Geometrically, a square has four equal sides and the area of a square is the product of any two of its sides. Imagine being given the area of a square, 81 cm$^2$. What are the lengths of its sides? The answer can be found by going backwards from 81; that is what number times itself is 81? In this case, the sides are 9 cm long because $9 \cdot 9 = 81$.

In mathematical terms, we use a square root to find the length of a square’s sides and use the operation “$\sqrt{\phantom{0}}$”, a radical sign to symbolize the “square root.” The number inside a square root is sometimes called a radicand and the positive square root is called the principal root.

There are two basic square root properties:

(a) **Product Property** of Square Roots states that the square root of a product is equal to the product of the square roots of the factors:

Examples: $\sqrt{20} = \sqrt{4 \cdot 5} = \sqrt{4} \cdot \sqrt{5} = 2\sqrt{5}$

$$\sqrt{5} \cdot \sqrt{20} = \sqrt{100} = 10$$

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

(b) **Quotient Property** of Square Roots states that the square root of a quotient is equal to the quotient of the square roots of the dividend and the divisor.

Examples: $\frac{3}{16} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{3}{4}$

$$\sqrt{\frac{8}{2}} = \sqrt{4} = 2$$

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

Square roots that have the same radicand are called like radical terms, and they may be added together like coefficients and variables.

**Example:** $4\sqrt{5}$ and $2\sqrt{5}$ are like radicals so: $4\sqrt{5} + 2\sqrt{5} = 6\sqrt{5}$.

To rationalize a denominator simply means to make the denominator into an integer by multiplying with an identical square root. For example: $\frac{2}{\sqrt{3}} = \frac{2}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{2\sqrt{3}}{3}$.

We can simplify square roots by using the above described concepts.

| Simplify: | 1. Break down into factors, look for perfect square factors.  
2. Remember that for 2 under the roof, 1 comes out.  
3. Single numbers stay under the roof. |
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<tbody>
<tr>
<td>$\sqrt{54}$</td>
<td>$\sqrt{9 \times 6}$</td>
</tr>
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<td></td>
<td>$\sqrt{3 \times 3}$</td>
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<td>$3\sqrt{6}$</td>
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