Remember your perfect squares (you should know them through 16)!

$$\sqrt{1} = 1 \quad \sqrt{25} = 5 \quad \sqrt{81} = 9 \quad \sqrt{169} = 13$$
$$\sqrt{4} = 2 \quad \sqrt{36} = 6 \quad \sqrt{100} = 10 \quad \sqrt{196} = 14$$
$$\sqrt{9} = 3 \quad \sqrt{49} = 7 \quad \sqrt{121} = 11 \quad \sqrt{225} = 15$$
$$\sqrt{16} = 4 \quad \sqrt{64} = 8 \quad \sqrt{144} = 12 \quad \sqrt{256} = 16$$

Also remember that

$$\sqrt{9} \bullet \sqrt{9} = \sqrt{81} = 9$$
$$\sqrt{11} \bullet \sqrt{11} = \sqrt{121} = 11$$

Do you see the pattern? We can skip the middle step and know that

---

Square Roots – Product Property
$$\sqrt{a \bullet b} = \sqrt{a} \bullet \sqrt{b}$$

Example 1   Simplify $\sqrt{20}$

Is there a perfect square that goes in there (the number 20)? Yes! **4** goes into 20.

$$\sqrt{20} = \sqrt{4} \bullet \sqrt{5} = \boxed{\mathbf{2\sqrt{5}}}$$

Example 2   Simplify $2\sqrt{5} \bullet 3\sqrt{15}$

Multiply (outside • outside) and (inside • inside)

$$2\sqrt{5} \bullet 3\sqrt{15} = 6\sqrt{75} = 6\sqrt{25} \bullet \sqrt{3} = 6 \bullet 5\sqrt{3} = \boxed{\mathbf{30\sqrt{3}}}$$

$$\boxed{\begin{array}{c} \text{Square Roots} - \text{Quotient Property} \\[6pt] \sqrt{\dfrac{\color{red}a}{\color{green}b}} = \dfrac{\sqrt{\color{red}a}}{\sqrt{\color{green}b}} \end{array}}$$

<u>Example 3</u>   Simplify $\sqrt{\dfrac{8}{9}}$

Use the quotient property to "split" the radical into two radicals.

$$\sqrt{\dfrac{8}{9}} = \dfrac{\sqrt{8}}{\sqrt{9}} = \dfrac{\sqrt{4} \cdot \sqrt{2}}{3} = \boxed{\dfrac{2\sqrt{2}}{3}}$$

Go to the next page to review how we know we are done simplifying a radical.

A radical (square root) is completely simplified when…

1. There are no perfect squares in the $\sqrt{}$ - see Examples 1 & 2
2. There are no fractions in the $\sqrt{}$ - see Example 3
3. There are no $\sqrt{}$ in the denominator of a fraction – let's look at eliminating $\sqrt{}$ in the denominators of a fractions

The general procedure looks like this…

$$\frac{3}{\sqrt{}} \quad = \quad \frac{3}{\sqrt{}} \cdot \frac{\sqrt{}}{\sqrt{}} \quad = \quad \boxed{\frac{3\sqrt{}}{}}$$

<u>Example 4</u>   Simplify $\sqrt{\dfrac{5}{24}}$

$$\sqrt{\frac{5}{24}} = \frac{\sqrt{5}}{\sqrt{24}} = \frac{\sqrt{5}}{\sqrt{4}\cdot\sqrt{6}} = \frac{\sqrt{5}}{2\sqrt{6}} = \frac{\sqrt{5}}{2\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} = \frac{\sqrt{30}}{2\cdot 6} = \boxed{\frac{\sqrt{30}}{12}}$$

Easier if you take care of perfect squares first

Multiply top and bottom by the same thing (then it's like multiplying by 1!)