

CHAPTER 1

INTRODUCTION TO BAKING

CHAPTER **OBJECTIVES**

1. Discuss the importance of accuracy in the bakeshop and how it is achieved.
2. Differentiate between volumetric and weight measurements and specify when each should be used.
3. Differentiate between metric and U.S. common units.
4. Introduce the concept of baker's percentages.
5. Discuss the importance of controlling ingredient temperatures.

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INTRODUCTION

Those who enter the fields of baking and pastry arts do so for a variety of reasons. For some, it is the joy of working with their hands, of creating edible works of art from a few basic ingredients. For others, it is the rush they get from the fast pace of the bakeshop, or from its satisfying sights and smells. Still others like the challenge of pleasing and surprising customers. No matter the reason, the decision to work in the field is usually grounded in a love of food, and maybe past experience in a bakeshop or a home kitchen.

Working in a professional bakeshop is different from baking at home, however. Production in a bakeshop is on a larger scale. It takes place day in and day out, sometimes under severe time pressures, in uncomfortably hot and humid conditions, and over long hours. Despite the discomforts and pressures, product quality must remain consistently high, because that is what the customer expects.

It takes specialized knowledge and practiced skills to accomplish these goals successfully. It helps to be attentive to the sights, sounds, and smells of the bakeshop. Experienced bakers and pastry chefs, for example, listen to the sound of cake batter being beaten in a bowl, knowing that changes in sound accompany changes to the batter itself. They push and pummel bread dough to feel how it responds. They use smells from the oven to judge when baking is nearly complete, and they sample their finished products before presenting them to the customer.

Experienced bakers and pastry chefs rely, too, on tools like timers and thermometers, because they know how time and temperature affect product quality. They also rely heavily on accurate scales.

THE IMPORTANCE OF ACCURACY IN THE BAKESHOP

Most bakery items are made of the same ingredients: flour, water, sugar, eggs, leavening agents, and fat. Sometimes the difference between two products is simply the method of preparation used in assembling the ingredients. Other times the difference is the proportion or amount of each ingredient in a formula. Because small differences in method and in proportion of ingredients can have a large effect on the quality of baked goods, it is crucial that bakers and pastry chefs follow methods of preparation carefully and measure ingredients properly. Otherwise, a product may turn out unexpectedly, or worse, it may turn out unacceptable or inedible.

For example, if too much shortening and too few eggs are added to a formula for moist, chewy oatmeal cookies, the cookies will likely turn out crisp and dry. If the same error is made with cake batter, the result will likely be a complete failure, since eggs provide structure and volume. In fact, bakers and pastry chefs require a higher degree of accuracy when measuring ingredients than do culinary chefs in the kitchen.

When the kitchen chef prepares a pot of soup, it doesn't really matter if a little less celery is added or an extra onion is included. The chef still has a pot of soup, and if the flavor is off, adjustments can be made along the way. Bakers and pastry chefs cannot make adjustments along the way. If too little salt is added to bread dough, it will do no good to sprinkle salt onto the bread once it is baked. Instead, ingredients must be weighed and measured accurately at the beginning.

This means that, more so than kitchen chefs, bakers and pastry chefs are chemists in the kitchen. As with chemists, creativity and skill are important for success, but so is accuracy. If a formula calls for two pounds of flour, it doesn't mean around two pounds, more or less. It means two pounds.

BALANCES AND SCALES

Formulas used in the bakeshop are in some ways like recipes in the kitchen. Formulas include a list of ingredients and a method of preparation (MOP). Unlike recipes used by the kitchen chef, however, formulas include exact measurements for each ingredient, and these measurements are usually given in weights. The process of weighing ingredients is called scaling because pastry chefs use scales to weigh ingredients.

The standard scale used in the bakeshop is a baker's balance scale. It measures ingredients by balancing them against known weights. It is an investment that should be selected for its durability and its precision. A good baker's scale can weigh amounts as large as 8 pounds (4 kilograms) or more and as small as 1/4 ounces (0.25 ounce or 5 grams). This provides the precision needed for most quantity food preparation.

Bakers and pastry chefs sometimes use digital electronic scales. While many affordable electronic scales provide the same or better precision than baker's scales, it is not necessarily the case. The precision of a scale—either baker's scale or electronic scale—depends entirely on the scale's design and construction.

HELPFUL HINT

Baker's scales and their accessories (scoops and weights) must be cared for if they are to remain in balance. They should be wiped regularly with a damp cloth and mild detergent, and they should not be banged or dropped. These precautions are necessary to keep the scale reading accurately.

To determine if a scale is in balance, empty both platforms and move the ounce weight indicator to the far left (i.e., to zero). With the scale at eye level, determine whether the platforms are at the same height. If they are not, adjust the weights located beneath the platforms as needed. Repeat this test with a scoop on the left platform and a counterweight on the right. If balancing is needed, do so by adding or removing weight from the counterweight.

MORE ON SCALE READABILITY

The readability of a scale, sometimes represented as *d* for scale division, is literally the increments in weight that are read off the scale's display panel. As weight is added onto a scale with a readability of 5 grams, for example, the reading on the display panel will change from 0 grams, to 5 grams, to 10, 15, 20, and so on. No matter the weight of the ingredient, the scale displays the weight in increments of 5 grams. If a sample in fact weighs 6 grams, the display will read 5 grams. If it weighs 8.75 grams, the display will read 10 grams.

Sometimes a scale fluctuates between readings. Let's say, for example, that the scale in the previous example keeps fluctuating between 5 grams and 10 grams. It is likely that the sample actually weighs about 7.5 grams, which is halfway between 5 grams and 10 grams.

Most digital electronic scales provide information about precision—also called readability—and capacity on their front or back panels. For example, a scale that is marked 4.0 kg × 5 g has a capacity of 4 kilograms, meaning it can measure quantities as large as 4 kilograms (about 8.8 pounds). The *readability* of this scale is 5 grams. Five grams is equivalent to just under 0.2 ounce, which is similar to the 0.25-ounce precision of a good baker's scale.

Consider another electronic scale, one marked *100 oz. × 0.1 oz*. This scale has a capacity of 100 ounces (6.25 pounds or 2.84 kilograms) and a readability of 0.1 ounce (3 grams). The smaller value for readability indicates that this scale provides better precision than a typical baker's scale, making it useful for weighing small quantities of spices or flavorings.

Just as baker's scales need to be checked periodically for accuracy, so too must digital scales. Digital scales typically come with a brass weight calibrated for accuracy. If the scale's reading does not match the mass of the brass weight, follow the manufacturer's instructions to adjust the scale. Because a scale is an important piece of equipment in a bakeshop, it is best to check its calibration at two different points (200 grams and 2000 grams, for example). The scale will need adjustment or repair if either of these two readings is off.

How an ingredient is added to a digital scale can make a difference in the accuracy of the reading. For example, multiple small additions will sometimes read lower than the identical amount added all at once. This can happen because scales are generally designed so that they don't fluctuate excessively with air movement, and the scale cannot necessarily differentiate a small amount of product from air movement. Vibration, heat currents, cordless and cell phones, and static electricity should all be avoided, since they can affect the ability of a scale to read consistently.

HELPFUL HINT

To determine if a scale provides enough precision for the task at hand, consider the readability of the scale. A good rule of thumb is that a scale is acceptable for weighing an ingredient as long as the error in measurement does not exceed 10 percent. To ensure that the error does not exceed 10 percent, be sure that the readability of the scale is 10 percent or less than the amount to be weighed. Stated another way as a workable formula:

Smallest quantity to be weighed = scale readability × 10

Consider a scale where the readability is 0.25 ounce (7 grams). This scale could appropriately weigh quantities as small as 2.5 ounces (70 grams) without more than a 10 percent error in measurement. Likewise, a scale with a readability of 0.1 ounce (3 grams) could adequately weigh quantities as small as 1 ounce (30 grams).

UNITS OF MEASURE

Digital and baker's scales measure in either standard U.S. common units (pounds and ounces; imperial units in Canada) or in metric units (kilograms and grams). Some versatile digital scales switch at the touch of a button from U.S./imperial units to metric units. Most countries throughout the world have adopted the metric

HOW CAN AN OUNCE SCALE PROVIDE THE PRECISION OF A GRAM SCALE?

One gram is a much smaller unit than one ounce (there are 28.35 grams in an ounce), so how is it possible for an ounce scale to provide the precision of a gram scale?

Certainly if the gram scale has a readability of 1 gram and the ounce scale has a readability of 1 ounce, the gram scale will measure more precisely than the ounce scale. But this is rarely the case.

Take, for example, the description of the two electronic scales given earlier. The first scale is a gram scale, with a readability of 5 grams, or 0.2 ounce (5 grams divided by 28.35 grams per ounce). The second scale is an ounce scale with a readability of 0.1 ounce (3 grams). In this particular example, the ounce scale weighs more precisely than the gram scale, because the design and construction of the scale allows it to read smaller amounts.

TABLE 1.1 ■
EQUIVALENCIES BETWEEN U.S. COMMON (IMPERIAL) AND METRIC UNITS

WEIGHT	
1 ounce	= 28.4 grams
1 pound	= 454 grams
VOLUME	
1 teaspoon	= 4.9 milliliters
1 quart	= 0.95 liters

system. This provides a means of sharing formulas more easily across national borders. More importantly, the metric system is simpler to use once you become familiar with it. With the metric system, for example, fewer math calculations are needed when converting a formula to a new batch size. Since 1 kilogram in metric equals 1,000 grams, you simply move decimal points to convert from one size unit to another. For example, 1.48 kilograms is equal to 1,480 grams, and 343 grams is equal to 0.343 kilograms. Try converting as quickly from pounds to ounces, or ounces to pounds! This ease of use is probably the main reason why more bakers and pastry chefs in North America are adopting the metric system for use in the bakeshop.

Using the metric system, for the most part, does not require tedious math conversions from ounces to grams or pounds to kilograms. This makes it much easier to use the metric system than most people believe. Table 1.1 lists the metric equivalents of a few U.S. common (imperial) units, for those times when you do need to convert from one system to another.

It is a common misconception that metric units provide better precision than U.S./imperial units. In fact, metric units are not necessarily more precise, although they are simpler to use. Once again, the precision of measurements depends on the design and construction of the scale, not on the units used.



WEIGHT AND VOLUME MEASUREMENTS

Home cooks in North America use volumetric measurements—measuring containers and measuring spoons—for all ingredients, including dry ingredients. This is a problem when measuring certain ingredients. For example, flour settles over time. When flour settles, there is less air between particles. Density increases, and more flour is needed to fill a container. On the other hand, if flour is sifted before it is measured, there is more air between particles. Density decreases, and less flour is needed to fill a cup.

To avoid these inconsistencies, pastry chefs and bakers do not use volumetric measurements for flour and other dry ingredients. Instead, they weigh dry ingredients—and most liquid ingredients—for accuracy. Density does not affect weight measurements the way it affects volume measurements. A pound of sifted flour weighs the same as a pound of unsifted flour, regardless of the density. They both weigh 1 pound!

TABLE 1.2 ■ A COMPARISON OF THE APPROXIMATE WEIGHTS OF 1 PINT AND 1 HALF LITER (500 MILLILITERS) OF VARIOUS INGREDIENTS

INGREDIENT	APPROXIMATE WEIGHT PER U.S. PINT (IN WEIGHT OUNCES)	APPROXIMATE WEIGHT PER HALF LITER (500 ML) (IN GRAMS)
Splenda	4.0	120
Ginger, ground	6.0	180
Flour, sifted	8.2	245
Flour, unsifted	9.2	275
Sugar, granulated	14.1	420
Oil, vegetable	14.8	445
Cream, heavy	16.4	490
Water	16.7	500
Milk, whole	17.0	510
Eggs, whole	17.2	515
Orange juice	17.4	520
Coffee liqueur	17.5	525
Simple syrup (equal parts sugar and water)	20.6	615
Honey, molasses, and glucose corn syrups	23.0	690

While some pastry chefs and bakers weigh all ingredients using a scale, others measure some liquids volumetrically. They use measuring containers for water and for liquids that have about the same density as water. While practices vary from bakeshop to bakeshop, ingredients that are often measured volumetrically include milk, cream, and eggs. Table 1.2 indicates why. Notice that the weights per pint (or per half liter) of milk, cream, and eggs are around the same as that of water. Measuring 1 pint of each of these ingredients yields about a pound or so (while these ingredients do not weigh exactly 1 pound per pint, they are approximately so; notice, however, that in the metric system, 1 half liter—500 milliliters—of water at room temperature does weigh exactly 500 grams. This is not a coincidence). Many other liquids, including honey, corn syrup, and oil, have densities much different from water. These liquids must be weighed, because 1 pint will not weigh 1 pound.



THE DIFFERENCE BETWEEN DENSITY AND THICKNESS

Density is a measure of the compactness of particles or molecules in a liquid or solid. If the particles or molecules are loosely packed, the liquid or solid is not dense, and the weight per cup or per liter of that ingredient is low. If the particles or molecules are closely packed, the liquid or solid is dense, and the weight per cup or weight per liter of that ingredient is high.

Viscosity or consistency is a measure of how easily a liquid flows. If a liquid's particles or molecules slide past each other easily, the liquid flows easily and is considered thin. If the particles or molecules bump or tangle

HELPFUL HINT

Do not judge the density of a liquid by its thickness. Unless you know for sure that the density of a liquid is close to that of water, assume that it is not; assume that it must be weighed.

TABLE 1.3 ■ VOLUMETRIC CONVERSIONS FOR U.S. COMMON UNITS

1 tablespoon	= 3 teaspoons
	= 0.5 fluid ounce
1 cup	= 48 teaspoons
	= 16 tablespoons
	= 8 fluid ounces
1 pint	= 16 fluid ounces
	= 2 cups
1 quart	= 32 fluid ounces
	= 4 cups
	= 2 pints
1 gallon	= 128 fluid ounces
	= 16 cups
	= 8 pints
	= 4 quarts

with each other, the liquid will not flow easily and is thick. This is the case with fruit purees. Tiny pulp pieces in fruit purees bump and tangle with one another, preventing water and pulp particles from flowing easily past one another. This makes the puree thick.

Some common liquids—honey and molasses, for example—are both dense and thick. The molecules are close together, making these liquids dense, and the molecules do not slide easily past each other, making the liquids thick. But consider vegetable oil. Vegetable oil is thicker than water, yet it is less dense than water (that is why oil floats). Notice how the density of a liquid cannot be judged by looking at its thickness.

THE DIFFERENCE BETWEEN WEIGHT OUNCES AND FLUID OUNCES

Refer to Table 1.3, which lists conversions between U.S. common volumetric measurements. Notice that there are 16 ounces in a pint (2 cups). Recall that there are 16 ounces in a pound. Why, then, did we see from Table 1.1 that a pint does not weigh 1 pound for all ingredients? Likewise, how can there be 16 tablespoons in a cup and 8 ounces in a cup, but 16 tablespoons does not necessarily weigh 8 ounces? These are the problems that result when one word—ounce—is used to represent two different concepts.

The term ounce represents a unit of weight or mass. It can also represent volume or capacity. That is, there are weight ounces that measure weight, and there are fluid ounces that measure volume. Notice that Table 1.3 specifies fluid ounces, not weight ounces, in each conversion. While 1 fluid ounce sometimes does weigh 1 ounce, it is not necessarily so.

HELPFUL HINT

If a formula includes measurements in ounces, be sure to check carefully to determine for each ingredient whether it is to be measured using fluid or weight ounces. Unless you know the density of an ingredient, do not interchange weight measurements with volumetric measurements, or vice versa.

Consider feathers and bullets. No one expects 1 cup of feathers to weigh the same as 1 cup of bullets. Likewise, food ingredients vary in how much they weigh per cup. Refer back to Table 1.2, which lists several ingredients—arranged from less dense to more dense—and their weights per pint (2 cups) and per half liter (500 milliliters). Notice the large range in values. This shows that the expression "a pint's a pound the world 'round" is not only false for feathers and bullets, but it is also false for many common bakeshop ingredients. It is approximately true for water and for ingredients with the same density as water. Because 1 fluid ounce of water (and ingredients with the same density as water) weighs about 1 ounce, and 1 milliliter of water weighs 1 gram, for practical purposes it doesn't matter whether water is weighed on a scale or measured volumetrically.



PHOTO 1.1 A comparison of volumes of equal weights of maple syrup, water, and flour. *Photo by Aaron Seyfarth*

BAKER'S PERCENTAGES

Formulas, especially bread formulas, are sometimes expressed in percentages called *baker's percentages.* With baker's percentages, each ingredient is expressed as a certain ratio or percent of the total amount of flour in the formula. Flour is used as the basis for baker's percentages because it is typically the predominant ingredient in most baked goods. Since the total amount of flour is designated as 100 percent, the percentages of all ingredients add up to more than 100 percent. Table 1.4 provides an example of a bread formula expressed in weight and in baker's percentages. Notice that more than one type of flour is included in this formula, but that together the weight of the flours adds up to 100 percent.

For formulas that do not contain flour, each ingredient is expressed as a percentage of the predominant and characteristic ingredient. In the case of a date filling, for example, each ingredient is expressed as a percentage of the amount of dates (Table 1.5). For baked custard, each ingredient is expressed as a percentage of dairy ingredients—milk and cream.

Baker's percentage—sometimes called *formula percentage* or indicated as "on flour weight basis"—is different than the percentages commonly taught in math classes. In the more common type of percentage, each ingredient is expressed as a certain percentage of the total batch size. In this case, ingredient percentages add up to 100 percent. Table 1.6 shows the bread formula from Table 1.4, this time expressed as a percentage of the total batch.

TABLE 1.4 ■ WHOLE WHEAT BREAD FORMULA EXPRESSED IN WEIGHT AND IN BAKER'S PERCENTAGES

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	6		3000	60%
Flour, whole wheat	4		2000	40%
Water	5	10.0	2800	56%
Yeast, compressed		6.0	190	4%
Salt		3.0	95	2%
Total	**16**	**3.0**	**8085**	**162%**

Note: Metric measures in this table and throughout the text are not necessarily exact conversions of U.S./imperial measures. This is done to avoid the use of awkward numbers. Because baker's percentages remain approximately the same, products are the same, regardless of the units of measure.

TABLE 1.5 ■ DATE FILLING FORMULA EXPRESSED IN WEIGHT AND IN BAKER'S PERCENTAGES

INGREDIENT	POUNDS	GRAMS	BAKER'S PERCENTAGE
Dates	6	3000	100%
Sugar	1	500	17%
Water	3	1500	50%
Total	**10**	**5000**	**167%**

TABLE 1.6 ■ WHOLE WHEAT BREAD FORMULA EXPRESSED IN WEIGHT AND IN PERCENTAGE OF TOTAL BATCH

INGREDIENT	POUNDS	OUNCES	GRAMS	PERCENTAGE OF TOTAL BATCH
Flour, bread	6		3000	37%
Flour, whole wheat	4		2000	25%
Water	5	10.0	2800	35%
Yeast, compressed		6.0	190	2%
Salt		3.0	95	1%
Total	**16**	**3.0**	**8085**	**100%**

TABLE 1.7A ■ A COMPARISON OF WHOLE WHEAT BREAD FORMULAS EXPRESSED IN WEIGHT AND IN BAKER'S PERCENTAGES (BREAD #1)

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	6		3000	60%
Flour, whole wheat	4		2000	40%
Water	5	10	2800	56%
Yeast, compressed		6	190	4%
Salt		3	95	2%
Total	**16**	**4**	**8085**	**162%**

TABLE 1.7B ■ A COMPARISON OF WHOLE WHEAT BREAD FORMULAS EXPRESSED IN WEIGHT AND IN BAKER'S PERCENTAGES (BREAD #2)

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	22		10000	60%
Flour, whole wheat	15		6800	40%
Water	21		9550	57%
Yeast, compressed		18	500	3%
Salt		6	190	1%
Total	**59**	**8**	**26965**	**161%**

Why bother expressing formulas in percentages at all? Percentages allow formulas to be easily compared. Table 1.7 illustrates this point. Compare the two formulas in Table 1.7 by looking at the weights of each ingredient. Can you tell quickly which formula is saltier? Before you conclude that the bottom formula is saltier because it contains 6 ounces (190 grams) of salt compared with 3 ounces (95 grams) in the top formula, notice that the bottom formula also yields a larger quantity of dough. Unless this difference in yield or batch size is accounted for, weights alone won't reveal which bread is saltier.

When baker's percentages for these formulas are used instead of weight for comparison, the difference in batch size is accounted for, and it becomes clear that the formula in Table 1.7A is saltier. The amount of salt in the formula for Bread #1 is about 2 percent of the weight of the flours compared with 1 percent in Bread #2 (Table 1.7B).

Baker's percentages have an advantage over percentages based on total batch size. Baker's percentages require fewer calculations when adding or changing the amount of one ingredient. If percentages used are based on total batch size, then every ingredient percentage will have to be recalculated when any one ingredient is changed, since the total batch size would also change. Needless to say, this is more complicated and time consuming and thus, baker's percentages are preferred by some bakers.

THE IMPORTANCE OF CONTROLLING INGREDIENT TEMPERATURES

The finest ingredients can be selected, they can be accurately weighed and properly mixed, but if temperatures are not carefully controlled, there is still a chance for failure. Why? Many ingredients change properties with temperature. Think of fat, especially fats that melt easily, such as butter. Butter must remain within a narrow

temperature range (65–70°F; 18–21°C) as it is spread onto croissant dough. If it is too cold, it will not spread properly; if it is too warm, it melts into the dough and flakiness is compromised.

Often, ingredients that are at widely different temperatures must be carefully combined to avoid damaging one ingredient with the shock of the heat—or cold—of another. In making vanilla custard sauce, for example, cold yolks cannot be added directly to hot milk, or the yolks could curdle. Instead, in a technique called tempering, small amounts of hot milk are stirred into the yolks, diluting them. The diluted yolks can now be safely added to the bulk of the hot liquid.

Tempering is also necessary when stabilizing whipped cream with a gelatin solution. Warmed gelatin hardens into tiny rubbery balls if it is added too quickly to a cold ingredient like whipped cream. The addition of a small amount of whipped cream to the warm gelatin dilutes the gelatin, so it can be added safely to the bulk of the cold whipped cream.

Notice that in the first example of tempering, a small amount of a hot ingredient is added to a cold ingredient, to prevent damage to the cold ingredient. In the second example, a small amount of a cold ingredient is added to a warm ingredient, to prevent damage to the warm ingredient.

Many other examples demonstrate the need for controlling ingredient temperatures and for carefully tempering ingredients. Look for them throughout the text.

HELPFUL HINT

If it is unclear which of two ingredients should be slowly added to the other ingredient, consider the following general rule when tempering ingredients:

Add small amounts of the ingredient that causes problems into the ingredient that is the problem.

In the first example, hot milk could cause egg yolks to curdle. Because the hot milk causes the problem and the yolks, if they curdle, are the problem, hot milk is added to egg yolks, and not the other way around.

Likewise, cold whipped cream could cause gelatin to solidify into tiny rubber balls. This means that the cream (which causes the problem) is added to gelatin (which, solidified into tiny balls, is the problem).

THE IMPORTANCE OF CONTROLLING OVEN TEMPERATURES

Chapter 2 is all about heat transfer and how to control it. Yet, the information in the next chapter is of little use if an oven is not calibrated properly. Nor is it of any use if an oven is not allowed to fully preheat before product is added, or if an oven door is opened too often and for too long. Paying attention to these simple points can go far in assuring that product coming from your bakeshop is of consistently high quality.

HOW IMPORTANT IS OVEN TEMPERATURE WHEN BAKING CAKES?

High ratio cakes are characterized by high percentages, or ratios, of liquid and sugar to the amount of flour. They are formulated to be mixed in a single step that whips large amounts of tiny air bubbles into the batter. While considered by many to be foolproof, things can go wrong when oven temperatures are off.

When the oven temperature is low, for example, a cake's structure sets later than it should. In the meantime, the batter slowly warms and as it does, it thins out. Air bubbles easily rise through the thin batter to the surface of the cake, while starch in the flour sinks to the bottom. If the oven temperature is quite low, the baked cake will have a thick rubbery layer along the bottom and a low volume overall. Or, it could simply have a series of thin tunnels running from bottom to top, tunnels that follow the trail of disappearing bubbles.

QUESTIONS FOR REVIEW

1. Why do bakers and pastry chefs require better accuracy in measuring ingredients than do kitchen chefs?
2. What does it mean for a baker's scale to be out of balance? Describe how to check and adjust a scale for proper balancing.
3. An electronic scale has the following printed on its front display panel: 500 g × 2 g. What does each number refer to?
4. What is the smallest amount that should be weighed on a scale that has 500 g × 2 g on its display panel? Assume that an acceptable amount of error in measurement is 10 percent or less.
5. What is the main advantage of metric weight measurements (grams and kilograms) over U.S. common or imperial measurements (ounces and pounds)?
6. Explain why weighing ingredients in grams is not necessarily more accurate than weighing in ounces.
7. Explain why judging the thickness of a liquid is not a good way to judge how much a cup of it will weigh.
8. When weighing flour that is to be sifted, does it matter whether the flour is sifted before or after it is weighed? Why or why not?
9. What are the two meanings of the word ounce? For which ingredients are they approximately equal?
10. List three ingredients that are sometimes measured using volumetric measures (pints, liters, tablespoons, and milliliters).
11. Why do bakers and pastry chefs prefer weight measurements to volume measurements? Use flour as an example when answering this question.
12. Explain how it is that 1 pint (500 ml) of water weighs approximately 16 ounces (500 grams) while 1 pint of glucose corn syrup weighs much more.
13. What is the main advantage of using formulas that are expressed in percentages?
14. What is an advantage of baker's percentages over percentages based on total yield?
15. What does it mean to temper ingredients?
16. Explain how to temper hot milk and egg yolks.

QUESTIONS FOR DISCUSSION

1. A friend is preparing a 1-2-3 cookie dough (which typically contains 1 pound sugar, 2 pounds butter, 3 pounds flour, and three eggs). Instead of weighing the ingredients, however, your friend uses measuring cups, measuring 1 cup sugar, 2 cups butter, and 3 cups flour. Why is it unlikely that the cookie dough will turn out properly?
2. You are preparing an orange sauce that calls for 32 fluid ounces of orange juice and 1 ounce of starch. You decide to weigh the 32 ounces on a scale. Using the information from Table 1.2, explain whether you will be adding too much or too little orange juice than actually required. Will your orange sauce turn out slightly too thick or too thin?
3. Using the information from Table 1.2, state which of the following measurements will be less accurate if a measuring container is used instead of a scale, when a formula is based on weight units: heavy cream or orange juice? Why?
4. Explain how to combine warmed melted chocolate and chilled whipped cream together, to prevent bits of chocolate from solidifying into small chips in the cold cream.

EXERCISES AND EXPERIMENTS

1. Rye Bread Formulas

Compare the following two formulas for rye bread.

Formula 1

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	8		3000	80%
Flour, white rye	2		2000	20%
Water	6		2800	56%
Yeast, compressed		6	190	4%
Salt		3	95	2%
Caraway seeds		2.4	75	1.5%
Total	16	4	8085	163.5%

Formula 2

INGREDIENT	POUNDS	OUNCES	GRAMS	BAKER'S PERCENTAGE
Flour, bread	22		10,000	60%
Flour, white rye	15		6,800	40%
Water	21		9,550	57%
Yeast, compressed		15	425	2.5%
Salt		9	260	1.5%
Caraway seeds		4.75	135	0.8%
Total	59	8	27,170	161.5%

1. Based on the amount of caraway seeds added to each, which would you expect to have a stronger caraway flavor? Explain how you got your answer.

_____

_____

2. Based on the amount of yeast added to each, which would you expect to rise faster and possibly have a stronger yeast flavor? Explain how you got your answer.

_____

_____

2. Weight of Ingredients

Complete the formula below by filling in the missing weights for unsifted pastry flour, molasses, and ginger. To do this, use information from Table 1.2 to convert the given volumetric measurements to weight measurements to one decimal place (note that weights are listed in Table 1.2 as "per pint," or 2 cups). Check your work by confirming that the weights in pounds and ounces add up to the total weight given.

INGREDIENT	VOLUME MEASUREMENTS	POUNDS	OUNCES
Flour, pastry, unsifted	9 cups		
Sugar	3 cups	1	5
Butter	2 cups	1	
Molasses	½ cup		
Eggs	3 each		5.2
Ginger	¼ cup		
Baking soda	1 Tbsp.		0.4
Salt	0.5 tsp.		0.1
Total		5	10.7

3. Density and Thickness in Volumetric Measurements



OBJECTIVES

- Show how density affects the weight of a cup of an ingredient.
- Show how thick samples are not necessarily denser than thin samples.
- Show how different methods of adding flour and other dry ingredients affect density.



MATERIALS AND EQUIPMENT

- Flour (any type)
- Small spoon or scoop
- Instant starch, such as National Ultrasperse 2000, or any cook-up starch, such as cornstarch



PROCEDURE

- Prepare a thickened starch solution by adding instant starch to water until noticeably thick, being careful to avoid whisking air into the mixture. *Do not pre-blend starch with sugar* (this will increase the density of the solution and alter the results of the experiment). Or, cook any starch with water (about 25 grams cornstarch into 400 grams water) until noticeably thick; cool to room temperature.
- Weigh 1 level cup (250 ml) of each of the following:
  - Flour lightly spooned into a measuring cup
  - Flour spooned into a measuring cup but shaken after every few spoonfuls to allow flour to settle

- Flour sifted first, then lightly spooned into measuring cup
- Water (room temperature)
- Thickened starch solution (room temperature)

- Record weights in the following Results Table. Be sure to indicate your units of measure—grams or ounces—in the table.
- Record any potential sources of error that might make it difficult to draw the proper conclusions from your experiment.
- Compare your weights and explain.



SOURCES OF ERROR

_____

_____

RESULTS TABLE ■ DENSITY MEASUREMENTS

PRODUCT	WEIGHT PER CUP
Flour, spooned	
Flour, spooned and shaken	
Flour, sifted then spooned	
Water	
Starch-thickened solution	



CONCLUSIONS

1. Rank flour samples—spooned, spooned and shaken, or sifted then spooned—from least dense to densest sample. Based on these results, explain why weight, not volume, is best for measuring flour and other dry ingredients.

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2. How did the density (weight per cup) of the starch-thickened solution compare with the density of water? How might you explain these results?

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3. Did you have any sources of error that might significantly affect the results of your experiment? If so, what could you do differently next time to minimize error?

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