# Convert Measurements for Culinary Arts Tasks

**Unit:** Culinary Science

**Problem Area:** Culinary Math

**Lesson:** Convert Measurements for Culinary Arts Tasks

## Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Convert decimals to fractions and fractions to decimals.**
2. **Convert U.S. Customary weight and volume measurements.**
3. **Convert metric weight and volume measurements.**
4. **Calculate and apply conversion factors to formulas/recipes.**
5. **Convert temperatures from Fahrenheit to Celsius and Celsius to Fahrenheit.**

## Resources.

The following resources may be useful in teaching this lesson:


Barnard, Frederick Augustus Porter. *The Metric System of Weights and Measures*. BiblioBazaar, 2008.

Blocker, Linda, Julia Hill, and The Culinary Institute of America. *Culinary Math*, 3rd ed. Wiley, 2007.

"Culinary Math," *The Culinary Institute of America's CIA kids.com*. Accessed Jan. 10, 2011. <http://www.ciakids.com/CulinaryMath1/index.html>.

"Culinary Math," *World Class CAD*. Accessed Jan. 10, 2011. <http://www.worldclasscad.com/culinary_math.htm>.


Jones, Terri. *Culinary Calculations: Simplified Math for Culinary Professionals*, 2nd ed. Wiley, 2008.

McGreal, Michael J., and Linda Padilla. *Culinary Math: Principles and Applications*. American Technical, 2009.

"Metric Conversion & Metric System," *FPSi*. Accessed Jan. 10, 2011. <http://www.france-property-and-information.com/metric_conversion_table.htm>.

## Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visuals from accompanying masters
- ✓ Copies of sample test, lab sheets, and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

## Key Terms.

The following terms are presented in this lesson (shown in bold italics):

- Celsius
- centi
- deci
- decimals
- denominator
- Fahrenheit
- fractions
- gallon
- gram
- kilo
- kilogram
- liter
- metric measurements
- milli
- numerator
- pound
- recipe conversion factor
- reduce
- standard
- standardization
- U.S. Customary measurements
- volume
- yield
- yield factor

**Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *Many students struggle with mathematics, and this lesson should decrease some of that anxiety. It is crucial to stress that the arithmetic and mathematics in this unit is "applied mathematics." The material has absolute hands-on value as opposed to mathematical theory.*

> *To accentuate this point, consider conducting a hands-on opener to this lesson. Have a water source available and a variety of measuring cups: gallon, quart, pint, cup, ¼ cup, and tablespoon, along with bowls in which to deposit the measured water. The best choice of measuring cups for this would be commercial metal cups with indented lines but no actual written measurements, though standard measures would work.*

> *Ask for two or three student volunteers to measure a pint of water for a recipe, and provide the volunteers with gallon measures. Answer no questions for the time being. If the students get "stuck," ask them to measure a quart of water and provide cup measures. Next, ask the volunteers to measure a cup of water, and provide a tablespoon measure. Finally, tell the student volunteers, who may or may not have problems with the measurements, that a second recipe calls for a pint of water but your order only requires you to make part of the recipe. Ask the students to measure the correct converted amount using any of the measuring devices provided.*

> *Many, if not most, students will have some problems with this exercise. That is the desired effect. Tell students the ability to measure, weigh, and convert accurately is one of the most essential parts of performing culinary tasks.*

# CONTENT SUMMARY AND TEACHING STRATEGIES

**Objective 1:** Convert decimals to fractions and fractions to decimals.

**Anticipated Problem:** How are decimals converted to fractions and fractions to decimals?

I. Converting decimals to fractions and fractions to decimals

A. Professional cooking and hospitality management are built upon standardization. A ***standard*** is an established measure that can be used as the basis for

comparisons. In the foodservice industry, ***standardization*** is the process of conforming to predetermined standard formulas/recipes, standard methods, standard ingredients, standard portions, and standard measurements. Standard formulas/recipes include several elements of standardization, such as:

1. Yield: Portion size, dipper size, pan size, etc.
2. Cooking time and temperature: Based on pan size, the amount of food in the pan, the number of pans placed in the oven, etc.
3. Ingredients: The ratio between flour and liquid varies with the kind of flour. Typically, cake flour is used in cake recipes (unless otherwise stated). Generally, all-purpose flour is used in other recipes (unless otherwise stated). Sodium-aluminum-sulphate-type baking powder (double acting) is used in most recipes. Fresh shell eggs weighing approximately 2 ounces (57 g) each are used in recipes. High ratio and/or hydrogenated fats are used in most cake and pastry recipes. Butter or margarine is commonly used in cookies and sauces. Solid fats (e.g., butter, margarine, and shortening) are interchangeable in recipes that only specify "fat." Unsaturated fat, including corn and vegetable oils, is used in most recipes that specify salad oil.
4. Abbreviations

| | | |
|---|---|---|
| a. | AP | as purchased |
| b. | c or C | cup |
| c. | °C | degrees Celsius |
| d. | doz | dozen |
| e. | EP | edible portion |
| f. | °F | degrees Fahrenheit |
| g. | fg | few grains (less than ⅛ t) |
| h. | fl oz | fluid ounce |
| i. | g | gram |
| j. | gal | gallon |
| k. | in | inch |
| l. | kg | kilogram |
| m. | L | liter |
| n. | lb or # | pound |
| o. | min | minute |
| p. | mL | milliliter |
| q. | oz | ounce |
| r. | pt | pint |
| s. | qt | quart |
| t. | t | teaspoon |
| u. | T | tablespoon |

5. Weight and volume: Weight is generally equated to "mass" when referencing culinary tasks. In a strict technical sense, an object's weight is referred to as the downward force it "feels" when sitting on the ground. It is measured in

newtons. In everyday use, "net weight 2 lb" or "net weight 500 g" is fine. However, when reading a scientific or technical article, the correct term would be "mass." According to the U.S. Metric Association:

a. When someone says, "On the moon you weigh about one-sixth of what you weigh on Earth," he or she is correctly using the term "weigh."
b. However, a 5 lb bag of sugar on Earth still weighs (in the everyday sense of the word) 5 lb on the moon. If a formula/recipe calls for 100 g of flour on Earth, a person would still need 100 g on the moon. The difference is that lifting 100 g of flour on the moon would not "feel" as heavy as it does on Earth.

B. ***Decimals*** ("deci" means 10) are real numbers expressed in tenths. ***Fractions*** (literally the "act of breaking") are ratios of two numbers other than zero. Decimals and fractions are numerical representations of a part or a whole—something less than 1 (e.g., 0.25, 0.50, 0.33, 0.75, ¼, ½, ⅓, and ¾) or a whole and part of that whole (e.g., 1.25, 1.50, 1.33, 1.75, 1¼, 1½, 1⅓, and 1¾). Every decimal has a fraction equivalent and vice versa; decimals and fractions are simply different ways to express the same measurement.

1. Decimals can be converted to fractions by simply counting the spaces to the right of the decimal (i.e., 10ths, 100ths, and 1000ths). This number will be the ***denominator***, which is the number below the fraction bar and the divisor of the numerator that shows how many parts are in the whole unit. The ***numerator*** is the number above the fraction bar that denotes the number of parts of the denominator; it will be the number shown in the decimal.
   a. The decimal 0.25 is the same as $^{25}/_{100}$.
   b. The fraction $^{25}/_{100}$ is not reduced to the lowest terms. To ***reduce*** (convert an expression to an equivalent but more fundamental expression) the fraction, divide both the numerator and the denominator by 25.
   c. The number 25 is the greatest common divisor (GCD) or greatest common factor (GCF) of the numbers 25 and 100. As a result, the numerator and the denominator should be divided by 25: 25 ÷ 25 = 1 and 100 ÷ 25 = 4.
   d. The fraction $^{25}/_{100}$ reduced to lowest terms is ¼.
2. Fractions can be converted to decimals by using the fraction bar as the symbol for "divided by." So, ⅜ is the same as 3 divided by 8.
   a. The numerator should be divided by the denominator.
   b. 3 ÷ 8 = 0.375

**Teaching Strategy:** *Use VM–A to review abbreviations used in standardized formulas/recipes. Review the standardized measuring devices for dry and liquid ingredients available in your laboratory. As a quick experiment, ask students to use a digital scale to measure the grams of table salt using various teaspoon-size measuring spoons. You may need to bring in various graduated measuring spoon sets to make the point—as diverse a grouping as possible. Record the various measurements.*

*Then use the VM–B commercial standard measure for table salt—20 grams—to compare and contrast the teaspoon measures available on the market and in your lab. Ask students to measure the number of grams in a tablespoon: If one teaspoon equals 20 grams, then one tablespoon should equal 60 grams, etc. Are the sets graduated accurately? Use VM–C to review the process of converting decimals to fractions and fractions to decimals. Assign LS–A.*

## Objective 2: Convert U.S. Customary weight and volume measurements.

**Anticipated Problem:** What are the common measurements in the U.S. Customary system? How are these measures converted?

II. U.S. Customary weight and volume conversions

A. ***U.S. Customary measurements*** are the measurement standards used in the United States. Weight (the amount that something weighs—poundage) is based on a ***pound*** (lb or #) that contains 16 ounces (oz). Volume (the amount of space occupied) is based on a ***gallon*** (gal) that contains 128 ounces. As a rule:

1. Volume measurements are used for liquids.
2. Dry ingredients are measured by weight. Dry ingredients would be measured in volume units only when indicated in a recipe.

B. Converting weights

1. To convert pounds to ounces, it is necessary to multiply the number of pounds by 16 (ounces in a pound). An example is 4.35 lb × 16 = 69.6 oz.
2. To convert ounces to pounds, it is necessary to divide the ounces by 16 (ounces in a pound). If the result is a decimal, that decimal represents that part of a pound (e.g., 56 oz ÷ 16 = 3.5 lb).

C. Converting volume: liquids

1. Three liquids used in culinary settings—water, whole milk, and fluid eggs—share identical values of weight and volume. In all other instances (of liquid measures), a fluid ounce and an ounce of weight are two completely different things. For example, a pint of water is 16 fluid ounces (fl oz), which also weighs 1 lb. However, a pint of juice and/or other liquids with pulp would weigh different amounts.
2. The rule of thumb for these three liquids—water, whole milk, and fluid eggs—is 1 gallon weighs 8 lb, and all breakdowns of a gallon follow suit: 1 quart = 32 oz, 1 pt = 16 oz, and 1 c = 8 oz. The weight to volume conversion for these three liquids is an important skill to master.
3. Volume measurements based on a liquid gallon of water include:
   a. 1 gallon = 128 oz = 4 qt = 8 pt = 16 c = 256 T
   b. 1 half-gallon = 64 oz = 2 qt = 4 pt = 8 c = 128 T
   c. 1 quart = 32 oz = 2 pt = 4 c = 64 T
   d. 1 pint = 16 oz = 2 c = 32 T

e. 1 cup = 8 oz = 16 T
f. 2 T = 1 oz
g. 1 T = 3 t
h. For example:
(1) Quarts to ounces: 3.25 qt × 32 oz (per qt) = 104 oz
(2) Pints to gallons: 18 pt ÷ 8 (pt/gal) = 2.25 gal
(3) Gallons to cups: 2.75 gal × 16 (cups/gal) = 44 c

4. Dry ingredients are best weighed for accuracy and standardization. A reliable scale is essential. For accuracy and product standardization, dry ingredients should be weighed.
a. 1 c granulated sugar = 7 oz
b. 1 c confectioners' sugar = 4 oz
c. 1 c packed brown sugar = 7½ oz
d. 1 c molasses, honey, or corn syrup = 12 oz
5. Some conversions may require multiple steps (as outlined in the examples above) to find the solution.

**Teaching Strategy:** *Use VM–D to review conversions of U.S. Customary weight and volume measurements. Assign LS–B for additional student practice.*

## Objective 3: Convert metric weight and volume measurements.

**Anticipated Problem:** How can metric measures be converted to U.S. Customary measures?

III. Metric weight and volume conversions

A. ***Metric measurements*** are the measuring standards for nearly all countries in the world. The metric standard for weight is a ***gram*** (g). The metric standard for volume is a ***liter*** (L). All subsequent measurements are variations of these two standards. The use of a gram scale is recommended for European formulas/recipes.

1. A gram is a tiny amount of weight, so small that the numbers would quickly become unwieldy, as larger weights are needed. To expedite this, the prefix ***kilo*** (meaning 1000) is used. A ***kilogram*** (kg) is equal to 1000 grams. The kilo prefix can be used with liters, referring to thousands of liters.
a. 1 kilogram = 2.2 lb
b. 28.35 g = 1 oz
c. 453.59 g (often estimated at 454 g) = 1 lb
d. To change grams to kilograms, it is necessary to move the decimal point three places to the left (e.g., 35 g = 0.035 kg).
2. The liter is more common in the United States, primarily due to soda being sold in 2-liter bottles. A liter equals about 34 oz (just 2 oz more than a quart).

For the purposes of estimation, a person can think of a metric liter as approximately the same as a U.S. Customary quart.

3. Grams and liters are used in amounts less than one, and the metric system accounts for this with prefixes that represent ten times more or less than the prefixes.
   a. ***Deci*** = $^{1}/_{10}$
   b. ***Centi*** = $^{1}/_{100}$
   c. ***Milli*** = $^{1}/_{1000}$
      (1) 1 deciliter (dl) = $^{1}/_{10}$ of a L
      (2) 500 milligrams (mg) = $^{500}/_{1000}$ of a g
4. Conversion between each is based on multiples of 10.
   a. 1 deciliter (dL) = 10 centiliters (cL) = 100 milliliters (mL)
   b. These prefixes are used for grams and liters.
5. Common conversions are often approximate conversions.
6. Standardization calls for a space to be used between the numerical value and unit symbol for metric amounts—25 kg, not 25kg.

B. Converting from U.S. weights and measures to metric—According to the authors of *Food for Fifty*, the two approaches to convert U.S. Customary to metric are by use of soft conversion and via hard conversion.

1. Soft conversion results in the exact conversion of U.S. Customary to its metric equivalent via a mathematical formula. Soft conversion is still common today and is utilized in this lesson plan.
2. Hard conversion requires changing to standardized metric units, which requires new measuring devices, different (possibly new) pans, and metrically packaged foods.

**Teaching Strategy:** *Use VM–E and VM–F. Assign LS–C to have students convert metric measures and to convert U.S. Customary to metric and vice versa.*

## Objective 4: Calculate and apply conversion factors to formulas/recipes.

**Anticipated Problem:** What is a conversion factor? How is it calculated? How is it applied in a culinary setting?

IV. Determining and using conversion factors

A. A ***recipe conversion factor*** (RCF) or ***yield factor*** (YF) is a number that represents a ratio or a percentage of an original recipe. It is used to convert each ingredient in the original recipe to provide a new ***yield*** (the resulting quantity or amount). A conversion factor can be used to increase or decrease the size of the original recipe's yield.

B. To calculate RCF or YF, have your students do the following steps:
   1. Step 1: Divide the desired yield (new yield) by the original yield (old yield). For instance, when 20 cupcakes are needed and an original recipe makes 12, the applied formula is 20 ÷ 12 = 1.67, so 1.67 is the conversion factor. Similarly, a recipe that makes 50 cupcakes where only 12 are needed would be solved by 12 ÷ 50 = 0.24, providing a yield factor of 0.24.
   2. Step 2: Multiply each ingredient by the RCF. For example, in the problem in which the yield RCF was 1.67 to make 20 cupcakes, if the original recipe called for:
      a. 10 oz milk, one applies the RCF as 1.67 × 10 oz = 16.7 oz of milk needed for the new increased recipe
      b. 3 c flour, one applies the RCF as 1.67 × 3 c = 5.01 c
   3. An easy way to remember the RCF formula is the acronym "**NO**"—**N**ew recipe over **O**ld recipe or **N**ew recipe over **O**riginal recipe.

C. To calculate RCF when the units are different:
   1. Step 1: Convert the different units to a common unit, such as:
      a. Old recipe = quarts
      b. New recipe = gallons
      c. Convert both recipes to a common unit (e.g., cups).
   2. Step 2: Divide the desired yield by the original yield to determine the RCF.
   3. Step 3: Multiply each ingredient by the RCF.

D. Cautions
   1. Chemical leaveners—If formulas/recipes indicate a chemical leavener by *volume* (e.g., t, T, and ⅛ c), the chef should not use the RCF to increase or decrease the amount. Instead, he or she should consult a reliable conversion chart (e.g., the one in *Food for Fifty*) to determine the amount needed. If the recipe is in ounces or grams (a weight measure), the RCF should be reliable.
   2. Spices, salt, hot peppers, saffron, and other potent ingredients—Many potent ingredients do not require any alternation from the original amount. For instance, when doubling a chili recipe, the amount of salt and/or hot chili powder required may not change from the original recipe. The ingredient is potent enough to accommodate the larger yield.
   3. Large shifts in yield—The more one alters a formula/recipe, the more likely a problem (in taste or quality) may occur. It is necessary to test the recipe prior to serving or to find a formula closer in volume to the yield required.

**Teaching Strategy:** *Use VM–G. Then assign LS–D.*

**Objective 5:** Convert temperatures from Fahrenheit to Celsius and Celsius to Fahrenheit.

**Anticipated Problem:** How are temperatures converted?

V. Converting Fahrenheit to Celsius and Celsius to Fahrenheit

A. ***Fahrenheit*** (°F) and ***Celsius*** (°C; sometimes referred to as the centigrade scale; centigrade means "consisting of or divided into 100 degrees") are temperature measurement systems. The Celsius scale is a tighter and more constricted scale, allowing for much more extreme temperatures to be measured without the use of huge numbers, making Celsius a common system to use in the sciences and physics. The Fahrenheit scale is most often used in the United States to measure common Earth atmospheric temperatures and the temperature inside homes and businesses, including cooking and baking temperatures. However, the use of Celsius temperatures for cooking and baking is becoming more common. As a result, being able to convert the two systems is important. Most standardized formulas/recipes provide both °F and °C temperatures. Basic temperature scale conversions to use as absolutes are:

1. 212°F = 100°C = boiling point of water
2. 32°F = 0°C = freezing point of water
3. 98.6°F = 37°C = normal body temperature
4. 69°F = 20°C = typical winter home heat setting
5. Fahrenheit and Celsius scales coincide at –40 degrees: –40°F and –40°C describe the same temperature (exceptionally cold).

B. To convert Fahrenheit to Celsius, have your students do the following:

1. Step 1: Subtract 32 from the Fahrenheit temperature.
2. Step 2: Divide that product by 1.8 (or $^{5}/_{9}$) to equal the °C.
   a. 80°F – 32 = 48 ÷ 1.8 = 26.67°C
   b. 95°F – 32 = 63 ÷ 1.8 = 35°C
   c. 75°F – 32 = 43 ÷ 1.8 = 23.89°C (rounded)
3. The conversion factor of 1.8 is found by the difference between the freezing point and boiling point of water: 212 – 32 = 180 Fahrenheit degrees. So one degree on the Fahrenheit scale is $^{1}/_{180}$ of the difference between the freezing and boiling points of water.

C. To convert Celsius to Fahrenheit, have your students do the following:

1. Step 1: Multiply the Celsius temperature by 1.8 (or $^{9}/_{5}$).
2. Step 2: Add 32 to that product to equal the °F.
   a. 14°C × 1.8 = 25.2 + 32 = 57.2°F
   b. 20°C × 1.8 = 36 + 32 = 68°F
   c. 30°C × 1.8 = 54 + 32 = 86°F

**Teaching Strategy:** *Use VM–H to review the conversion calculations for temperature. Have students practice temperature conversions, and add other conversion problems as needed. Assign LS–E.*

*If necessary, review the algebra concept of adding and subtracting negative numbers prior to the use of VM–H and LS–E. If your students require a refresher, consider using http://www.cimt.plymouth.ac.uk/projects/mepres/book7/bk7i15/bk7_15i1.htm.*

- **Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle.

- **Application.** Use the included visual masters and lab sheet to apply the information presented in the lesson.

- **Evaluation.** Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

- **Answers to Sample Test:**

### Part One: Matching

1. c
2. b
3. d
4. f
5. g
6. a
7. e
8. h

### Part Two: True/False

1. F
2. F
3. T
4. T
5. T
6. T
7. F
8. T

9. F
10. T

## Part Three: Completion

1. standard
2. RCF (or recipe conversion factor or yield factor)
3. fraction
4. yield
5. abbreviations
6. weighed
7. 1.3725
8. liquids
9. gram, liter
10. new (desired), old (original)

**Sample Test**

Name _____

# Convert Measurements for Culinary Arts Tasks

## Part One: Matching

***Instructions:*** **Match each amount with its definition.**

a. 48 oz
b. 16 oz
c. 128 oz
d. 34 oz
e. 32 oz
f. 3 t
g. 4.5 lb
h. 8 c

_____1. The weight of one gallon of water

_____2. One pint or 2 cups of liquid

_____3. The weight of one liter

_____4. Equal to 1 tablespoon

_____5. The combined weight of 2 cups water, 4 cups whole milk, and 3 cups liquid eggs

_____6. The weight of 3 liquid pints of whole milk

_____7. The weight of one quart

_____8. The number in ½ gallon

## Part Two: True/False

***Instructions:*** **Write *T* for true or *F* for false.**

_____1. There are 6 tablespoons in 2 fluid ounces.

_____2. One kilogram is equal to 100 grams.

_____3. A metric conversion of 10 deciliters to centiliters equals 100 centiliters.

_____4. A conversion of 0.125 lb is equal to 2 oz.

_____5. The fraction is equal to the decimal 0.4.

_____6. There are 8 cups in ½ gallon of water.

_____7. A conversion of 32°F to °C equals 100°C.

_____8. 500 milligrams is equal to 0.5 grams.

_____9. As a rule of thumb, one gallon of water weighs 16 lb.

____10. U.S. Customary quarts and metric liters are roughly the same measurement.

## Part Three: Completion

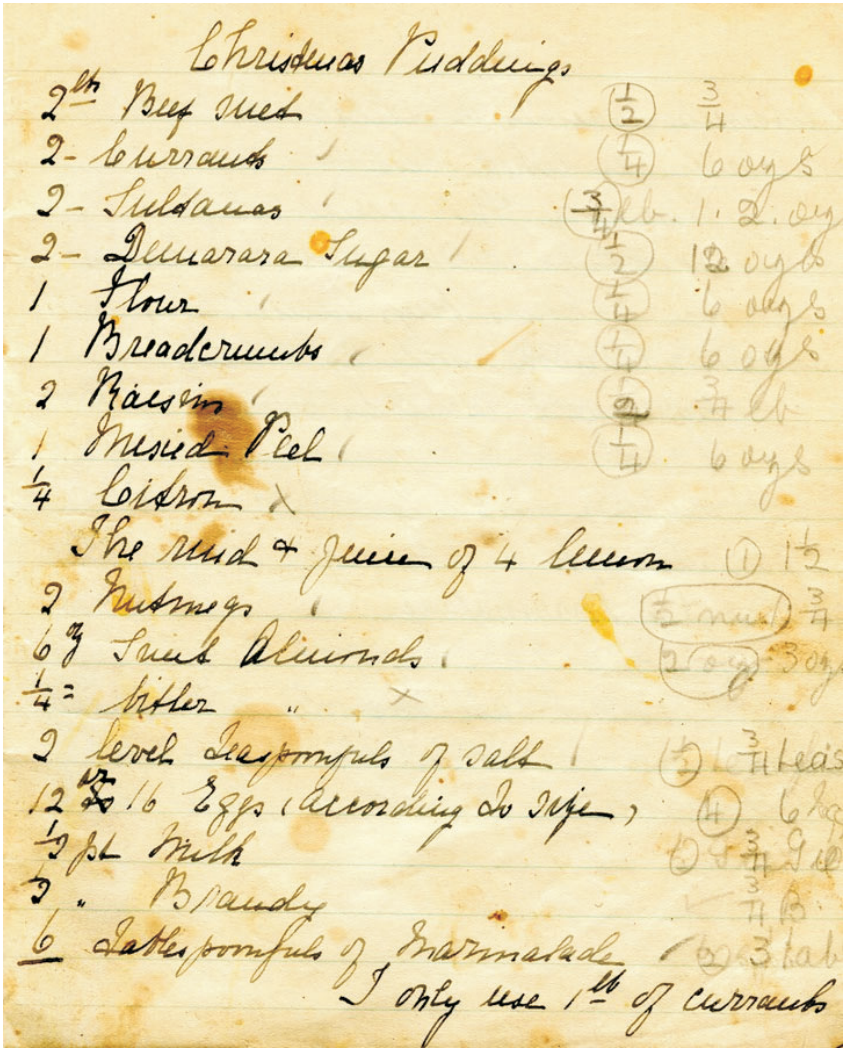
***Instructions:*** **Provide the word or words to complete the following statements.**

1. A means of determining what a thing should be—an established measure that can be used as the basis for comparisons—is known as a _____.
2. Kelly wants to make 18 cookies, but the original recipe makes 144 cookies. To do so, Kelly must calculate the _____ to convert her recipe.
3. Every decimal has a _____ equivalent and vice versa; they are simply different ways to express the same measurement.
4. Conversion factors change the _____ of a recipe.
5. °C, doz, EP, fl oz, and g are _____ for degrees Celsius, dozen, edible portion, fluid ounce, and gram.
6. Dry ingredients are best _____ for accuracy and standardization.
7. Jeff has a recipe that calls for 2.25 lb flour, and he is changing the recipe to a different yield. He has calculated a conversion factor of 0.61, which means he will need _____ lb of flour in the new version.
8. As a rule, volume measurements are used for _____.
9. The metric standard for weight is a _____; the metric standard for volume is a _____.
10. To calculate a recipe conversion factor/yield factor, the _____ recipe yield is divided by the _____ recipe yield.

VM–A

# ABBREVIATIONS IN STANDARDIZED FORMULAS/ RECIPES

Was this old recipe for *Christmas Pudding* written using standardized abbreviations? Someone has begun converting this recipe from metric to U.S. Customary. Did the individual use standardized abbreviations?



Christmas Puddings

2 lbs Beef suet
2 - Currants
2 - Sultanas
2 - Demarara Sugar
1 Flour
1 Breadcrumbs
2 Raisins
1 Mixed Peel
¼ Citron
The rind & juice of 4 lemons
2 Nutmegs
6 oz Sweet Almonds
¼ = bitter "
2 level Teaspoonfuls of Salt
12 oz 16 Eggs (according to size)
½ pt Milk
2 " Brandy
6 Tablespoonfuls of Marmalade
I only use 1 lb of currants

| | |
|---|---|
| ♦ AP | as purchased |
| ♦ c or C | cup |
| ♦ °C | degrees Celsius |
| ♦ doz | dozen |
| ♦ EP | edible portion |
| ♦ °F | degrees Fahrenheit |
| ♦ fg | few grains (less than ⅛ t) |
| ♦ fl oz | fluid ounce |
| ♦ g | gram |
| ♦ gal | gallon |
| ♦ in | inch |
| ♦ kg | kilogram |
| ♦ L | liter |
| ♦ lb or # | pound |
| ♦ min | minute |
| ♦ mL | milliliter |
| ♦ oz | ounce |
| ♦ pt | pint |
| ♦ qt | quart |
| ♦ t | teaspoon |
| ♦ T | tablespoon |

*NOTE:* Metric unit symbols are case-sensitive, so uppercase and lowercase letters have different meanings. For example, mm is a millimeter (one-thousandth of a meter), but Mm is a megameter (one million meters).

# MEASURING DEVICES

- The most accurate device for measuring dry ingredients is a scale, whether digital- or platform-type.

- Transparent measuring cups may be used to measure liquids—U.S. Customary and metric measurements.


- Some people believe that all commercial teaspoons measure the same volume. However, they do not. There is a wide disparity between measurements using different manufacturers' graduated measuring tools.

According to John Willoughby, *Gourmet Magazine*, the variance between measurements is between 5% and 33%. This disparity is not so important when seasoning soup, but it is critical when preparing pastries and yeast breads. The standard for commercial baking is 20 grams of table salt per teaspoon. How do the teaspoons used in the foods lab compare to this standard?

# DECIMAL AND FRACTION CONVERSIONS

## Convert a decimal to a fraction:

1. Count the number of places to the right of the decimal and place the decimal over that number. For example, use the decimal 0.25.
2. 0.25 goes to the 100th's place
3. $0.25 = {}^{25}/_{100}$
4. Reduce the fraction $^{25}/_{100}$ to lowest terms by dividing the numerator and the denominator by 25:

   $25 \div 25 = 1$

   $100 \div 25 = 4$
5. $0.25 = {}^{1}/_{4}$

## Convert a fraction to a decimal:

1. Look at the fraction bar as the symbol for "divided by." For example, use the fraction ⅜:
2. ⅜ is the same as 3 divided by 8.
3. Divide the numerator by the denominator:

   3 ÷ 8 = 0.375 (three hundred seventy-five thousandths)

# U.S. CUSTOMARY WEIGHTS & VOLUME CONVERSIONS

## Convert weight:

1. Weight measures are based on a pound.

   1 lb = 16 oz

2. To convert pounds to ounces, multiply by 16.

   3.4 lb × 16 (oz/lb) = 54.4 oz

3. To convert ounces to pounds, divide by 16.

   84 oz ÷ 16 (oz/lb) = 5.25 lb

## Convert volume:

1. Volume measures are based on a gallon.

   1 gallon = 128 oz = 4 qt = 8 pt = 16 c = 256 T

   1 half-gallon = 64 oz = 2 qt = 4 pt = 8 c = 128 T

   1 quart = 32 oz = 2 pt =4 c = 64 T

   1 pint = 16 oz = 2 c = 32 T

   1 cup = 8 oz = 16 T

   2 Tablespoons = 1 oz

   1 Tablespoon = 3 t

2. Two examples:

   How many quarts are in 96 oz?

   96 qt ÷ 32 (oz/qt) = 3 qt

   How many ounces are in 1.25 gallons?

   1.25 gal × 128 (oz/gal) = 160 oz

# U.S. CUSTOMARY TO METRIC CONVERSIONS TABLE

| To Convert From | To | Multiply By | More Precisely, Multiply By |
|---|---|---|---|
| feet (ft) | meters (m) | 0.3 | 0.3048 |
| fluid ounces (fl oz) | milliliters (mL) | 30 | 29.573 53 |
| gallons (gal) | liters (L) | 3.8 | 3.785 411 784 |
| inches (in) | centimeters (cm) | 2.54 | 2.54 |
| ounces (oz) | grams (g) | 28 | 28.349 52 |
| pounds (lb) | kilograms (kg) | 0.45 or divide by 2.2 | 0.453 592 37 |
| quarts (qt) | liters (L) | 0.9 | 0.946 352 946 |

*NOTE: Ounces and pounds refer to avoirdupois units. Fluid ounces, quarts, and gallons refer to U.S. liquid measures.*

# METRIC WEIGHTS AND VOLUMES

## Weight measures are based on a gram (g)

1. 1 oz = approximately 28 g
2. Kilo (K) = 1000
3. Kilogram (kg) = 1000 g
4. 1 Kg = 2.2 lb

## Volume measures are based on liters (L)

1. 1 L = 34 oz (approximately 1 qt)
2. Weights and volumes less than a g or L use these prefixes:

   deci = $^1/_{10}$

   centi = $^1/_{100}$

   milli = $^1/_{1000}$

   10 dg = 1 g

   500 mL = ½ L

   450 cg = 4.5 g

The mass of a nickel is 5 g; a penny is 2.5 g.

The diameter of a CD or DVD is 12 cm.

# CONVERSION FACTOR

## Recipe Conversion Factor (RCF) or Yield Factor (YF)

A RCF (or YF) is a number that represents a ratio or percentage of an original recipe. This factor is used to convert each ingredient in an original recipe (O) to a new (N) YIELD.

$$\text{Formula: } \frac{\text{New Yield}}{\text{Original Yield}} = \text{RCF}$$

## PRACTICE:

- New Yield (N) = 8 cupcakes
- Original Yield (O) = 40 cupcakes

$$\frac{8}{40} = 0.20 \text{ RCF}$$

Multiply each ingredient in the original recipe by the RCF to get the desired yield.

**"NO" = N**ew recipe over **O**ld recipe

# CONVERTING FAHRENHEIT AND CELSIUS

## To convert °F to °C:

- Step 1: Subtract 32 from the °F.
- Step 2: Divide that product by 1.8.

$$80°F - 32 = 48 \div 1.8 = 26.67°C$$
$$95°F - 32 = 63 \div 1.8 = 35°C$$

## Practice:

- Convert 75°F to °C.
- Convert -10°F to °C.

## To convert °C to °F:

- Step 1: Multiply the °C by 1.8.
- Step 2: Add 32 to that product.

$$14°C \times 1.8 = 25.2 + 32 = 57.2°F$$
$$30°C \times 1.8 = 54 + 32 = 86°F$$

## Practice:

- Convert 20°C to °F
- Convert –4°C to °F

LS–A

Name _____

# Decimal and Fraction Conversions

## Purpose

The purpose of this activity is to practice converting fractions to decimals and decimals to fractions.

## Objectives

1. Convert fractions to decimals.
2. Round decimals to the nearest 100th place.
3. Convert decimals to fractions.
4. Reduce fractions to lowest terms.

## Materials

- lab sheet
- VM–C
- writing utensil
- scratch paper
- calculator, optional

## Procedure

1. Work independently to complete each of the conversion problems shown below.
2. Convert these fractions to decimals. Round answers to the nearest 100th place.
   a. $^{3}/_{5}$= _____
   b. $^{4}/_{7}$ = _____

c. $^{2}/_{9}$ = _____

d. $^{1}/_{6}$ = _____

e. $^{12}/_{13}$ = _____

f. $^{22}/_{30}$ = _____

g. $^{2}/_{3}$ = _____

h. $^{14}/_{17}$ = _____

3. Convert these decimals to fractions. REDUCE to lowest terms.

a. 0.9 = _____

b. 0.25 = _____

c. 0.875 = _____

d. 0.47 = _____

e. 0.1 = _____

f. 0.525 = _____

g. 0.070 = _____

h. 0.29 = _____

4. Turn in your completed lab sheet to your instructor.

# Decimal and Fraction Conversions

2. Convert fractions to decimals. ROUND to nearest 100th.
   a. $^{3}/_{5}$= 0**.6**
   b. $^{4}/_{7}$ = 0**.57**
   c. $^{2}/_{9}$ = 0**.22**
   d. $^{1}/_{6}$ = 0**.17**
   e. $^{12}/_{13}$ = 0**.92**
   f. $^{22}/_{30}$ = 0**.73**
   g. $^{2}/_{3}$ = 0**.67**
   h. $^{14}/_{17}$ = 0**.82**
3. Convert decimals to fractions. Reduce to lowest terms.
   a. 0.9 = $^{9}/_{10}$
   b. 0.25 = $^{1}/_{4}$
   c. 0.875 = $^{7}/_{8}$
   d. 0.47 = $^{47}/_{100}$
   e. 0.1 = $^{1}/_{10}$
   f. 0.525 = $^{21}/_{25}$
   g. 0.070 = $^{7}/_{100}$
   h. 0.29 = $^{29}/_{100}$

Name _____

# U.S. Customary Weight and Volume Conversions

## Purpose

The purpose of this activity is to practice converting U.S. Customary weights and volume measurements.

## Objectives

1. Interpret standard abbreviations.
2. Convert U.S. Customary weight measurements.
3. Convert U.S. Customary volume measurements.

## Materials

- lab sheet
- VM–A
- VM–D
- scratch paper
- writing utensil
- calculator, optional

## Procedure

1. Work independently to complete each of the weight and volume conversion problems shown below.
2. Interpret each abbreviation to convert the following U.S. Customary volume measurements.

   a. 1 qt = _____ oz

b. 2.5 pt = _____ oz

c. 3.25 lb = _____ oz

d. ½ gal = _____ c

e. 2 qt = _____ pt

f. ½ c = _____ T

g. 1.5 gal = _____ oz

h. 1 oz liquid = _____ t

i. 2.75 lb = _____ oz

j. 512 oz = _____ lb

k. 0.375 lb = _____ oz

l. 1 qt = _____ gal

m. 2 c + 1 pt + 1 qt liquid = _____ oz

n. 1 gal – 3 pt liquid = _____ c

o. If a gallon of milk weighs 8 lb, then 1 pt weighs _____.

3. Turn in your completed lab sheet to your instructor.

# U.S. Customary Weight and Volume Conversions

2. a. 1 qt = **32** oz
   b. 2.5 pt = **40** oz
   c. 3.25 lb = **52** oz
   d. ½ gal = **8** c
   e. 2 qt = **4** pt
   f. ½ c = **8** T
   g. 1.5 gal = **192** oz
   h. 1 oz liquid = **6** t
   i. 2.75 lb = **44** oz
   j. 512 oz = **32** lb
   k. 0.375 lb = **6** oz
   l. 1 qt = **¼ or 0.25** gal
   m. 2 c + 1 pt + 1 qt liquid = **64** oz
   n. 1 gal – 3 pt liquid = **10** c
   o. If a gallon of milk weighs 8 lb, then 1 pt weighs **1 lb**

LS–C

Name _____

# Metric Weight and Volume Conversions

## Purpose

The purpose of this activity is to practice converting metric weights and volumes.

## Objectives

1. Interpret standard abbreviations.
2. Convert metric weight measurements.
3. Convert metric volume measurements.
4. Convert metric to U.S. Customary measurements and vice versa.

## Materials

- lab sheet
- VM–A
- VM–E
- scratch paper
- writing utensil
- calculator, optional

## Procedure

1. Work independently to complete each of the conversion problems shown below.
2. Interpret each abbreviation to convert the following metric measurements. You will need to convert U.S. Customary to metric and vice versa for some items. Hints:
   - deci = $^{1}/_{10}$

- centi = $^{1}/_{100}$
- milli = $^{1}/_{100}$
- kilo = 1000
- 28 g = 1 oz
- 1 L = 34 oz

3. Solve the following equations:
   a. 2.5 kg = _____ g
   b. 1 gram = _____ cg
   c. 1 L = _____ mL
   d. 4 oz = _____ g
   e. 4 L = _____ oz
   f. 12 g = _____ mg
   g. 400 cL = _____ dL
   h. 4 kg = _____ lb
   i. 5.5 L = _____ oz
   j. 2g + 350 cg = _____ g
   k. 2500 mL + 35 dL = _____ L

4. Which weighs more: 500 g or 8 oz?

5. How many L are in a 750 mL bottle?

6. If you have 5000 mg of salt and 500 dg of sugar, how many total grams do you have?

7. Which has more volume: a six-pack of 12 oz soda cans or a 2 L bottle of soda?

8. Turn in your completed lab sheet to your instructor.

# Metric Weight and Volume Conversions

3. a. 2.5 kg = **2500** g
   b. 1 gram = **100** cg
   c. 1 L = **1000** mL
   d. 4 oz = **113.4** g
   e. 4 L = **136** oz
   f. 12 g = **12,000** mg
   g. 400 cL = **40** dL
   h. 4 kg = **8.8** lb
   i. 5.5 L = **187** oz
   j. 2g + 350 cg = **5.5** g
   k. 2500 mL + 35 dL = **6** L
4. Which weighs more: 500 g or 8 oz?

   **500 g**
5. How many liters are in a 750 mL bottle?

   0**.75 L**
6. 5000 mg of salt and 500 dg of sugar equal how many total grams?

   **55 g**
7. Which has more volume: six 12-oz soda cans or a 2 L bottle of soda?

   **six-pack of 12-oz soda cans**

Name _____

# Conversion Factors

## Purpose

The purpose of this activity is to practice calculating and applying conversion factors to culinary tasks.

## Objectives

1. Calculate conversion factors.
2. Apply conversion factors to formulas/recipes.

## Materials

- lab sheet
- VM–G
- scratch paper
- writing utensil
- calculator, optional

## Procedure

1. Work independently to complete each of the culinary conversion problems shown below.
2. Apply the conversion factor formula (RCF/YF) to problems "a" through "d," and compute the conversion factors. Round to the hundredths place.
   a. Jeff needs to make 18 gallons of soup, and his recipe makes 4 gallons. What is the conversion factor? _____
   b. Dave only needs to make 24 blueberry muffins for the order he is preparing, but his recipe makes 160. What is the conversion factor? _____

c. Lisa has a punch recipe that makes 1.5 gallons. She has a big party coming up and needs 25 gallons. What is the conversion factor? _____

d. An online recipe for bagels makes 18 lb of dough. Annette only needs 1.25 lb for her family's needs. What is the conversion factor? _____

3. The brownie recipe below has a yield of 120 brownies. Find the conversion factor to make 24 brownies. Then apply the conversion factor to each recipe ingredient.

   a. What is the conversion factor? _____

***Original Brownie Recipe***

b. 9 lb flour
c. 7.5 lb granulated sugar
d. 1.5 qt water
e. 42 oz eggs
f. 3¼ lb cocoa
g. 3 oz vanilla
h. 2 oz baking soda
i. 6¼ c walnuts
j. ¼ gal corn syrup

***New Brownie Recipe***

b. _____ flour
c. _____ granulated sugar
d. _____ water
e. _____ eggs
f. _____ cocoa
g _____ vanilla
h. _____ baking soda
i. _____ walnuts
j. _____ corn syrup

# Conversion Factors

2. a. RCF/YF = **4.5**
   b. RCF/YF = **0.15**
   c. RCF/YF = **16.67**
   d. RCF/YF = **0.07**
3. a. RCF/YF = **0.2**
   b. **1.8 lb flour**
   c. **1.5 lb granulated sugar**
   d. **0.3 qt water (or about 9.6 oz)**
   e. **8.4 oz eggs**
   f. **0.65 lb cocoa (or about 10.4 oz)**
   g. **0.6 oz vanilla (or about 1 T + ½ t)**
   h. **0.4 oz baking soda (or about 2¼ t)**
   i. **1¼ c walnuts**
   j. **0.8 c corn syrup (or about ⅞ c)**

*NOTE 1*: If the amount of baking soda had been listed in volume (e.g., T) instead of weight, students could have been directed to a reliable conversion chart rather than using the conversion factor.

*NOTE 2*: Following this activity may be an opportunity to show students how to measure each of the amounts for the new brownie recipe (e.g., 0.65 lb cocoa, 0.6 oz vanilla, 0.4 oz baking soda, and 0.8 c corn syrup).

Name _____

# Temperature Conversions

## Purpose

The purpose of this activity is to practice converting temperatures from Fahrenheit to Celsius and Celsius to Fahrenheit.

## Objectives

1. Convert temperature readings from Fahrenheit to Celsius.
2. Convert temperature readings from Celsius to Fahrenheit.
3. Convert negative temperature readings.

## Materials

- lab sheet
- VM–H
- scratch paper
- writing utensil
- calculator, optional

## Procedure

1. Work independently to complete each of the temperature conversion problems shown below.
2. Solve each of these temperature conversion problems:
   a. 42°F = _____°C
   b. 350°F = _____°C

c. 122°C = _____°F

d. 71°C = _____°F

e. 151°F = _____°C

f. –2°C = _____°F

g. 5°F = _____°C

h. 250°C = _____°F

i. 98°F = _____°C

j. 16°C = _____°F

3. Turn in your completed lab sheet to your instructor.

# Temperature Conversions

1. Direct students to round these temperature conversions to the hundredths place. Conduct a quick debriefing of the solutions to each problem.
   a. Students may wish to discuss the use of some of the conversion solutions, such as 350°F to 176.67°C, which primarily have industrial uses.
   b. Students may wish to discuss negative temperature calculations. For example, –2°C is converted to °F using the same formula as for all °C to °F conversions:
      (1) –2°C × 1.8 = –3.6 + 32 = 28.4°F
      (2) You may need to review adding and subtracting negative numbers if students did not complete the practice problems on VM–H. If students are using a calculator, a reminder to enter the "minus sign" ahead of a negative temperature reading may be necessary.

2. a. 42°F = **5.55°C**
   b. 350°F = **176.67°C**
   c. 122°C = **251.6°F**
   d. 71°C = **159.8°F**
   e. 151°F = **66.11°C**
   f. –2°C = **28.4°F**
   g. 5°F = **-15°C**
   h. 250°C = **482°F**
   i. 98°F = **36.67°C**
   j. 16°C = **60.8°F**