CA 9900: Culinary Concepts
Lesson 2 Instructor's Notes
Measurement Conversion

Main Math Topic	***Main Quantitative Reasoning Context***
Unit Conversion & The Bridge Method	*Units of measurement in Culinary Arts*

Prerequisite Assumptions

Before beginning this lesson students should be able to:

- *Multiply two fractions*
- *Divide two fractions*
- *Simplify fractions by "canceling" or dividing common factors in the numerator and denominator*
- *Multiply fractions by 1 (in the form of number/number) to create common denominators*

Learning Goals

Students will come to understand that:

- *Ingredients may be measured in terms of volume, weight, and count*
- *Metric and Standard are two systems of measurement*
- *Standard measurement is most commonly used in the U.S.*
- *Units of measurement provide meaning to the numbers in a recipe*
- *The units of measure in a solution may be used as a guide to determine the operations required for a problem – that is, fractions (or rates) are positioned so that the appropriate units cancel*

Students will be able to:

- *Differentiate between units of measurement within weight and volume*
- *Differentiate between Metric and Standard units*
- *Use the "bridge method" to convert between units of measurements*
- *Know how to measure the volume and weight of wet and dry ingredients with the appropriate kitchen tool or equipment*

Suggested Timeline

Duration	*Activity*	*Suggested Structure*
10 minutes	*Do Now*	*Individual work*
10 minutes	*Intro to units of measurement and applications*	*Direct instruction/class discussion*
10 minutes	*Measuring Ingredients: Weight, Volume, and Count*	*Direct instruction/class discussion*
5 minutes	*Systems of Measurement*	*Direct instruction/class discussion*
5 minutes	*Introduction to Converting Units of Measurement*	*Direct instruction/class discussion*
45 minutes	*Weights and Measurements In Class Activity*	*Small groups*
15 minutes	*Post Activity Discussion*	*Class discussion*
15 minutes	*How to Convert Between Units of Measurement: The Bridge Method*	*Direct instruction/class discussion*
15 minutes	*Problem situation 1*	*Direct instruction/class discussion*
15 minutes	*Problem situation 2*	*Small groups/class discussion*
15 minutes	*Problem situation 3*	*Small groups/class discussion*
If time allows...	*Further applications*	*Small groups*

**20 minutes available for break and extra time for discussion, if necessary*

DO NOW:

Locate the "Math Foundations" section of your "CA 9900 Formula Cheat-Sheet". Recalling the concepts you learned in last week's class, fill in the blanks to complete the rules and formulas related to rounding numbers and calculating with fractions, decimals and percents. Throughout the semester you will use this "cheat-sheet" to record the rules and formulas you learn in class.

UNITS OF MEASUREMENT:

To accurately measure ingredients in the kitchen, it is important to know the standard units of measurement, the relationship between the units of measurement, and the tools we use to measure ingredients. Before we get started, let's first discuss:

Applications: *What are units of measurement that we use in the kitchen?*

_____

_____

_____

E.g. Teaspoons, tablespoons, cups, quarts, liters, pounds, ounces, grams.

Applications: *What are the benefits of having standardized units of measurement?*

_____

_____

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Proper measurement allows cooks to maintain food quality and consistency as well as manage cost and reduce waste.

This lesson focuses on the units of measurement most frequently used in the kitchen. We'll review what those units of measurement are, the tools we use to measure them, and the relationship between these different units. What do we mean by the relationship between units of measurement?

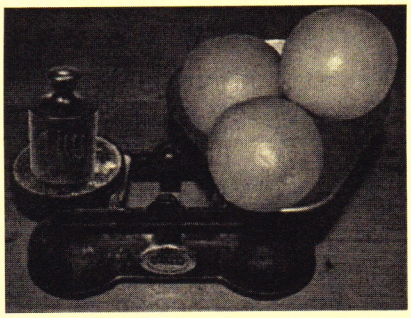
Say, for instance, that a recipe calls for a 1/2 pound of potatoes but your digital scale only provides measurements in ounces. What now? In this case, in order to measure the proper amount of potatoes, you need to convert the amount you need from pounds to ounces. In other words, you need to know the relationship between pounds and ounces.

Measuring Ingredients: Weight, Volume, and Count

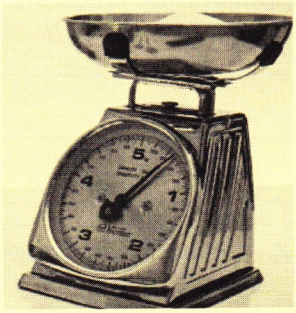
In recipes, quantities of ingredients may be listed by *weight*, *volume*, or count

Weight refers to the *heaviness* of an ingredient. Often, solid ingredients are measured by weight. In the kitchen, digital scales, balance-beam scales and spring-loaded scales may be used to measure weight.

Digital Scale



Balance Beam Scale



Spring-loaded Scale

Applications: What are common units of measurement for weight that we use in the kitchen?

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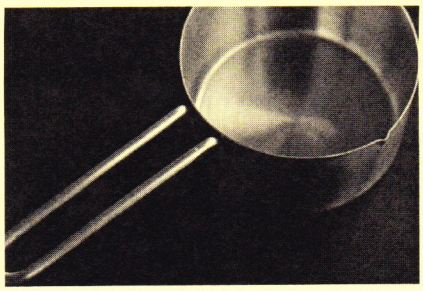
_____

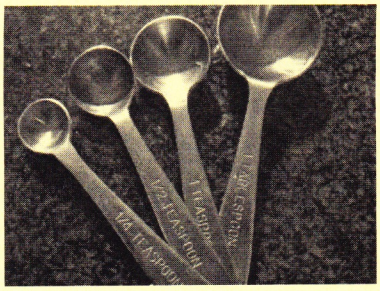
_____

Ounces, pounds, and grams.

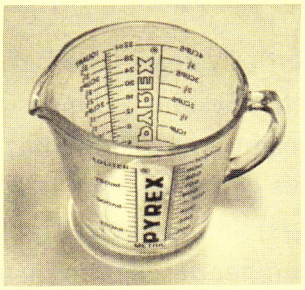
Volume refers to the *amount of space* that an ingredient occupies. While we generally think of volume as a way to measure liquids, volume can actually be used to measure anything that takes the shape of the container it's in. This includes dry ingredients such as sugar, flour, salt, spices, herbs, dried beans, and rice. Volume is often measured using tools such as measuring cups and measuring spoons.



Dry Measuring Cup



Measuring Spoons



Liquid Measuring Cup

Applications: What are common units of measurement for volume that we use in the kitchen?

_____

_____

_____

Cup, teaspoon, tablespoon, fluid ounce, pint, quart, gallon.

Count refers to *the total number* of an ingredient. Typically, when a recipe measures an ingredient by count, it is referring to a whole item, such as a whole fruit or vegetable. In this case, a recipe will often describe the item's size as well, such as one medium apple, two large cloves of garlic, or one whole chicken (typically a weight estimate would also be included in this case).

Many ingredients may be measured by more than one method. Take a can of diced tomatoes, for example. A recipe may call for 1 can (count), 14.5 ounces of diced tomatoes (weight), or 2 cups of diced tomatoes (volume).

U.S. Standard System for Measuring Weight and Volume

The U.S. Standard System, also known as the Customary System, is the system most commonly used in the United States for measuring volume and weight. The U.S. Standard system uses teaspoons, tablespoons, ounces, cups, pints, quarts and gallons to measure volume, and ounces and pounds to measure weight.

The Metric System for Measuring Weight and Volume

The Metric System is the system of measurements favored by most of the world. Many believe the Metric System to be easier to use than the Standard System, as each type of measurement (e.g. weight and volume) has only one basic unit of measure. In the metric system, the unit of weight is grams, and the unit for volume is liters. Converting to other units (e.g. milligrams and milliliters) simply involves multiplying or dividing these units of measure by multiples of 10. There are a number of scenarios in which knowledge of the metric system is important. These include:

- Working in foreign countries
- Using recipes from other countries
- Ordering ingredients
- Calculating nutritional information

Introduction to Converting Units of Measurement in The Kitchen

It is important to know the relationship between units of measurement because foodservice professionals frequently need to convert between them. In fact converting between units of measurement happens in the kitchen all of the time. For example, when food workers:

- Increase or decrease the yield (or servings) of a recipe
- Order product (ingredients)
- Determine the cost of recipes
- Determine calorie count
- Have limited measuring equipment

There are multiple approaches to converting between units of measurement. Today, we are first going to convert between units of measurement by using ingredients and kitchen equipment. Then we will convert between units of measurement using math. You will get to decide which method is easier, faster, cleaner, and more accurate.

Weights and Measurements In-Class Activity

Demonstrate:

In lesson 1, we met with our groups, took a tour of the kitchen, and reviewed proper attire and conduct in the kitchen. Today, we're actually going to *use* the kitchen to get our feet wet with converting between units of measurement by measuring two ingredients: flour and water.

Before we get started, I am going to demonstrate how to use a scale and how to properly measure ingredients. And yes, measuring ingredients correctly is really important. You'll see why as we make our way through this course.

Demonstrate:

- How to properly hold/carry a scale
- How to tare a scale
- How to measure weight using scales (oz., lb., g., kg.)
- How to clean a scale
- How to measure volume of dry ingredients
- How to measure volume of wet ingredients

Also, be sure to provide clear clean-up instructions.

In-Class Activity Instructions:

Each group has an assigned station with access to flour, water, and the tools necessary to measure weight and volume. You are tasked with completing the following sheet using only the tools at your station, including the ones you are bringing with you: pen/pencil, your brain, your voice, and the in-class activity sheet – please do not bring your packet with you. You will see the back of your sheet is blank in case you need extra writing space. While you are working as a group, each student should complete his or her own sheet – this is for you to hold on to.

Volume

How many...	Are in...	Your answer	Your method
teaspoons (t, tsp)	1 tablespoon (T, Tbsp)	3 t	
tablespoons (T, Tbsp)	1 fluid ounce (fl. oz.)	2 T	
tablespoons (T, Tbsp)	1 cup (C, c)	16 T	

fluid ounces (fl. oz.)	1 cup (C, c)	8 fl oz	
cups (C, c)	1 pint (pt)	2 C	
pints (pt)	1 quart (qt)	2 pt	
quarts (qt)	1 gallon (G, gal)	4 qt	
cups (C, c)	1 gallon (G, gal)	16 C	
teaspoons (t, tsp)	1 cup (C, c)	12 t	
fluid ounces (fl. oz.) *Hint: Standard unit	1 liter (L) *Hint: Metric unit	33.8 fl. oz.	

Weight

How many...	Are in...	Your answer	Your method
ounces (oz)	1 pound (lb, #)	16 oz	
grams (g) *Hint: Metric unit	1 ounce (oz) *Hint: Standard unit	28.35 g	
pounds (lb, #) *Hint: Standard unit	1 kilogram (kg) *Hint: Metric unit	2.21 lb	

Post Activity Discussion:

Bring the large group together and present the answers to the students – you can do this by showing them the tables at the end of this lesson, giving them a separate handout, or projecting the answers from a slide. Ask the students what their methods were for finding the answers. Some will have measured each out by hand, others may have done a little math. For those who did math, ask them to quickly demonstrate some of the math they performed. Inquire if any groups reached some wrong answers. Ask what their methods were and why their method may not have led to the answer they received. Explain that it may not mean that their method was bad, it just might not be the best method for that particular task.

Inform students that because they will work with kitchen measurements on a regular basis in the industry, they will need to know these basic measurement conversions. One way of doing this is to explain:

These are the most basic unit conversions you'll find in the kitchen – and you will use them frequently. A table of these same conversions has been provided for you at the end of this lesson. Rarely will I ask you to memorize information; however, this is one exception. It is important that you know the basic units conversions in the tables provided as it will benefit you not only in this class but also in future culinary classes and in any professional kitchen.

How to Convert Between Units of Measurement: The Bridge Method

In the in-class activity, we converted units of measurement using ingredients and equipment. But there is another method: using a pen, paper, and some math.

Many foodservice professionals – including cooks, chefs, nutritionists, and food scientists – use the bridge method to convert between different units of measurement. Many people can do simple conversions without using the bridge method. For example, how many teaspoons are in two tablespoons? Some of us can quickly figure out the answer in our head. However, as conversions become more complex, it is easier to make mistakes in our head. The advantage of using the bridge method is that it is a way to organize your work and to check your calculations as you go. While it is always important that you develop your own methods to solve problems, this is a time when you are encouraged to learn and use a specific method. Once you have learned the bridge method, you can decide when to use it and when to use other methods.

Problem Situation 1:

When determining how many pounds of turkey to purchase for a Thanksgiving meal, a cook must take into account the number of guests being served and how much each guest will eat. According to some sources, when purchasing a whole, uncooked turkey, one should figure approximately 24 **ounces** of uncooked turkey per guest. If a cook expects to serve 18 guests, how many **pounds** of uncooked turkey should he or she purchase?

First determine what you know:

- A cook is preparing turkey for 18 guests
- We need to purchase roughly 24 *ounces* of uncooked turkey per guest. This can be written as a fraction (or rate):

$$\frac{24\ ounces}{1\ guest}$$ (the fraction bar can be read as "per" or "for every")

Next, decide what you are looking for:

Pounds of turkey to order for 18 guests, or simply:

$\rightarrow pounds$

Now, we will start building our calculation as a chain of fractions in which the units cancel out until we are left with the unit pounds. Since we know we are expecting 18 guests, let's start there:

$$18\ guests \qquad \rightarrow pounds$$

Next we want to cancel out the unit "guests." We can do that by multiplying by a fraction (or rate) that has **guest** in the **denominator**. Do we have such a rate? Yes! The problem gave us one:

$$18\ guests\ x\ \frac{24\ ounces}{1\ guest} \qquad \rightarrow pounds$$

The unit "guest" now cancels out and we are left with ounces.

$$18\ \cancel{guests}\ x\ \frac{24\ ounces}{1\ \cancel{guest}} \qquad \rightarrow pounds$$

But ounces does not get us to the final answer we need, which is pounds. Next, you need to cancel out the unit "**ounces**" by multiplying by a fraction (or rate) that has ounces in the **denominator**. Does the problem give you any additional information? No. But you already know something about the relationship between ounces and pounds. What is it?

- There are 16 ounces in a pound. This can also be written as a fraction (or rate):

$$\frac{16\ ounces}{1\ pound} \quad \text{or} \quad \frac{1\ pound}{16\ ounces}$$

In this case, we will write the rate as 1 pound over 16 ounces because we want to cancel out ounces and be left with pounds. When we plug this rate into the our calculation, the units of each fraction cancel out and we are left with pounds

$$18\ \cancel{guests}\ x\ \frac{24\ \cancel{ounces}}{1\ \cancel{guest}}\ x\ \frac{1\ pound}{16\ \cancel{ounces}} \rightarrow pounds$$

The final step is to multiply the digits to get the final answer:

$$18\ \cancel{guests}\ x\ \frac{24\ \cancel{ounces}}{1\ \cancel{guest}}\ x\ \frac{1\ pound}{16\ \cancel{ounces}} \rightarrow \mathbf{27\ pounds}$$

Note: Before you work your way through the next problem, determine if students are ready to work on problem situation 2 and/or 3 and the further application in their small groups. If you choose to task students with working on a problem in their small groups, walk around the room to get a sense of how the groups are operating. Some groups may need encouragement to work together, to help each other follow along, or to listen to each other. Only offer assistance if you think that students cannot productively struggle through a problem on their own. If groups finish early, suggest that they get started on the next problem situation, or further application. They may also work together in class on their homework.

Once groups have finished the problem situation, bring the large group together and ask what answer they received and their method for achieving that answer. Inquire if any groups received a different answer or if they achieved the same answer with a different method. Allow students to correct each other and if a group made a mistake, ask the class for help on where they might have gotten of course. Remind students it's alright to make mistakes, it's part of the learning process. Making mistakes means we are working towards gaining new knowledge.

Problem Situation 2:

Let's say the cook is also preparing individual pumpkin tarts. Each tart requires 5 tablespoons of flour. Use the bridge method to calculate how many **cups** of flour he or she will need to make 30 individual pumpkin tarts.

First determine what you know:

- A cook is preparing 30 pumpkin tarts
- Each tart requires 5 tablespoons of flour. This can be written as a fraction (or rate):

$$\frac{5\ Tbsp}{1\ tart} \quad \text{or} \quad \frac{1\ tart}{5\ Tbsp}$$

Next, decide what you are looking for:

Cups of flour you need for the recipe, or simply:

$\rightarrow cups$

Now, we will start building our calculation as a chain of fractions in which the units cancel out until we are left with the unit cups. Since we know we are making 30 tarts, let's start there:

$$30\ tarts \qquad \rightarrow cups$$

Next we want to cancel out the unit "tarts." We can do that by multiplying by a fraction (or rate) that has **tart** in the **denominator**. Do we have that? Yes! The problem gave us one:

$$30\ tarts\ x\ \frac{5\ Tbsp}{1\ tart} \qquad \rightarrow cups$$

The unit "tart" now cancels out and we are left with tablespoons.

$$30\ \cancel{tarts}\ x\ \frac{5\ Tbsp}{1\ \cancel{tart}} \qquad \rightarrow cups$$

But tablespoons does not get us to the final answer we need, which is cups. Next, you need to cancel out the unit "**tablespoons**" by multiplying by a fraction (or rate) that has tablespoons in the **denominator**. Does the problem give you any additional information? No. But you already know something about the relationship between tablespoons and cups. What is it?

There are 16 tablespoons in 1 cup. This can also be written as a fraction (or rate):

$$\frac{16\ Tbsp}{1\ cup} \quad \text{or} \quad \frac{1\ cup}{16\ Tbsp}$$

In this case, we will write the rate as 1 cup over 16 Tbsp because we want to cancel out tablespoons and be left with cups. When we plug this rate into the our calculation, the units of each fraction cancel out and we are left with cups:

$$30\ \cancel{tarts}\ x\ \frac{5\ \cancel{Tbsp}}{1\ \cancel{tart}}\ x\ \frac{1\ cup}{16\ \cancel{Tbsp}} \rightarrow cups$$

The final step is to multiply the digits to get the final answer:

$$30\ \cancel{tarts}\ x\ \frac{5\ \cancel{Tbsp}}{1\ \cancel{tart}}\ x\ \frac{1\ cup}{16\ \cancel{Tbsp}} \rightarrow \mathbf{9.375\ cups}$$

We are not done yet! We can't really measure .375 of a cup so next we need to simplify the answer to the nearest whole measurements.

9 cups is already a whole measurement so we will set that aside for a minute

But .375 can be converted to a smaller unit of measurement. How would we convert .375 cups to tablespoons?

$$.375\ \cancel{cups} \times \frac{16\ Tbsp}{1\ \cancel{cup}} \rightarrow 6\ Tbsp$$

(You can also further simplify 6 tablespoons to ¼ cup + 2 tablespoons)

Now, let's combine the cups and tablespoons to reach our final, answer:

9 cups and 6 tablespoons or 9 ¼ cups and 2 tablespoons

Problem Situation 3:

Review the following ingredients for a *Lemon Drizzle Cake* recipe that yields 12 portions:

110 g butter

170 g flour

4 tablespoons milk

170 g caster sugar

2 eggs

lemon zest and juice from 1 lemon

3 tablespoons icing sugar

How many *ounces* of butter does the recipe require?

$$110\ \cancel{grams} \times \frac{1\ ounce}{28.35\ \cancel{grams}} \rightarrow \textbf{3.88 ounces}$$

How many *pounds* of sugar would be required to produce 60 servings of lemon drizzle cake?

$$60\ \cancel{servings} \times \frac{170\ \cancel{grams}}{12\ \cancel{servings}} \times \frac{1\ \cancel{ounce}}{28.35\ \cancel{grams}} \times \frac{1\ lb}{16\ \cancel{ounces}} \rightarrow \textbf{1.87 lbs.}$$

Simplify the answer to the previous question by *rounding to the nearest whole ounce*. (Hint: you only need to convert the number after the decimal place).

1 lb is already a whole number so let's set that aside for a minute

$$.87 \cancel{lbs} \times \frac{16 \ ounces}{1 \ \cancel{lb}} = 13.92 \ ounces \approx 14 \ ounces$$

→ 1 lb 14 oz.

Making Connections:

Record the important mathematical ideas from the discussion.

Further Applications:

1. Consider the two ways you converted between units of measurement today: (1) physically measuring ingredients and (2) using math.

    a. In your opinion, which of the two methods do you think will produce the most accurate results? Why?

    b. What could potentially lead to inaccuracies with this method?

    c. Is there any way to help prevent inaccuracies with this method?

    d. Are there any instances you can think of in which the other method may be better?

2. You can use the bridge method in any situation in which you are converting units. In the following example you need to convert hourly wage to pay per month. The same rules apply: determine what you know, determine what you want to find out, pick rates with the appropriate numerators and denominators, cancel out, and multiply.

(Continued onto next page)

According to the Bureau of Labor Statistics, in 2014, the average hourly wage of a short order cook in the United States was $9.97 per hour. How much money would a short order cook earn (pre-tax) in a year? Let's assume he or she works on average 8 hour per day and 5 days per week. Round to the nearest whole dollar.

$$\frac{\$9.97}{1\ \cancel{hour}} \times \frac{8\ \cancel{hours}}{1\ \cancel{day}} \times \frac{5\ \cancel{days}}{1\ \cancel{week}} \times \frac{52\ \cancel{weeks}}{1\ year} \rightarrow \$20{,}738\ per\ year$$

HOMEWORK

1. Read:
   Chapter 2: p. 25-35
   Chapter 3: p. 40-44

2. Complete:
   Chapter 2: p. 36 #3-5
   p. 38 #18-20
   p. 39 #26-30
   Chapter 3: p. 45 #1-3
   p. 48 #18-23

Unit Conversion Tables:

U.S. Standard Volume Equivalents	
Volume Measurements	Volume Equivalents
1 tablespoon (T, Tbsp)	3 teaspoons (t, tsp)
1 fluid ounce (fl oz)	2 tablespoons (T, Tbsp)
1 cup (C, c)	8 fluid ounces (fl oz) or 16 tablespoons (T, Tbsp.)
1 pint (pt)	2 cups (C, c)
1 quart (qt)	2 pints (pt)
1 gallon (G, gal)	4 quarts (qt)

U.S. Standard Weight Equivalents
1 pound (lb, #) = 16 ounces (oz)

Metric Volume Equivalents
1 liter (L) = 1,000 milliliters (mL)

Metric Weight Equivalents	
Weight Measurements	Weight Equivalents
1 gram (g)	1,000 milligrams (mg)
1 Kilogram (kg)	1,000 grams (g)

Oftentimes, you will need to convert units of measurement between the U.S. Standard and Metric Systems. If so, use the following conversions.

Volume Conversion Between U.S. Standard and Metric	
Standard Volume Measurement	Metric Volume Equivalent
33.8 fluid ounces (fl oz)	1 liter (L)
1 fluid ounce (fl oz)	29.57 milliliters (mL)

Weight Conversion Between U.S. Standard and Metric	
Standard Weight Measurement	Metric Weight Equivalent
1 ounce (oz)	28.35 grams (g)
2.21 pounds (lb, #)	1 kilogram (kg)

The foregoing lesson, CA 9900: Culinary Concepts Lesson 2 Instructor's Notes, was developed by the Center for Economic and Workforce Development as a derivative adaptation of QUANTWAY®, A Pathway Through College--Level Quantitative Reasoning, Instructor's Notes 3.1 Version 2.3. Quantway® is licensed by the Carnegie Foundation for the Advancement of Teaching under a Creative Commons Attribution--NonCommercial 3.0 Unported License. (CC BY--NC). Quantway® is a registered trademark of the Carnegie Foundation for the Advancement of Teaching. To access a copy of QUANTWAY®, A Pathway Through College--Level Quantitative Reasoning, Instructor's Notes 3.1 Version 2.3, contact:

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