18)^3 = 18 \times 18 \times 18 = 5832$
 $(19)^3 = 19 \times 19 \times 19 = 6859$
 $(20)^3 = 20 \times 20 \times 20 = 8000$
 $(21)^3 = 21 \times 21 \times 21 = 9261$
 $(22)^3 = 22 \times 22 \times 22 = 10648$
 $(23)^3 = 23 \times 23 \times 23 = 12167$
 $(24)^3 = 24 \times 24 \times 24 = 13824$
 $(25)^3 = 25 \times 25 \times 25 = 15625$

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Perfect Powers of Four

1

16

81

256

625

Sep 7-8:53 AM

TRY THIS

Work with a partner.
You will need a calculator to check your estimates.

A. Write the two consecutive perfect squares closest to 20. Estimate the value of $\sqrt{20}$. Square your estimate. Use this value to revise your estimate. Keep revising your estimate until the square of the estimate is within 1 decimal place of 20.

B. Write the two consecutive perfect cubes closest to 20. Estimate the value of $\sqrt[3]{20}$. Cube your estimate. Use this value to revise your estimate. Keep revising your estimate until the cube of the estimate is within 1 decimal place of 20.

C. Write the two consecutive perfect fourth powers closest to 20. Use a strategy similar to that in Steps A and B to estimate a value for $\sqrt[4]{20}$.

4.1 Math Lab: Estimating Roots

Try This p.1

TRY THIS

Write the two consecutive perfect squares closest to 20.

Fill in the table until the square of the estimate is within 1 decimal place of 20.

Estimated value of $\sqrt{20}$	Square of estimate

4.1 Math Lab: Estimating Roots

Try This p.4

TRY THIS

Write the two consecutive perfect cubes closest to 20.

Fill in the table until the cube of the estimate is within 1 decimal place of 20.

Estimated value of $\sqrt[3]{20}$	Cube of estimate

4.1 Math Lab: Estimating Roots

Try This p.5

TRY THIS (continued)

D. Copy and complete this table. Use the strategies from Steps A to C to determine the value of each radical.

Radical	Value	Is the Value Exact or Approximate?
$\sqrt{16}$	4	Exact
$\sqrt{27}$	5.1962	Approximate
$\sqrt[3]{16}$	$\frac{4}{3}$ or 0.4	Exact
$\sqrt[3]{0.64}$		
$\sqrt[4]{16}$		
$\sqrt[4]{27}$		
$\sqrt[4]{16}$		
$\sqrt[4]{81}$		
$\sqrt[5]{0.64}$		
$\sqrt[5]{-0.64}$		
$\sqrt[6]{16}$		
$\sqrt[6]{27}$		
$\sqrt[6]{16}$		
$\sqrt[6]{81}$		
$\sqrt[6]{0.64}$		

Choose 3 different radicals.
Extend then complete the table for these radicals.

4.1 Math Lab: Estimating Roots

Try This p.2

TRY THIS

Determine the value of each radical.

Radical	Value	Is the Value Exact or Approximate?
$\sqrt{16}$	4	Exact
$\sqrt{27}$	5.1962	Approximate
$\sqrt{\frac{16}{18}}$	$\frac{4}{9}$ or $0.\bar{4}$	Exact
$\sqrt{0.64}$		
$\sqrt[3]{16}$		
$\sqrt[3]{27}$		
$\sqrt[3]{\frac{16}{18}}$		

4.1 Math Lab: Estimating Roots

Try This p.7

TRY THIS

Choose 3 different radicals. Complete the table for these radicals.

Radical	Value	Is the Value Exact or Approximate?

4.1 Math Lab: Estimating Roots

Try This p.9

TRY THIS (continued)

E. How can you tell if the value of a radical is a rational number? What strategies can you use to determine the value of the radical?

F. How can you tell if the value of a radical is *not* a rational number? What strategies can you use to estimate the value of the radical?

Rational Numbers
Numbers that can be written as fractions. (Numbers that terminate)

Irrational Numbers
Decimals that never terminate or repeat.

4.1 Math Lab: Estimating Roots

Try This p.3

TRY THIS

Write the two consecutive perfect fourth powers closest to 20.

Fill in the table until the fourth power of the estimate is within 1 decimal place of 20.

Estimated value of $\sqrt[4]{20}$	Fourth power of estimate

4.1 Math Lab: Estimating Roots

Try This p.6

TRY THIS

Determine the value of each radical.

Radical	Value	Is the Value Exact or Approximate?
$\sqrt[3]{0.64}$		
$\sqrt[3]{-0.64}$		
$\sqrt[4]{16}$		
$\sqrt[4]{27}$		
$\sqrt[4]{\frac{16}{18}}$		
$\sqrt[4]{0.64}$		

4.1 Math Lab: Estimating Roots

Try This p.8

TRY THIS

How can you tell if the value of a radical is a rational number? What strategies can you use to determine the value of the radical?

How can you tell if the value of a radical is *not* a rational number? What strategies can you use to estimate the value of the radical?

4.1 Math Lab: Estimating Roots

Try This p.10

**Activate Prior Learning:
Square Roots and Cube Roots**

When a number x can be written as the product of two equal factors, then the square root of x , represented by \sqrt{x} , is one of these factors. For example, $\sqrt{64} = 8$ because $8^2 = 64$.

The cube root of a number x , represented by $\sqrt[3]{x}$, is one of three equal factors of the number. For example, $\sqrt[3]{64} = 4$ because $4^3 = 64$.

Calculate each root: $\sqrt{144}, \sqrt[3]{27}$

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4.1 Math Lab: Estimating Roots

Activating Prior Learning p.1

**Activate Prior Learning:
Powers with Integer Bases**

Powers

Base \rightarrow **B** \leftarrow Exponent
 \downarrow
 Power

A power with a positive integer exponent represents repeated multiplication.

Example: $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

Example: Identify the base and the exponent for each expression

a) 4^3	b) 7^{23}	c) a^b
Base: 4	Base: 7	Base: a
Exponent: 3	Exponent: 23	Exponent: b

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**Activate Prior Learning:
Powers with Integer Bases**

Express each expression as a power

a) $(7)(7)(7)(7)$ b) $(4)(4)(4)(4)(4)(4)(4)$

c) $(z)(z)(z)(z)(z)$ d) $(c)(c)(c)(c)(c) + (a)(a)(a)(a)$

7^4

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Can you see the difference?

-4^2 $(-4)^2$

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THINK

$(-1)^2 =$
 $(-1)^3 =$
 $(-1)^4 =$
 $(-1)^5 =$
 \vdots
 Did you see a pattern??
 $(-1)^{10247} =$ $(-1)^{29584} =$

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$(-1)^{10247} = -1$ $(-1)^{29584} = 1$

THINK

😊 Evaluating powers when the base is negative...

If the exponent is **even** the answer will be **positive**.
 If the exponent is **odd** the answer will be **negative**.

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