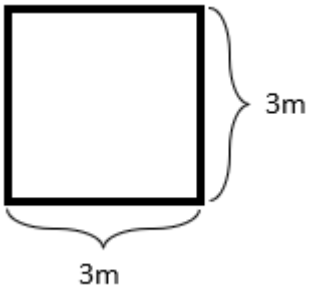
Lesson 10: Radicals and Rational Exponents

Objectives	Terms
• To be able to identify the parts of a radical expression. • To be able to translate expressions between radical and exponential form. • To simplify square roots and higher order radical expressions.	• Index • Root • Radical • Radicand • Equivalent Expressions • Rational Exponent • Simplify

Think about this: What does Area have to do with Radical Expressions?

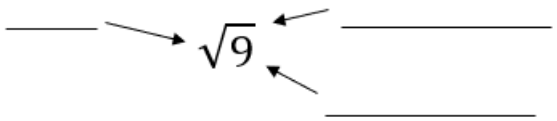
- When finding the area of a square, we square the length of the side:
  - $Area =$ _____
- **Radical expressions** allow us to _____ this process.
  - How can you find the side length of a square given the area?
    - $\sqrt{Area} =$ _____



Definitions

- **Index**: The _____ you are trying to find.
  - If there is no index or root indicated, you are finding the second or _____ root.
- **Radical**: The symbol used to indicate finding the root of a number
- **Radicand**: The value _____ the radical symbol.

Label the Diagram



This tells us that we are finding:

the _____ root of _____

How does this relate to Area and Side Length?

$$\sqrt{9} = \sqrt{3^2} = 3$$

- What does the radicand of a square root represent?
  - _____
- What does the simplified square root expression represent?
  - _____
- When simplifying this expression, we can ask ourselves:
  - What number, when multiplied by itself _____ gives us 9?
    - The answer to this question is the simplified radical expression.

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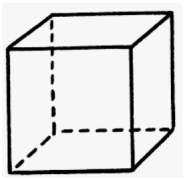
How does this relate to Volume and Side Length?



- When finding the volume of a cube, we "cube" the length of the side:
  - $Volume =$ _____
  - $\sqrt[3]{Volume} =$ _____
- What does the radicand of a cube root represent?
  - _____
- What does the simplified square root expression represent?
  - _____
- When simplifying this expression, we can ask ourselves:
  - What number, when multiplied by itself _____ gives us 8?
    - The answer to this question is the simplified radical expression.

$\sqrt[3]{8} =$ _____

Evaluate the following expressions:

1. $\sqrt[3]{\quad}$ 2. $\sqrt{\quad}$ 3. $\sqrt[5]{\quad}$ 4. $\sqrt[4]{\quad}$

****You cannot take the _____ root of a _____ number.

Think about this: How can we determine if radical expressions are equivalent?

Remember, to determine if two expressions are equivalent:

- Collect evidence by testing values in both expressions.
  - If each expression returns a different value, then they are not equivalent.
- Justify why the expressions are equivalent.

Which expressions are equivalent? Check with the value x = __.

$x + 2x$

$4x - 1$

$3x$

What can we do to maintain equivalent radical expressions?

We can show some properties of radicals by using the properties of equivalency.

1. Are these expressions equivalent?

   a. Are they equivalent? Yes or No

   b. Write a statement showing your conclusion:

Use a = __ and b = __ to determine if the expressions are equivalent.

$\sqrt{a+b} = \sqrt{a} + \sqrt{b}$

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2. Are these expressions equivalent?

   a. Are they equivalent? Yes or No

   b. Write a statement showing your conclusion:

Use a = __ and b = __ to determine if the expressions are equivalent.

$$\sqrt{a \cdot b} = \sqrt{a} \cdot \sqrt{b}$$

3. Are these expressions equivalent?

   a. Are they equivalent? Yes or No

   b. Write a statement showing your conclusion:

Use a = __ and b = __ to determine if the expressions are equivalent.

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

***The properties from #2 and #3 also apply to higher order radical expressions (root >2).*

Extra Practice: Use x = _____ to determine if the following expressions are equivalent.

$\sqrt{x+2}$ $\quad$ $\sqrt{x}+2$ $\quad$ $\sqrt{x}+\sqrt{2}$	$\sqrt{\frac{x}{4}}$ $\quad$ $\frac{\sqrt{x}}{\sqrt{4}}$

Try this: Use your calculator to determine if the following expressions are equivalent.

$\sqrt[3]{8}$ and	and $27^{2/3}$	$\sqrt{4^2}$ and

Definition:

- **Rational Exponent:** exponents that are _____.
  - **Numerator:** _____.
  - **Denominator:** _____.
  - **Base:** _____
- **Translate**: You can translate between radical expressions and expressions with rational exponents.
  - The expressions are _____ to each other.
  - Index or root is the _____.

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Practice: Translate each expression into either a radical expression or a rational exponent**.**

Given	$50^{1/2}$	$\sqrt[3]{392x^5}$	$256^{1/4}$	$\sqrt[5]{32y^6}$
Equivalent Expression				

Think about this: What does it mean to simplify and evaluate radical expressions? How does factoring help us simplify radical expressions?

Example

- Simplify the expression: $\sqrt{50}$
  - Identify the root: _____
  - What are the factors of 50?
    - What factors are perfect squares?
  - Rewrite the radical as a product of radicals.
    - ex. $\sqrt{a \cdot b} = \sqrt{a} \cdot \sqrt{b}$
  - What is the simplified form of $\sqrt{50}$?

$\sqrt{50}$

- Simplify the expression: $(392)^{1/3}$
  - Rewrite as a radical expression.
  - Identify the root: _____
  - Factor 392 using a factor tree and rewrite the radical in factored form.
  - Simplify the expression.

$392^{1/3}$

Practice: Simplify the following radical expressions. Leave your answer in radical form.

$\sqrt[3]{270}$	$\sqrt{48}$	$96^{1/5}$

Where will you see this in upcoming material?	What are the calculator skills you needed?