

## LESSON 9 – UNITS & CONVERSIONS

### INTRODUCTION

*U.S. units of measure* are used every day in many ways. In the United States, when you fill up your car with gallons of gas, drive a certain number of miles to work, or buy a quart of milk you are utilizing *U.S. units of measure*. There is another measuring system also seen in the U.S. but more prevalent in other countries and that is the *metric system*. The *metric system* is easier to use than the U.S. system because all the units are incremented by different powers of 10. The U.S. has never fully converted to the metric system but metric units are all around us as well. In this lesson, we will learn how to work within and between the two systems.

The table below shows the specific objectives that are the achievement goal for this lesson. Read through them carefully now to gain initial exposure to the terms and concept names for the lesson. Refer back to the list at the end of the lesson to see if you can perform each objective.

Lesson Objective	Related Examples
Perform <i>one-step conversions</i> of U.S. units	1, 2, YT10
Convert using <i>U.S. mixed units</i>	3, 4, 5, 6, YT10
Perform <i>multi-step conversions</i> of U.S. units	7, 8, 9, YT10
<i>Add and subtract</i> U.S. units of measure	11, 12, YT13
Perform <i>conversions</i> within the metric system	14, 15, YT16
Perform <i>conversions</i> between the U.S. and metric system	17, 18, YT19

### KEY TERMS

The key terms listed below will help you keep track of important mathematical words and phrases that are part of this lesson. Look for these words and circle or highlight them along with their definition or explanation as you work through the MiniLesson.

- U.S. System of Measure
- U.S. Units and Abbreviations
- U.S. Unit Conversions
- U.S. Mixed Units
- Metric System
- Metric Units and Abbreviations
- Metric Unit Conversions
- U.S./Metric Conversions

### LESSON CHECKLIST

Use this page to track required components for your class and your progress on each one.

Component	Required? Y or N	Comments	Due	Score
Mini-Lesson				
Online Homework				
Online Quiz				
Online Test				
Practice Problems				
Lesson Assessment				

## MINILESSON

## U.S. UNITS OF MEASURE &amp; SINGLE CONVERSIONS

To understand a little bit about straightforward conversions within the U.S. system, let's look at a typical example:

Barry is starting a woodworking project. He measures carefully and finds that he needs 8 pieces of wood that are each 18 inches long. He heads to the lumber store and finds that the shortest sections of the wood he needs are sold in lengths of 2 feet. When he buys the 8 pieces he needs, how many inches will he have to remove from each one?

The quickest way for Barry to solve his problem is to do a simple conversion from feet to inches. How many inches are in 2 feet? Here is how the conversion would be performed.

2 feet = _____ inches	
$\frac{2 \text{ feet}}{1} \cdot \frac{12 \text{ inches}}{1 \text{ foot}}$	From the conversion table, 1 ft = 12 in. Set this up as a fraction with feet in the denominator.
$\frac{2 \cdot 12 \text{ feet}}{1 \text{ feet}} \cdot \frac{\text{inches}}{1}$	Rearrange to write the numbers as a fraction and the units as separate fractions.
24 inches	Remove the like ratios (feet/feet) and simplify the fractions with denominator 1. Multiply to get the final result.
2 feet = 24 inches	

Since boards are sold in lengths of 2 feet = 24 inches, Barry will need to cut  $24 - 18 = 6$  inches from each board when he gets home.

The conversion steps above are VERY lengthy (and you probably could have done this one in your head) but use as many steps as needed until you get a feel for how these work. In general, for single conversions, the steps below are good to follow.

**Recommended Process for single-step US unit conversion problems:**

1. Identify the conversion you will need from the table and write it down.
2. Write the conversion as a fraction. Orient that fraction so that the units you no longer want will cancel out and leave the desired units behind.
3. Perform all necessary calculations.

The following table provides a list of the most common U.S. units, abbreviations, and conversions. Reference this table as you work through the rest of the MiniLesson.

US Units/Conversions		
Length	Mass/Weight	Area
Units: <ul style="list-style-type: none"> <li>Inches (in)</li> <li>Feet (ft)</li> <li>Yards (yd)</li> <li>Miles (mi)</li> </ul> Conversions: <ul style="list-style-type: none"> <li>1 ft = 12 in</li> <li>1 yd = 3ft</li> <li>1 mi = 5280 ft</li> </ul>	Units: <ul style="list-style-type: none"> <li>Ounces (oz)</li> <li>Pounds (lb)</li> <li>Tons</li> </ul> Conversions: <ul style="list-style-type: none"> <li>1 lb = 16 oz</li> <li>1 ton = 2000 lb</li> </ul>	Units: <ul style="list-style-type: none"> <li>Square Inches (in<sup>2</sup>)</li> <li>Square Feet (ft<sup>2</sup>)</li> <li>Square Yards (yd<sup>2</sup>)</li> </ul> Conversions: <ul style="list-style-type: none"> <li>144 in<sup>2</sup> = 1 ft<sup>2</sup></li> <li>9 ft<sup>2</sup> = 1 yd<sup>2</sup></li> </ul>
Volume	Time	
Units: <ul style="list-style-type: none"> <li>Ounces (oz)</li> <li>Cup (c)</li> <li>Pint (pt)</li> <li>Quart (qt)</li> <li>Gallon (gal)</li> <li>Cubic Feet (ft<sup>3</sup>)</li> <li>Cubic Yard (yd<sup>3</sup>)</li> </ul> Conversions: <ul style="list-style-type: none"> <li>1c = 8 oz</li> <li>1pt = 2c</li> <li>1 qt = 2pt</li> <li>1qt = 32 oz</li> <li>1 gal = 4 qt</li> <li>1728 cubic in = 1 cubic ft</li> <li>27 cubic ft = 1 cubic yd</li> </ul>	Units: <ul style="list-style-type: none"> <li>Seconds (sec)</li> <li>Minutes (min)</li> <li>Hours (hr)</li> <li>Days</li> <li>Weeks (wk)</li> <li>Months (mo)</li> <li>Years (yr)</li> </ul> Conversions: <ul style="list-style-type: none"> <li>1 min = 60 sec</li> <li>1 hr = 60 min</li> <li>1 day = 24 hr</li> <li>1 wk = 7 day</li> <li>1 yr = 52 wk</li> <li>1 yr = 12 mo</li> <li>1 yr = 365 days</li> </ul>	



**Example 1:** Perform each of the following single-step conversions following the recommended process listed on the previous page. Round any decimals to tenths.

a. 4 lb = \_\_\_\_\_ oz

b. 10 yd = \_\_\_\_\_ ft

c. 2.4 pt = \_\_\_\_\_ c



**Example 2:** Sarah needs 1.5 cups of ketchup to make her famous meatloaf recipe. She has a brand new, 20-oz bottle of ketchup in her cupboard. How much of this will she need for her meatloaf?

**SINGLE UNIT/MULTIPLE UNITS CONVERSIONS**

The following examples illustrate additional basic conversions within the U.S. System. A modified form of the conversion process will be used for these problems.

 **Example 3:** Write 26 inches in feet and inches.

 **Example 4:** Write 5 lbs, 6 oz in ounces.

 **Example 5:** Write 30 months in months and years.

 **Example 6:** Write 1 min, 20 sec in seconds.

**U.S. MEASUREMENTS & MULTI-STEP CONVERSIONS**

Some conversions require more than one step. See how the single-step conversion process is expanded in each of the following problems.

 **Example 7:** How many minutes are in a week?

 **Example 8:** Bryan needs 10 cups of fruit juice to make Sangria. How many quarts of juice should he buy at the grocery store?



**Example 9:** Raldo measured a room at 9 ft long x 10 ft wide to get an area measurement of 90 square feet (area is length times width). He wants to carpet the room with new carpet, which is measured in square yards. Raldo knows that 1 yd is equivalent to 3 ft so he ordered 30 square yards of carpet. Did he order the correct amount?

YOU TRY

10. Perform each of the following conversions within the U.S. system. Round to tenths as needed. Show complete work.

a. A young girl paced off the length of her room as approximately 8 feet. How many inches would that be?

b. 18 oz = \_\_\_\_\_ lb

c. 100 yd = \_\_\_\_\_ ft

d. 10,235 lb = \_\_\_\_\_ tons

e. How many inches are in 6 feet, 8 inches?

f. How many square inches are in 10 square feet?

## ADDING/SUBTRACTING U.S. MEASUREMENTS

Follow the process used in the examples below to add or subtract with U.S. measurements. Circle the GIVENS and underline the GOAL to get started with each problem.

 **Example 11:** Darry recently flew from Phoenix, AZ to Asheville, NC. On his outbound flight, he flew first to Atlanta (3 hours, 35 minutes) then to Asheville (45 minutes). What was his total flying time in hours and minutes?

 **Example 12:** Add 1 gal 2 qt and 3 gal 6 qt. Leave your final answer in gallons and quarts.

## YOU TRY

13. Rayene needs a board that is exactly 8 inches long to add a little security to the window in her room. She has a board that is 1 ft, 3 inches long to work with. How much, inches, would she have to cut in order to use the board?

<b>METRIC CONVERSIONS</b>
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The *metric system* originated in Europe around 1800 and was quickly adopted around the world as a standard system of measurement. In fact, the U.S. is the only industrialized country that does not use the metric system as its official measurement system even though there are metric units utilized in the U.S. for various things.

The strength of the *metric system* is that it is based on powers of ten as you can see in the chart below. Prefixes are the same for each power of ten above or below the base unit.

<b>Metric Chart</b>						
KILO	HECTO	DEKA		DECI	CENTI	MILLI
1000 x Base	100 x Base	10 x Base	Base Unit	.10 x Base	.01 x Base	.001 x Base
Kilometer (km)	Hectometer (hm)	Dekameter (dam)	Meter (m)	Decimeter (dm)	Centimeter (cm)	Millimeter (mm)
Kiloliter (kl)	Hectoliter (hl)	Dekaliter (dal)	Liter (l)	Deciliter (dl)	Centiliter (cl)	Milliliter (ml)
Kilogram (kg)	Hectogram (hg)	Dekagram (dag)	Gram (g)	Decigram (dg)	Centigram (cg)	Milligram (mg)

<b>Some Common Metric Conversions</b>
1 centimeter (cm) = 10 millimeters (mm)
1 meter (m) = 100 centimeters (cm)
1 kilometer (km) = 1000 meters (m)

The process below works very well for making conversions between metric system units.

<b>Recommended Process for Working Metric Conversion Problems:</b>
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1. Use the metric chart above and locate the initial unit and desired unit on the chart (note some charts may be displayed with the smaller units on the left).
2. Count the columns between units (do not count initial unit column).
3. If the desired unit is LARGER than the initial unit, move the decimal to the LEFT the same as the number of columns from step 2. If the desired unit is SMALLER than the initial unit, move the decimal to the RIGHT the same as the number of columns from step 2.

**Example 14:**

a. 4200 g = \_\_\_\_\_ mg      b. 45 cm = \_\_\_\_\_ m      c. 7,236,137 ml = \_\_\_\_\_ kl



**Example 15:** If a person's pupillary distance (from one pupil to the other) is 61 mm and the distance from their pupil to the middle of their upper lip is 7 cm, which distance is longer?

## YOU TRY

16. Perform each of the following conversions within the metric system. Show complete work.

a.  $1510 \text{ m} = \underline{\hspace{2cm}} \text{ mm}$     b.  $13.50 \text{ ml} = \underline{\hspace{2cm}} \text{ l}$     c.  $5\text{k} = \underline{\hspace{2cm}} \text{ m}$

## METRIC/US CONVERSIONS

Although the U.S. relies heavily on our standard measurement system, we do use some metric units. Therefore, we need to know how to move back and forth between the systems.

Some Common Metric/U.S. Conversions			
<b>Length</b> 1 mi = 1.61 km 1 yd = 0.9 m 1 in = 2.54 cm	<b>Mass/Weight</b> 1 kg = 2.2 lb 1 g = 0.04 oz 1 metric ton = 1.1 ton	<b>Area</b> 1 in <sup>2</sup> = 6.45 cm <sup>2</sup> 1 yd <sup>2</sup> = 0.84 m <sup>2</sup> 1 mi <sup>2</sup> = 2.59 km <sup>2</sup>	<b>Volume</b> 1 L = 1.1 qt 1 gal = 3.8 L 1 L = 2.1 pt
.621 mi = 1 km 1.094 yd = 1m .394 in = 1cm	.454 kg = 1lb 1 oz = 28.3 g		1 yd <sup>3</sup> = 0.76 m <sup>3</sup> 1 in <sup>3</sup> = 16.4 cm <sup>3</sup>

**Recommended Process for Working Metric/US Conversion Problems:**

1. Identify the conversion or conversions you will need from the table and write them down on your paper.
2. Write the conversion as a fraction. Orient that fraction so that the units you no longer want will cancel out and leave the desired units behind.
3. Perform all necessary calculations.

 **Example 17:** Express 5 ml in terms of cups.

 **Example 18:** The country of Cambodia is approximately 700 km from N to S. What would this distance be in miles?

## YOU TRY

19. Perform each of the following U.S. to metric or metric to U.S. conversions. Round to hundredths as needed.

a. Soda pop is often sold in 2-liter containers. How many quarts would this be? How many gallons?

b. Your friend Leona is planning to run her first 10km race in a few weeks. How many miles will she run if she completes the race?

c. A roll of Christmas wrapping paper is 3 meters long. How long is this in yards?

d. Convert 10 ml to cups.