

We will focus on converting among  
U.S. standard measurements.

Measurement: U.S. Customary Units and Unit Conversion (Section 5.2)

When you measure a board as 7 feet long or an amount of paint as 4 gallons, you are using standards. These **units** or **standards** are convenient in size and they are standardized. Some started out differently than they are defined today. A foot was literally defined as the length of a man's foot. Since that depends on the man you have in front of you, we instead use standardized versions of these measurements. We basically agreed upon other non-subjective definitions with which we are familiar today. In the U.S., we use the **English** or **U.S. customary system of units**.

We will work on converting from one unit to another. Here are some common conversions.

### Length Units

1 foot (ft) = 12 inches (in.)  
1 yard (yd) = 3 ft = 36 in.  
1 rod (rd) =  $16\frac{1}{2}$  ft  
1 mile (mi) = 5280 ft = 1760 yd

### Liquid Capacity Units

1 tablespoon (T) = 3 teaspoons (t)  
1 fluid ounce (fl oz) = 2 tablespoons (T)  
1 measuring cup = 8 fl oz  
1 pint (pt) = 2 cups = 16 fl oz  
1 quart (qt) = 2 pt = 32 fl oz  
1 gallon (gal) = 4 qt = 128 fl oz

### Weight Units

1 pound (lb) = 16 ounces (oz)  
1 ton = 2000 lb

### Unit Analysis:

Again, as shown earlier, we will use unit analysis to help these conversions go smoothly. We will take a measurement (like 5 feet) and multiply it by what is called a **unity fraction** (like  $\frac{1 \text{ yard}}{3 \text{ feet}}$ ). They are called that because the top is the same as the bottom and so is equal to 1. We will see some units cancel out and others will remain for our answer.

expl 1: Convert 18.4 pints to cups. Round to the nearest tenth.

We choose the unity  
fraction so that  
"pints" will cancel,  
leaving us "cups".

Other conversions will require more than one unity fraction. Using this method keeps everything organized.

expl 2: Convert 18.4 pints to gallons. Round to the nearest tenth.

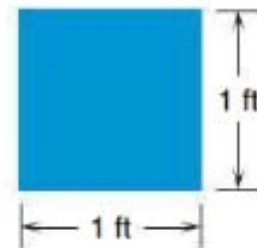
Use the information from page 1 to work your way to gallons.

### Area Conversions:

How many square inches are in a square foot? The answer may surprise you.

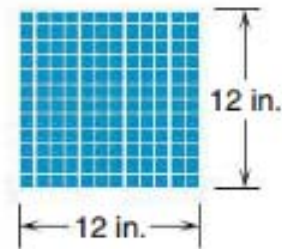
Here is a picture that the book provides.

Directly to the right is a square that is 1 foot by 1 foot, or 1 square foot. So, how many square inches is equivalent to that?



A common answer is 12 square inches but we can see that is *not* right if we picture it as the bottom right picture shows.

In fact, there are 12 x 12 or 144 square inches in 1 square foot. Below are some other such conversions.



#### Area Units

1 square foot (sq ft or ft<sup>2</sup>) = 144 square inches (sq in. or in.<sup>2</sup>)

1 square yard (sq yd or yd<sup>2</sup>) = 9 sq ft = 1296 sq in.

1 square rod (sq rod) = 30.25 sq yd

1 acre = 160 sq rod = 4840 sq yd = 43,560 sq ft

1 sq mile (sq mi or mi<sup>2</sup>) = 640 acres

expl 3: Convert 1.50 lb/sq in. to lb/sq ft.

### Volume Conversions:

We do similar stuff with volume. Use these Notes as reference.

#### Volume Units

1 cubic foot (cu ft or ft<sup>3</sup>) = 1728 cubic inches (cu in. or in.<sup>3</sup>)

1 cubic yard (cu yd or yd<sup>3</sup>) = 27 cu ft = 46,656 cu in.

1 gallon (gal) = 231 cu in. or 1 cu ft  $\approx$  7.48 gal

1 bushel (bu) = 2150.42 cu in.

1 fluid ounce (fl oz) = 1.805 cu in.

1 pint (pt) = 28.875 cu in. (liquid measure)

**Note:** Before, we were told that 1 gallon equals 128 fluid ounces. That is a measure of **liquid capacity**. Here, we see 1 gallon equals 231 cubic inches, which is a measure of the 3D space it takes up, or **volume**.

expl 4: Convert 660 lb/cu ft to lb/cu in. Round to the nearest hundredth.

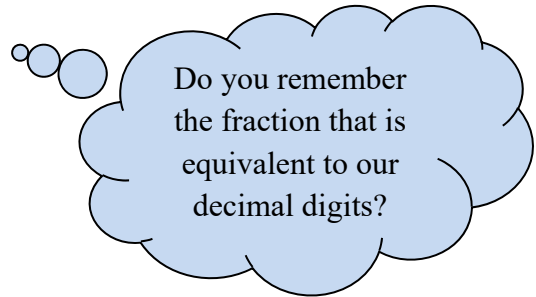
**Various Forms of Answers:**

I have 326 ounces of gold dust. How many pounds is that? What if I wanted the answer as pounds with leftover ounces? Let's practice this.

expl 5: Convert 326 ounces to the following.

a.) \_\_\_\_\_ pounds (as a decimal)

b.) \_\_\_\_\_ pounds (as a mixed number)



c.) \_\_\_\_\_ pounds \_\_\_\_\_ ounces

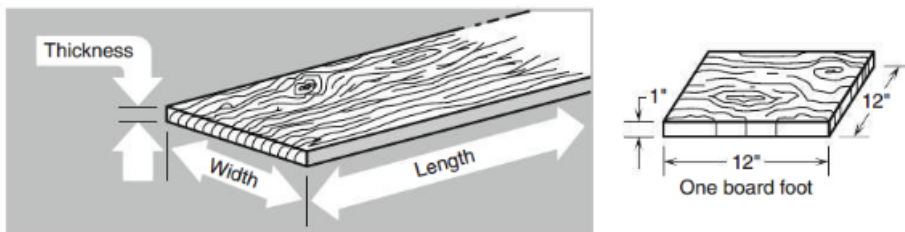
expl 6: The Manitou Incline, which leads to the top of Pike's Peak in Colorado, climbs from an elevation of 6574 feet to 8585 feet above sea level. The fastest reported time for running up this incline is 16 minutes and 42 seconds. How many vertical feet per second is that? Round to 1 decimal digit.

expl 7: Convert  $2.72 \pm 0.04$  feet to inches. Round to the nearest tenth of an inch.

Convert and round each number separately.

### Miscellaneous Conversions:

**Lumber Measure** Carpenters and workers in the construction trades use a special unit of volume to measure the amount of lumber. The volume of lumber is measured in **board feet**. One board foot (bf or bd f or fbm) of lumber is a piece having an area of 1 sq ft and a thickness of 1 in. or less.



$$\text{Number of board feet} = \text{thickness in inches} \times \text{width in feet} \times \text{length in feet}$$

To find the number of board feet in a piece of lumber, multiply the length in feet by the width in feet by the thickness in inches. A thickness of less than 1 in. should be counted as 1 in. If the lumber is dressed or finished, use the full size or rough stock dimension to calculate board feet.

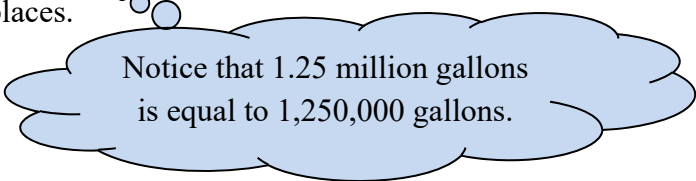
**Time Units**

1 minute (min) = 60 seconds (sec)

1 hour (hr or h) = 60 min = 3600 sec

1 day = 24 hr or 24 h

expl 8: A sewer line has a flow rate of 1.25 MGD (million gallons per day). Convert this to cfs (cubic feet per second). Round to two decimal places.



Notice that 1.25 million gallons is equal to 1,250,000 gallons.