

When Does Spaghetti and Meatballs Become Meatballs and Spaghetti?

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Content Objectives

Introduction

I am a special education teacher, who teaches 7th grade math and science at an alternative school in Charlotte, North Carolina. My school consists of mostly serious emotional disorder and behavior emotional disorder children. Teaching this population of children can be exhausting and tiring, especially when they lack an interest in a subject such as math. Math is a subject area that everyone needs to know, but many lack interest in. As a new teacher, I am always searching for new strategies to use to teach my students. I know that if I can find a topic that is interesting, I can integrate the topic they like with math and make it enjoyable. I want them to enjoy my classes and find a yearning for learning math.

In my classroom, I keep snacks in my cabinet. The snacks were for me until I learned that the kids like receiving extrinsic values (Ms. Heath's snacks). The students loved when I would give them candy for correct math problems or bring special baked goods on Friday for good behavior weekly. As I was thinking about a curriculum unit I would like to do, a light bulb went off in my head. I would combine math and food and create a unit on ratio and proportions. When you talk about cooking, everyone thinks of Paula Deen, Rachel Ray, Bobbie Flay, and many others; however, math is a part of every kitchen, every recipe card that we use, and at each holiday event where there is food. When we use the stove to bake cookies, math is there. For instance, if we stayed in Canada where Celsius is used for temperature, but had a recipe that was in Fahrenheit from the United States, we would use math to convert the temperature into the degrees needed in Celsius. Math is also used when we need more of a recipe. Let's say the school is having a bake sale and you want to make five dozen cupcakes from scratch. The recipe that you found only makes a dozen cupcakes. Now, you could make a batch of cupcakes over and over again, or you can use math and make one batch for the amount of cupcakes needed. Math in cooking can also tell you how much something is going to cost. Let's imagine you were planning a Christmas party and you wanted to know if it would be more cost effective to make cheesecake or sugar cookies. As you start to price the ingredients that are needed in each recipe, you will be able to see which recipe would be more cost effective. Most of the time, the mathematics of cooking often goes unnoticed, but in reality, there is a large quantity of math skills involved in cooking and baking.

The unit that I have created will help children explore math through recipes. Not simply by mixing ingredients in a bowl, but showing how an offset in one ingredient can change taste and flavor of food through ratios and proportions. My intent with writing this unit is to teach kids ratios and proportions outside of the textbook. The book, "*Spaghetti For All!*" by Marilyn Burns is a great book that can be used to teach many math concepts. The unit is intended for middle school children, but can be modified for an elementary and high school curriculum. For

elementary, the teacher can teach a lesson on perimeter and area. For high school, the teacher can use the book to formulate equations. The common core standards that align with this curriculum are:

7.RP.2.a

Recognize and represent proportional relationships between quantities. A) Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line.

7.RP.2.b

Recognize and represent proportional relationship between two quantities. B) Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

7.RP.2c

Recognize and represent proportional relationships between quantities. C) Represent proportional relationships by equations.

Rationale

When we look around the world, we can see that most of things that have been created were made exhibiting symmetry and proportion. Take for example your house; it has a kitchen, bathroom, bedrooms, and beautiful windows. We all know that these things are the makeup of every blue print of a house design. Now let's say that instead of using one or two windows in a room, there were ten. What would ten windows in a bedroom feel like? What would ten windows in a living room look like? The average homeowner knows that the ratios of windows to the room size must be proportioned. In cooking, a chef uses proportion to balance and unbalance the flavor in difference in food; food is my favorite example of how to demonstrate proportion. I have chosen to write this unit on ratios and proportions because I believe this will be an interesting topic for the kids and it will help my students. I am trying to strengthen my math skills as I strengthen the skills of my students. I do not have a degree in math; however, I have a yearning to learn. Through research and innovation, I want kids to learn there are a variety of ways to learn ratios and proportions.

Mathematical Content

In order for this unit to be taught, students should understand that ratios are comparisons. For instance, if you have five animals, of which there are three dogs and two cats, the comparison, or ratio of dogs to cats is 3:2. The ratio of dogs to animals is 3:5. Students will also need to know that ratios are fractions. Fractions and ratios are very similar, meaning students should be able to tell you that $\frac{3}{5}$ of the animals are dogs. The only difference in showing ratios is colon instead of fraction symbol. $\frac{3}{5}$ as a ratio would be 3:5. Students should also understand that proportions are only equations made up of two ratios. The two ratios of a proportion should always equal. Students should also have a strong understanding of multiplication and division. When students are trying to solve proportions, they must understand how to multiply a number to find out if the proportions are equal. Division is need when students must find the least common denominator

in order to simplify a fraction; For example, $12/15$ has a least common denominator of 3. If we divide the twelve by three, we get 4 and if we divide the fifteen by three it would be five. So the simplified answer would be $4/5$. Students most know how to get to this answer.

Teaching Strategies

To begin the unit, we will discuss how proportion plays a role in the world around us. How does ratio play a role in what we see and even what we see as beautiful? To begin, the students will consider a house. It has a kitchen, bathroom, bedrooms, and beautiful windows. We all know that these things are the makeup of every blue print of a house design. Suppose that instead of using one or two windows in a room, there were ten. What would ten windows in a bedroom feel like? What would ten windows in a living room look like? The average homeowner knows that the ratios of windows to the room size must be proportioned. We will then find the number of windows in our classroom and see if that ratio stays consistent with another classroom in the school. This is a natural place to begin this discussion as the ratio will be like 5 to 1 or 6 to 1. Later, the proportions will change.

Proportion plays a very important role in food. First, there is serving size. Often, we overlook this measurement. I keep snacks in my cabinet. We will select one of Ms. Heath's snacks and count out the suggested serving size. We'll create a line on the floor with one end representing "serving size is too small" and the other side "serving size is too large" with the middle being "just right". The students will be asked to stand up and walk to the place on the line that reflects how they see this suggested serving size. We will try this for several snacks. We will see 1) that people vary in their perception of proper ratios and 2) that taste can also vary how one sees proportion.

From here, we will discuss eating out and serving size. Where do you like to go? Does that restaurant have big serving sizes? Who has good "deals" on food? Why is it a good deal? Each of these ideas connects to the idea of getting more for your money, which is again connected to our idea of ratio. While I will not go into a lot of detail at this point in the lesson, such discussions will contextualize our unit and how ratio is a real world concept.

Then, we will discuss how fancy restaurants sometimes have very small serving sizes. Imagine going out for dinner and getting the following plate of spaghetti and meatballs. How would you respond? How many plates of food would you need for a dinner? What would fill your tummy? Again, we are finding a ratio of food to someone's appetite.



This discussion sets the stage for a book that will springboard this unit's focus on ratio and cooking.

Spaghetti and Meatballs for All by Marilyn Burns

At this point in the unit, I will read *Spaghetti and Meatballs for All!* The book is about Mr. and Mrs. Comfort who have decided to invite their neighbors over for dinner. Before long, thirty people have accepted their invites, so they will be feeding thirty two people including themselves. Mr. Comfort is the cook, the more right brain and creative one. Mrs. Comfort is the more left brain problem solving one. Mrs. Comfort figures that there are not enough chairs and tables for everyone and decides to rent some from the local party supply store. She tells the local party store that she needs to rent eight tables that seat four people each. After multiplying eight by four, Mrs. Comfort asks to rent thirty-two chairs, but they only bring thirty-one chairs. Mrs. Comfort finds an extra chair folding chair in the garage. Everything seems to be going fine until the guests start to arrive and they do not want to sit at separate tables for four. After moving furniture around, they come up with a plan and finish the party. Now what if the story wasn't about how many table and chairs, but how many meatballs could be dished per plate, or how much spaghetti should be on the plate per person?

I want to create a PowerPoint presentation that places issues from this book into the classroom. Specifically, we will consider "When does Spaghetti and Meatballs become Meatballs and Spaghetti?" This is a matter of proportion. One might wonder in what way ratios play a role? First, consider a plate containing only one meatball, five meatballs and 22 meatballs as seen below. At some point, a dish of meatballs and noodles is really a plate of meatballs with a few noodles.



To help with this idea, I will revise the story. Mr. and Mrs. Comfort still decide to have their party. Before long, the list of people for the party grows to 30 people. Mr. Comfort wants to make his famous spaghetti and meatball dish. He is so excited for the party and makes a total of 640 meatballs! Mrs. Comfort does not want a whole plate of just meatballs. She knows that every guest should be given the right ratio of meatballs to noodles. So, she looks for a recipe that can help her determine how to dish the food appropriately. She finds the following recipe:

Spaghetti and Meatballs
(Serving size: 4)
2 cups of cooked spaghetti
2 cups of sauce
4 golf ball sized meatballs

Wait a moment. This party will have 30 people, not 4. Let's first figure out how many meatballs each person gets under this recipe. That is one way to figure out how many people Mr. Comfort's meatballs can feed. Math can help us solve this and save the party!

Students will each be given a worksheet to use to solve their math problems. The math problems will deal with ratios and proportions that are found in recipes. Students will begin working on solving equations for the recipe. I will go over ratio and proportion with the sheet and ask students questions on the worksheet. After the worksheet, I will show students correct answers and give them a grade.

For example, I will ask questions like the following: If a recipe calls for two cups of flour per serving and you need three servings, how could I find how many cups of flour I need? How many tablespoons would give to have four ounces of peanut butter? Three quarts of water would give you how many cups of soup? How many teaspoons would equal three tablespoons of baking soda? Two pints of ice cream is how many ounces?

Day two -The second day I will set up a peanut butter and jelly station. The station would consist of peanut butter, jelly, white bread, napkins, plastic knives, and recipe sheet. The recipe sheet will serve ten people. Students will be given a worksheet, where they will need to convert the sandwiches into serving for $\frac{1}{2}$ a serving, one serving, two servings, or five servings. I will group students into groups of three. Each group will be given a card of a serving amount of peanut butter they will need to add to their sandwiches. The amount of jelly (1 serving) will remain constant for all sandwiches; however, the peanut butter amount will change. After the four groups of three have received their card. Each group member will be given two pieces of white bread and a knife. After receiving which amount of peanut butter they should put on sandwich, they will resume to making their sandwiches. After sandwiches are made, the teacher will give a taste testing sheet that has three ratings- too much, too little or just right. The students will place a check in the box they believe fits the taste of the sandwich. The teacher will ask each group to pass out their sandwiches starting with the $\frac{1}{2}$ serving group. Between group tasting, the teacher will give students a minute to discuss taste and rate the sandwiches. After taste testing the teacher will ask questions about the sandwiches to the students.

Directions : Students will put a check under the taste of the sandwich they are trying : Example ½ serving may taste though it does not have enough peanut butter, students will place a check under too little peanut butter ½ servings.

Servings	Too Little Peanut Butter	Just Right	Too Much Peanut Butter
½ serving			
1 serving			
2 servings			
5 servings			

Day three- Students will start the day journaling about the peanut butter and jelly lab from the previous day. Students will receive a sheet about the Kool-Aid and hot chocolate that they will create on that day. Students saw how too much of something can affect flavor, but what about not enough. Students will work together to make Kool-Aid with sugar. Students will be divided into three groups. Each group will make a pitcher of Kool-Aid according to recipe given. One group will have to make Kool-Aid with normal amount of sugar, second group will make Kool-Aid with ½ amount of sugar as directed, and third group will make Kool-Aid with ¼ amount of sugar as directed. Each group will set up stations around the room with their cups of Kool-Aid. Students will take a taste tester sheet around room and place a check under the column that it fits. After the Kool-Aid lab, students will clean up their stations, while I pass out the ingredients they will need for hot chocolate.

The reason I will include hot chocolate in this lab is because sometimes heat can intensify the flavor. As most of us know, ice cream is not overly sweet when it is frozen, but when it melts we begin to taste the extra sugar that was added to the ice cream. The reason this occurs is because our taste buds are made up of micro channels and receptors that affect the way we perceive food at various temperatures.

The hot chocolate lab would again consist of three groups. The groups will make cups of hot chocolate according to their group's recipe. One group will have to make hot chocolate with normal amount of sugar, second group will make hot chocolate with ½ amount of sugar as directed, and third group will make hot chocolate with ¼ amount of sugar as directed. Each group will set up stations around the room with their cups of hot chocolate. Students will again take a taste tester sheet around room and place a check under the column that it fits. The taste tester sheet plays a role similar to the line that indicated one's perception of the suggested serving size of the snacks from my cabinet. These labs are designed to get similar feedback from students. However, it is entirely likely that again, we will see how people vary in their perception of desired proportion in food preparation.

The taste tester sheet is below:

Servings	Too Little Sugar	It's drinkable	Just right
¼ serving of sugar added			
½ serving of sugar added			
2 cups of sugar added			

After lab, students will discuss the flavors of the Kool-Aid. Students will use knowledge from classroom lab to help with proportion and ratio problems given. I will give a ratio word problem to use as an exit ticket with students. Students will be chosen randomly at the end of class to be in groups for a cooking show the following week. A cooking show will be used as an assessment to see if students understand concepts taught in previous classes.

Modifications for Special Education Students

To help some of my students who have learning disabilities, I will make sure that I have created a few samples of the above items. I will have the teacher assistant in the morning make a sample tray of what the above recipes would taste like. The students, who need help, will work with teacher assistant in that particular station, while I walk around and observe the other groups. The students in the group with the teacher assistant will be able to tell the teacher assistant what they taste and does adding or deleting an ingredient make a difference in taste. I will also make sure that during the cooking show that I pair students according to their abilities. So I would number the students from high to low in the classroom. The highest achieving student would pair with the lowest achieving student to ensure that the groups are equal in levels.

Day four- Students will be given a group packet to use for their project. Students will randomly be given an index card with a recipe that they will have to convert into the correct amounts for 1 serving. After distributing the recipe cards, I will explain to the students what is in the packet. The packet will be called,

The 7th Grade Math Scholar Cooking Show.

After reading the packet below, students will be asked to convert their recipe into the correct measurement. Students will pick a group leader to make sure that student's recipes are correct. After picking a group leader, students will come up theme for their cooking show and make sure that their show follows the rubric design. Student will prepare for the rest of the math period.

Day five through day seven - Groups will prepare their recipe and be graded during these three days with rubrics below. Students will taste food on each day and give feedback immediately

after each group. If student's recipe modifications were incorrect, teacher will write their recipe on smart board and have class answer what the correct modification should have been.

In order for the students to work with recipes and scale them up and down, they will need to have a cooking measurement equivalent chart. The chart they will use that will allow them to adjust their recipes according to their needs is given below.

Cooking Measurement Equivalent – needed to complete package correctly

1 tablespoon (tbsp) =	3 teaspoons (tsp)
1/16 cup (c) =	1 tablespoon
1/8 cup =	2 tablespoons
1/6 cup =	2 tablespoons + 2 teaspoons
1/4 cup =	4 tablespoons
1/3 cup =	5 tablespoons + 1 teaspoon
3/8 cup =	6 tablespoons
1/2 cup =	8 tablespoons
2/3 cup =	10 tablespoons + 2 teaspoons
3/4 cup =	12 tablespoons
1 cup =	48 teaspoons
1 cup =	16 tablespoons
8 fluid ounces (fl oz) =	1 cup
1 pint (pt) =	2 cups
1 quart (qt) =	2 pints
4 cups =	1 quart
1 gallon (gal) =	4 quarts

I will direct the students as follows:

You have all learned that increasing or decreasing a key ingredient in a recipe can change the taste of the recipe. Each of you will be put into a group and randomly given a recipe. The recipe is to be prepared for eight people; however, the recipe will need to be modified. Recipes will either need to be decreased or increased to get the correct number of servings needed. *This will change the ratio of the ingredients.*

An example recipe and how it would be modified will also be supplied. Brownies are a great example as they are used in parties of various sizes. Knowing how to adapt the number of servings is a skill far beyond the mathematical classroom. I will walk through adapting a recipe as given in the following example. Below the recipe is how I will further instruct the students

toward preparing their TV cooking show.

Example: Ingredients for 16 serving of Brownies

- | | |
|--|---------------------------------------|
| <input type="checkbox"/> 1/2 cup (1 stick) butter or margarine, melted | 1/2 divided by 2(8 brownies) = 1/4 |
| <input type="checkbox"/> 1 cup sugar | 1 divided by 2 = 1/2 cup |
| <input type="checkbox"/> 1 teaspoon vanilla extract | 1 teaspoon divided by 2= 1/2 teaspoon |
| <input type="checkbox"/> 2 eggs | 2 eggs divided by 2= 1 egg |
| <input type="checkbox"/> 1/2 cup all-purpose flour | 1/2 cup divided by 2= 1/4 cup |
| <input type="checkbox"/> 1/3 cup HERSHEY'S Cocoa | 1/3 cup divided by 2= 1/6 cup |
| <input type="checkbox"/> 1/4 teaspoon baking powder | 1/4 teaspoon divided by 2= 1/8 tsp |
| <input type="checkbox"/> 1/4 teaspoon salt | 1/4 teaspoon divided by 2= 1/8 tsp |
| <input type="checkbox"/> 1/2 cup chopped nuts (optional) | 1/2 cup divided by 2= 1/4 cup |

In red is the new recipe, modified for 8 servings of brownies. Now it's your turn. Once you have been randomly chosen to complete the recipe from below for your group, modify it so that recipe now serves 8 servings beside the original recipe, just as shown in previous example. There is only one recipe that has the exception of making more than eight servings, and that is **Oreo Truffle** (Example recipes makes 24 rice crispy treats, modify it to make 8 rice crispy treat; recipe makes one cup of sauce, modify it to make eight cups of sauce.)

I will give the following recipes to the groups with the associated directions.

Rice Crispy Treats (24 servings)

- 1/4 cup of butter
- 5 cups of rice crispy cereal
- 4 cups of miniature marshmallows

Directions

1. Melt margarine in large sauce pan over low heat. Add marshmallows and stir until melted and well-blended. Cook 2 minutes longer, stirring constantly. Remove from heat.
2. Add cereal. Stir until well coated.
3. Using buttered spatula or waxed paper, press mixture evenly and firmly in buttered 13 x 9 inch pan. Cut into 2 x 2 inch squares when cool.

Oreo Truffles (3 1/2 dozen; make one dozen ONLY)

- 1 (16 ounce) package OREO Chocolate Sandwich Cookies, divided
- 1 (8 ounce) package PHILADELPHIA Cream Cheese, softened
- 2 (8 ounce) packages BAKER'S Semi-Sweet Baking Chocolate, melted

Directions

1. Crush 9 of the cookies to fine crumbs in food processor; reserve for later use. (Cookies can also be finely crushed in a reseal able plastic bag using a rolling pin.) Crush remaining 36 cookies to fine crumbs; place in medium bowl. Add cream cheese; mix

- until well blended. Roll cookie mixture into 42 balls, about 1-inch in diameter.
2. Dip balls in chocolate; place on wax paper-covered baking sheet. (Any leftover chocolate can be stored at room temperature for another use.) Sprinkle with reserved cookie crumbs.
 3. Refrigerate until firm, about 1 hour. Store leftover truffles, covered, in refrigerator.

Strawberry Milkshake (2 servings)

- 8 strawberries hulled
- ½ cup of skim milk
- ½ cup of yogurt
- 3 tablespoons of white sugar
- 2 teaspoon of vanilla extract
- 6 cubes of ice crushed

Directions

1. In a blender combine strawberries, milk, yogurt, sugar and vanilla.
2. Toss in the ice.
3. Blend until smooth and creamy.
4. Pour into glasses and serve.

Now that your groups have converted the original recipe to the modified version, let’s get prepared for the cooking show!!! Each of your groups will be given a time slot to showcase your recipe. The recipe will not be checked until after the teacher and class has sampled the recipe; believe me, just like the extra peanut butter made a different taste in the sandwiches from the previous lesson, the taste of your recipe will tell if you accurately prepared the dish. As teacher begins to film your group, you will work out the recipe on the board for class, and use the modified recipe to prepare your dish for the class. You will be given two project grades (recipe accuracy; cooking show performance). Please use the rubric as your guide for your grade. If you need help with understanding the rubric, please ask the teacher before you begin the cooking project. So let’s begin! The groups will present in the following order: strawberry milkshake group, rice crispy treat group, and the Oreo truffle group. Please be prepared on your day to present.

RECIPE TASTE TEST			
	Poor 1 pts	Fair 2 pts	Good 3 pts
Texture	The recipe is not consistent and does not look edible	The recipe is consistent and looks somewhat appealing	The recipe is correct and looks appealing.
Smell	The recipe has a funny smell, like some additional ingredient was added.	The recipe smells OK, but something is just not right.	The recipe smells wonderful.

Taste	The recipe tastes like it was mixed you're your brother's dirty socks.	The recipe tastes bland, maybe too much of an ingredient or not enough was added.	The recipe taste wonderful!!! I would like another piece!
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COOKING SHOW RUBRIC				
Category	Scale 4	Scale 3	Scale 2	Scale 1
Place & Measurements	All the ingredients were gathered properly and weighing was done accurately	All the ingredients were gathered properly. Weighing was a little off but corrected upon review	Ingredients were not all gathered and measurements were off quite a large amount	No attempt was made to start the process
Cooking methods used	The methods called for in the recipe were all utilized properly and everything done correctly	The methods were all used but not quite understood without review. still a good experience	The methods were not followed or understood and needed to be done by the instructor to save the product	No cooking method knowledge was demonstrated
Flavor, Appearance and Aroma	The item tasted very good, the ingredients were fresh and very attractive	The item tasted good, the ingredients were fresh but inconsistent. still attractive	The item was edible but needed to be reworked by the instructor to be satisfactory	The item did not exist due to no preparation
Cleanliness and Sanitation	The student followed all proper guidelines in sanitation, kept the area clean during production and cleaned and sanitized when done	The student followed all the proper guidelines. Was a little messy in production, but safe and cleaned and sanitized well	The student made a mess in production and did not clean or sanitize properly	The student showed no knowledge of cleanliness or sanitation

Method of Preparation	The method of preparation was followed correctly and the item was done properly	The ingredients were all correct and the method of preparation needed 1 or 2 adjustments	The ingredients were incorrect and the method of preparation was not understood	There was nothing gathered to follow a method of preparation
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There are many ways to be entertained with math – from magic tricks to mathematical art. In this unit, I touch on a way that math plays into entertaining itself! We use math to prepare to entertain friends and family at a party. Mr. and Mrs. Comfort, in the story that begins this unit, used math to think the seating of their guests. We use proportion every day when we cook. If we use prepared foods, someone has already determined the ratio of spices that give a distinctive taste. This unit underscores how math gives KFC chicken its secret recipe and even sodas their distinctive tastes. Further, this unit will enable students to be engaged with math in a natural way. Eating together will enable the class to fellowship and share while learning. Such learning environments deepen student understanding, enable me to gauge student learning in informal, conversational ways, and enrich the classroom environment.

I look forward to sharing this unit with my class and seeing how math helps us serve spaghetti with meatballs. Without proper proportion, we could mistakenly give a bowlful of meatballs and have meatballs with spaghetti, which for some may even be by their proper proportion! As in life, finding proper proportion is an important skill.

List of books for students to read

The Hershey Milk Chocolate Bar Book by Jerry Pallotta

Full House: An Invitation To Fractions by Dayle Ann Dodds

Funny and Fabulous Fraction Stories: 30 Reproducible Math Tale and Problems to Reinforce Important Skills by Jared D. Lee

Pythagoras and the Ratios: A Math Adventure by Julie Ellis

Math Doesn't Suck: How To Survive Middle School Math Without Losing Your Mind or

Breaking A Nail by DanicaMckellar

List of books for Teachers

The Golden Ratio: The Story of PHI by Mario Livio

Cooking For Geeks: Real Science, Great Hacks, and Good Food by Jeff Potter

Making Sense of Fractions, Ratios, and Proportions by Bonnie H. Litwiller

Work Cited

Burns, Marilyn. *Spaghetti and Meatballs For All! A Mathematical Story*. Scholastic Paperback, 2008.

This book was an easy read. It talks a lot about area and perimeter; however, can be used to teach other math concepts.

Lappan, Fey, Fritzzgerald, Friel, and Phillips. *Comparing and Scaling; Connected Mathematics 7th grade student edition*. Prentice Hall, 2007.

This is the book most CMS middle school teachers are using to teach ratios and proportions. It was helpful in creating proportions and for vocabulary.

Ruhlman, Michael. *Ratio: The Simple Codes Behind the Craft of Everyday Cooking*. Scribner, 2010.

This book was very easy in breaking down ratios of recipes and modifying them. It showed the importance of how ratios can change the taste of food.