



EMPower

extending mathematical power

Keeping Things in Proportion

Reasoning with Ratios



TEACHER BOOK

Mathematical Concepts Covered for Keeping Things in Proportion: Reasoning with Ratios

Book Description: Students use various tools—objects, diagrams, tables, graphs, and equations—to understand proportional and non-proportional relationships.		
Lesson Number:	Lesson Name:	Mathematical Concepts/ Topics Covered:
Opening the Unit	Comparing and Predicting	<ul style="list-style-type: none"> Additive and multiplicative ways to compare amounts demonstrated Ability to solve proportional and non-proportional problems assessed Experiences with rate, ratio, and proportion shared
Lesson 1:	A Close Look at Supermarket Ads	<ul style="list-style-type: none"> Ratios in everyday consumer advertisements identified Equal ratios determined and equality demonstrated with diagrams Mathematical rule for establishing equal ratios developed Problems solved using equal ratio diagram or mathematical rule
Lesson 2:	It's a Lot of Work!	<ul style="list-style-type: none"> Sample of work conducted and described over a period of time Sample used to make a prediction for a larger amount by reasoning with equal ratios
Lesson 3:	Tasty Ratios *	<ul style="list-style-type: none"> Ratios used to describe taste and visual comparisons Ingredients adjusted so that proportions are correct
Lesson 4:	Another Way to Say It	<ul style="list-style-type: none"> Two amounts compared using alternate but equivalent method Percents as ratios used to compare the part to the whole amount Whole numbers rounded to make comparisons more manageable
Lesson 5:	Mona Lisa, Is That You?	<ul style="list-style-type: none"> Reproductions in various sizes judged by eye to determine if proportional to an original Measurements used to determine whether reproductions are proportional Graph used as a tool to test for good reproductions (equal ratios) Graph points connected with number pairs
Lesson 6:	Redesigning Your Calculator	<ul style="list-style-type: none"> Rectangular shapes that are similar to one another drawn and measured Fractions of a centimeter expressed as decimals Area and perimeter changes are contrasted when length and width are doubled and halved
Interim Assessment	Checking In	<ul style="list-style-type: none"> Sets of equal ratios created Comparisons, predictions, and decisions made with ratios Ratios in various formats written and interpreted

Lesson 7	Comparing Walks	<ul style="list-style-type: none"> • Speed described and quantified as relationship of distance and time • Strategy to find unit rate for a/b developed
Lesson 8	Playing with the Numbers	<ul style="list-style-type: none"> • Cross-product property introduced as another tool to check that two ratios are equal • True and false proportion equations examined Estimation used to predict for more complicated numbers in proportions • Missing number in a proportion determined
Lesson 9	The Asian Tsunami	<ul style="list-style-type: none"> • Proportional reasoning concepts applied to international currency conversion • Estimation used to predict for difficult numbers in proportion problems • Exact (or nearly exact) answer determined for a missing number in proportion problem
Lesson 10:	As If It Were 100	<ul style="list-style-type: none"> • Percents used to make comparisons between data sets of different sizes, some with very large numbers • 1,000 used as a base for comparison between data sets of different sizes
Closing the Unit	Reasoning with Ratios	<ul style="list-style-type: none"> • Various tools used to address different proportionality situations assessed • Comparisons, predictions, and decisions made with ratios



Tasty Ratios

What do ratios have to do with taste?

Synopsis

This lesson gives students an opportunity to play with ratios using their sense of taste. The focus for students is twofold: to maintain the ratio of the ingredients when making a new recipe and to adjust ingredients in order to fix a failed recipe.

1. The class discusses the need for using correct proportions when cooking.
2. In small groups, students taste three orange juice mixtures and speculate about the ratio of water to concentrate. They compare their conclusions before checking them against the recipes actually used.
3. Students consider how to fix the failed mixtures so the ingredients are in the right proportion to one another.
4. Students summarize ways to ensure that the ratio of two ingredients is maintained.

Objectives

- Use ratios to describe taste and visual comparisons
- Determine how to adjust ingredients so that the proportions are correct

Photo by Kampus Production from Pexels

Materials/Prep

- Markers
- Easel paper
- Sticky notes
- Small paper cups (three per student) for sampling orange juice
- Three spoons for stirring mixtures

Prepare student copies of *Orange Juice Recipe (Blackline Master 4)* or *Alternate Orange Juice Recipe (Blackline Master 5)*, depending on the number of students in your class.

Prepare to display, have students add and comment on, and save three tables like the one below—one table for each orange juice mixture (A, B, and C) in *Activity 1*:

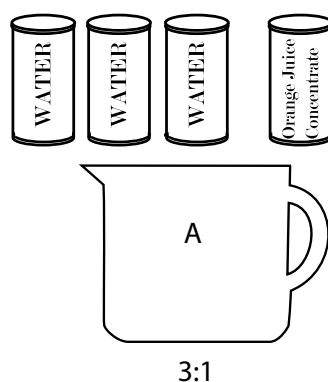
Mixture A
Describe the taste:
Describe the look:
Guess the ratio of water to frozen concentrate:

Orange Juice Recipe for a class of more than five students

- 1 gallon of water
- 2 (12 fl. oz.) cans of frozen orange juice concentrate that calls for three cans of water to one can of concentrate
- 3 empty containers (at least one-half gallon capacity each) to hold the three orange juice mixtures

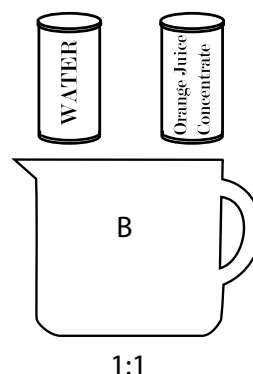
Prepare Mixture A, where the proportions are correct (3 parts water:1 part concentrate). Add three cans of water to one can of orange juice concentrate and stir. This will yield a normal mixture.

Step 1



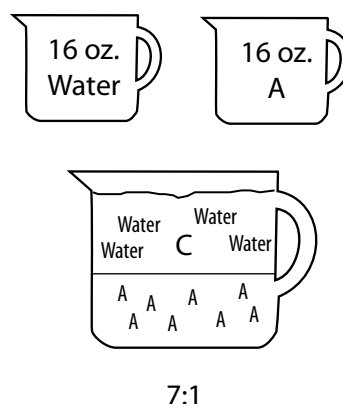
Prepare Mixture B with one-third the recommended amount of water (1 part water:1 part concentrate). Add one can of water to one can of orange juice concentrate and stir. This will yield a thick mixture.

Step 2



Prepare Mixture C, in which there is much more water than there should be (7 parts water:1 part concentrate). Pour 16 fl. oz. (2 cups—not cans) of Mixture A into a container and add 16 fl. oz. of water. This will yield a very weak mixture.

Step 3



Alternate Recipe (for a class of five or fewer students)

- 1 (12 fl. oz.) can of frozen orange juice concentrate that calls for three cans of water to one can of concentrate
- $\frac{1}{2}$ gallon of water
- 3 empty containers (at least one-half gallon capacity each) to hold the three orange juice mixtures

Divide the concentrate into thirds.

Prepare Mixture A, where the proportions are correct (3 parts water:1 part concentrate). Add one can of water to one-third of a can of orange juice concentrate and stir. This will yield a normal mixture.

Prepare Mixture B with one-third the recommended amount of water (1 part water:1 part concentrate). Add one-third of a can of water to one-third of a can of orange juice concentrate and stir. This will yield a thick mixture.

Prepare Mixture C, in which there is much more water than there should be (7 parts water:1 part concentrate). Add $2\frac{1}{3}$ cans of water to $\frac{1}{3}$ of a can of orange juice concentrate. This will yield a very weak mixture.

Heads Up!

Prepare orange juice mixtures before the class begins. Be sure to use the ratios described in the directions for preparation above.

Opening Discussion

Begin by asking students to consider the role of proportion in cooking. Refer students to the recipe for pancakes on p. 35 of the *Student Book*. Once they have examined the recipe, ask:



If only one of the ingredient amounts in this pancake recipe were changed, what would the pancakes taste like? For example, what if the amount of flour were doubled? What if the amount of baking powder were cut in half? What if the sugar were tripled?

Listen to responses. Do students have a sense of the effect of changing one ingredient? Ask students to consider their own personal experiences with recipes.



Have you ever made a mistake following a recipe? What happened? How did it taste? Why?

After students share experiences, say:



Today you will use your senses of taste and sight to make judgments about whether I used the correct proportions when making mixtures of orange juice.



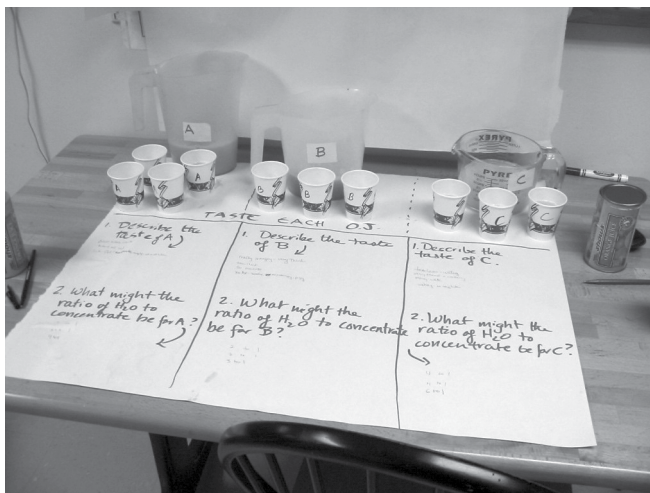
Later you will figure out how to fix any mistakes I might have made.



Activity 1: Orange Juice Taste Test

For this activity, students will examine and taste a little of each of the three containers of orange juice that you prepared. Each container will be a different concentration, stirred and well labeled (A, B, or C).

Set up a station as shown in the picture (or pass around cups labeled A, B, and C). Also have either the empty can or the label available for students to examine.



Ask everyone to pour a little of each mixture into three cups, labeling their cups “A,” “B,” and “C.” Before taste-testing each mixture, ask students to look at the mixtures and predict what they think the ratio of water to concentrate is for each. Then ask students to taste a little of each to adjust their predicted ratio and then to write their predictions down on p. 36 in the *Student Book*.

Also ask students to share their predictions on a sticky note on the each of the displays “Mixture A,” “Mixture B,” and “Mixture C.”

After everyone has written their responses, hand out your actual recipe (either *Blackline Master 4* or 5, depending on which recipe you used). Ask:



What do you think of the guesses? Which guess was the closest in each case?

Give students plenty of time to figure this out alone and in pairs, and then ask for responses. Figuring out Mixture C is a real challenge and should elicit discussion and a lot of drawing.

There are many ways to think about this. Some people might think about Mixture C this way:

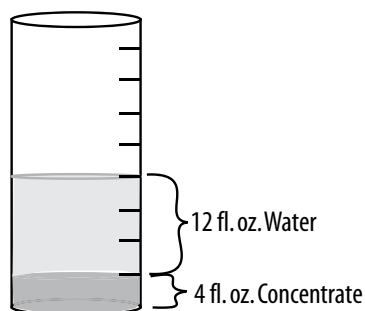
16 fl. oz. of Mixture A has 3 parts water and 1 part concentrate, but Mixture C has 4 more parts of water. That makes 7 parts water and 1 part concentrate (14 fl. oz. of water to 2 fl. oz. of concentrate). So Mixture C is a 7:1 ratio.

Other students may interpret the Mixture C recipe as follows:

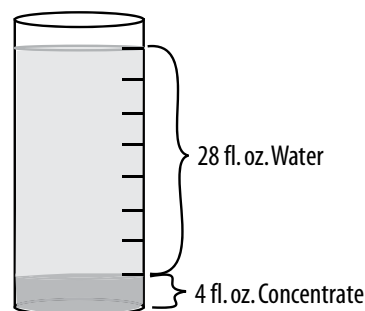
16 fl. oz. of Mixture A has 12 fl. oz. of water and 4 fl. oz. of concentrate (3 to 1). If you add 16 more fl. oz. of water, you get a mixture with 28 fl. oz. of water and 4 fl. oz. of concentrate. This is a 7 to 1 ratio of water to concentrate.

A diagram might look like this:

Mixture A (3:1)



Mixture C (7:1)



Activity 2: “Doctoring” the Orange Juice

Encourage students to work in pairs or triads to figure out how to create mixtures that are in balance from the failed Mixtures B and C.

Ask:



How would you fix Mixture B without throwing any away?



How would you fix Mixture C without throwing any away?

Encourage picture drawing.

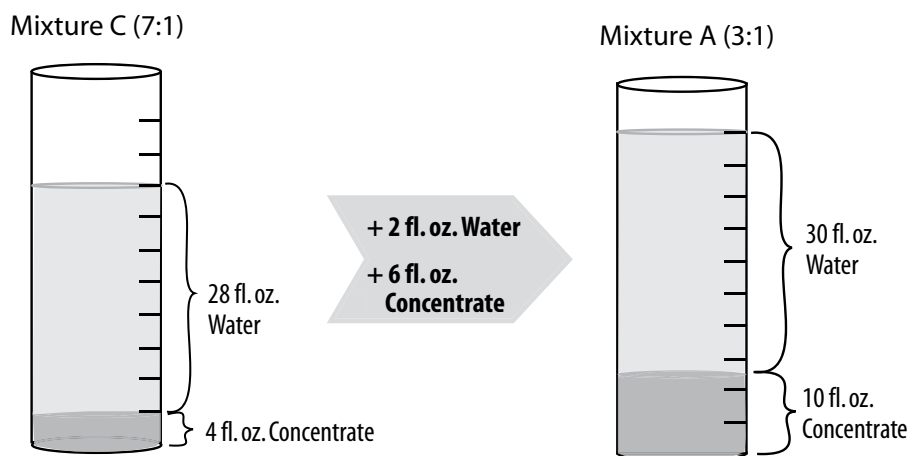
For Mixture B, the “fix” is fairly easy if you add 2 more cans of water.

For Mixture C, you would have to add some more concentrate and possibly a little water. But how much? Some people might think of it this way:

If you have 28 fl. oz. of water and 4 fl. oz. of concentrate, and you want to bring the strength up to a 3 to 1 ratio, you could add about 4 fl. oz. of concentrate ($\frac{1}{3}$ of a can). That would bring you up to about 28 fl. oz. to 8 fl. oz., a $3\frac{1}{2}$ to 1 ratio which would be better.

To be more exact, you could add 2 more fl. oz. of water to bring the amount of water to 30 fl. oz., and 6 more fl. oz. ($\frac{1}{2}$ can) of concentrate to bring the concentrate to 10 fl. oz. This will produce a 3:1 ratio of water to concentrate.

A diagram might look like this:



Ask prompting questions to help students think critically about how to reason about this, both with diagrams and numbers. (See *Lesson in Action*, pp. 49–50, for one teacher’s facilitation strategy when students got stuck.)

Summary Discussion

Ask:



How can mathematics help in a situation where a ratio is out of balance?

Students should mention using concrete representations and pictures, using a rule such as doubling both numbers or multiplying both amounts by the same number.

Then ask students to reflect on today’s activity in the *Reflections* section (*Student Book*, pp. 141–144).



Heads Up!

Remember to save the mixture displays with students’ notes for the next lesson.



Practice

How Does It Taste? p. 38

Provides practice in making predictions about sets of ratios.

Lemonade for the Party, p. 39

Offers more practice with mixtures.

Building a Set of Equal Ratios, p. 40

Gives students more practice with creating equal ratios.

Popcorn Party Mix, p. 41

Students look at the ratio of two ingredients within a recipe.

Dressing It Up, p. 42

Students practice tripling and quadrupling recipes.

Doctor This, p. 43

Gives students an opportunity to create new equal ratios from out-of-balance ratios.



Extension

Reasoning with Ratios, p. 44

Gives students a chance to reason about ratios without using numbers.



Test Practice

Test Practice, p. 46



Looking Closely

Observe whether students are able to

Use ratios to describe taste and visual comparisons

Students should be able to visually distinguish between the mixture that is too weak (too much water) and that which is too strong (too much concentrate). If students don't often drink orange juice, they may have a little more difficulty distinguishing between the mixture with the correct ratio and the weak mixture. The key point is that students realize that ratios are commonly used in everyday life, and when the ratios are out of balance, things are just not "quite right."

Determine how to adjust ingredients so that the proportions are correct

This may be a bit challenging for students, but they can work with what ingredient needs to be added (water or concentrate). Encourage students to draw pictures or actually act out the process in order to figure out how to adjust the ingredients.

Thinking about the ratio of ingredients in a mixture can be especially challenging because one cannot separate the ingredients. To think about the relationship between the amount of water and concentrate, it may be helpful to think about the point at which the mixture was created. Ask students to consider what went into the mixture.

WHAT TO LOOK FOR IN LESSON 3	WHO STANDS OUT? (LIST STUDENTS' INITIALS)			NOTES FOR NEXT STEPS
	STRONG	ADEQUATE	NEEDS WORK	
Concept Development <ul style="list-style-type: none"> Connects taste and appearance with the idea of ratios Judges accuracy of predictions based on correct recipe ratios Given a mixture that is too strong or weak, reasons with ratios to "doctor" it 				
Expressive Capacity <ul style="list-style-type: none"> Describes the strength of a mixture with ratios Writes a ratio in several forms (a/b, a per b, a parts of one to b parts of the other.) Can explain clearly how predictions compare to the correct recipe 				
Use of Tools <ul style="list-style-type: none"> Uses pictures or objects to show that two ratios are or are not equal Uses a mathematical rule (multiply both amounts by the same number) to compare ratios Uses a table to keep track of information 				
Background Knowledge <ul style="list-style-type: none"> Connects personal experience with recipes to the activity at hand 				

Rationale

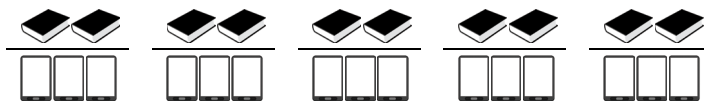
Although everyday experiences are ratio-rich, math textbooks often go straight to the word problems. Here students are asked to connect with the concrete experience and reflect on ratios within that experience. This lesson is rich in mathematics, yet students feel a sense of play as they predict and then determine actual ratios of ingredients.

Math Background

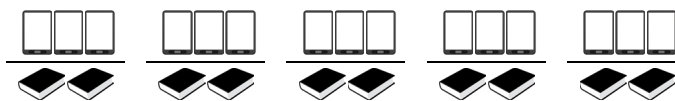
Part-to-Part versus Part-to-Whole

A ratio is a comparison of two things at a time. Because the orange juice activity involves three amounts—water, concentrate, and the resulting juice mixture—students need to stay focused on the two items they are comparing each time. In this lesson, the part-to-part ratio is the central idea.

However, in any situation where a whole is made of parts, usually several ratios are of interest. Consider, for example, a class with an enrollment of 25 students, 10 of whom prefer paper books to e-readers. These are part-to-part ratios. For example, the students preferring books:students preferring e-readers ratio can be expressed as 10 to 15, or 2:3.



Or the e-reader:book ratio can be expressed as 15 to 10, or 3:2.



There are **part-to-whole** (part:whole) **ratios**. For example, the ratio of students who prefer books: total students can be expressed as 10 to 25, 10 out of 25, or 2:5.



Or the ratio of students who prefer e-readers: total students can be expressed as 15 to 25, or 3:5.



Part/whole ratios are consistent with the common model for fractions and percents, where the numerator is a part and the denominator is the whole ($\frac{3}{5}$ prefer e-readers and $\frac{2}{5}$ prefer books).

This presents some puzzles. First, why do we use $\frac{2}{3}$ when comparing part to part and $\frac{2}{5}$ when comparing part to whole? This will be further explored in *Lesson 4: Another Way to Say It*.

Secondly, in the part-to-part model, the fractions do not “act” the same as they do in the part-to-whole model. It would make sense to add: $\frac{2}{5}$ (the book reader component) + $\frac{3}{5}$ (the e-reader component) = $\frac{5}{5}$ (the whole class). But it does not make sense in this case to add $\frac{2}{3}$ (the ratio of students who prefer books to those who prefer e-readers) + $\frac{3}{2}$ (the ratio of students who prefer e-readers to those who prefer books).

Using Friendly Fractions

The relative difficulty of the numbers affects how easily ratios can be seen. That is why this unit begins with small whole numbers. However, in this lesson, students are expected to be comfortable handling common fractions such as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{3}$, and $\frac{1}{8}$ (called “benchmarks” in the units *Using Benchmarks* and *Split It Up*). Students are not only asked to consider scaling up by factors of 2, 3, and 10, but are also presented with situations where they need to multiply a recipe by $1\frac{1}{2}$. They might also triple a recipe that starts out with $2\frac{1}{2}$ cups of an amount. Students who have covered the work in the earlier units should be able to do these problems in their heads and support their reasoning with diagrams. It is not necessary to know the arithmetic algorithms for fraction operations.

Context

Recipes are used here as a context for proportional reasoning; proper proportions are everything when it comes to how food tastes and the quality of such things as baked goods. However, written recipes with standard cooking units are not always used. Be sure to acknowledge that many good cooks rarely use written recipes and that recipes may be more common for baked goods. Also note that it is sometimes difficult to imagine the ratios in mixtures such as orange juice because everything is mixed together. The ratios cannot be empirically proved because one cannot physically separate the concentrate from the water once everything has been mixed together.

Facilitation

Allow students plenty of time to explore and make predictions. Students often begin to gain a more positive attitude about math when they see how it relates to their own lives and how it can be fun. Connecting math to the sense of taste can be a rewarding experience if they are allowed to explore.

One student commented at the end of this lesson, “I feel much more comfortable tackling math problems. I’m having fun, and now I see ratios everywhere. I really like these lessons—the fact that we’re focusing on different senses.”

Making the Lesson Easier

If students have predicted the amounts using fractions (such as a $\frac{1}{2}$ cup of water), encourage them to change the amounts to fluid ounces. This will allow them to work with whole numbers rather than fractional parts.

Because it is difficult to “see” the individual ingredients in the orange juice mixture, you might want to begin with a different recipe. A trail mix, fruit salad, or bean salad is an alternative way to help students see the implication for changes in ratios.

Making the Lesson Harder

Challenge students to think proportionately without numbers—in other words, qualitatively rather than quantitatively. Assign *Extension: Reasoning with Ratios* (*Student Book*, p. 44).

Alternatively, ask students to compare the two recipes (*Blackline Masters 4 and 5*) and come up with yet another way to arrive at the three mixtures in the ratios of 3:1, 1:1, and 7:1. There is more than one way to produce juice mixtures of these strengths.

LESSON 3 IN ACTION

These are the predictions from one group of taste testers when we piloted this activity.

Taste of A	Taste of B	Taste of C
sour not bad medium—tastes like airplane OJ bland normal	very thick	tasteless, watery mostly water watery
What might the ratio of water to concentrate be?		
3 to 1 3 to 1 4 to 1 3 to 1 3 to 1	1 to 1 1 to 2 2 to 1 1/2 to 1/2 1 to 1	10 to 1 6 to 1 6 to 1 8 to 1 5 to 1

*Mary Jane Schmitt
TERC, Cambridge, Massachusetts*

Students entered into the discussion with gusto; however, keeping track of the three amounts—the concentrate, the water, and the mixture—was sometimes a challenge.

Three students were in class that day, so I only used one large can of orange juice concentrate. This got me, the teacher, thinking proportionately right from the start while preparing to teach this lesson. I divided the concentrate into three equal parts, which gave me 4 fl. oz. per mixture.

Recipe A	Recipe B	Recipe C
Concentrate: 4 fl. oz.	Concentrate: 4 fl. oz.	Concentrate: 4 fl. oz.
Water: 12 fl. oz.	Water: 4 fl. oz.	Water: 28 fl. oz.

After everyone taste-tested, we captured the predictions on chart paper. The students all used $\frac{1}{3}$ of the can of concentrate as a basis for comparison because they knew that I had used only one can and created three mixtures.

Mixture	Betty	Laura	Terri
A	1/3 can concentrate to 1 can water	1/3 can concentrate to 2/3 can water	1/3 can concentrate to 1/3 can water
B	1/3 can concentrate to 1/2 can water	1/3 can concentrate to 1/3 can water	1/3 can concentrate to 1/12 can water
C	1/3 can concentrate to 11/2 can water	1/3 can concentrate to 1 (3/3) can water	1/3 can concentrate to 2/3 can water

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Because everyone used fractions to make their predictions, I intentionally used fluid ounces to share the actual comparisons. I wanted to challenge the students to link the fluid-ounce ratios to their ratios as fractions.

After sharing the recipe where Mixture A had a ratio of 4 fl. oz. of concentrate to 12 fl. oz. of water, I asked whether either of the predictions they chose was correct. A lively discussion ensued, with Terri quite articulate in explaining why both her answer ($\frac{1}{3}$ to $\frac{1}{3}$) and Betty's ($\frac{1}{3}$ to 1) were correct. She went into detailed explanation about the fact that the entire can held 12 fl. oz., so $\frac{1}{3}$ of that was 4 fl. oz., providing a drawing to support her viewpoint. She then explained that the correct mixture used three cans of water, or 36 fl. oz. She stated, "Betty is right because one can of water would represent 12 fl. oz., and I'm right because $\frac{1}{3}$ of 36 is 12." After a great deal of discussion, I think she finally realized that what she was comparing and what she was being asked to compare were two different things. Her thinking was correct—but *not* for the question posed.

Everyone agreed that Mixture B was pretty thick, that I had probably added too much concentrate or too little water. I showed them the ratio of 4 fl. oz. concentrate/4 fl. oz. water and then asked them whether either of the predictions was correct. Although Laura's answer was right, Terri had used the same logic she had used earlier, so her reasoning was actually quite sound (although incorrect, given the items being compared). When she was working on her prediction, she had asked me what half of $\frac{1}{3}$ was. I asked her what $\frac{1}{2}$ of a $\frac{1}{2}$ was, then $\frac{1}{2}$ of a $\frac{1}{4}$. In each instance, she was able to give me the correct response. I then asked what $\frac{1}{2}$ of $\frac{1}{3}$ was. She tentatively replied, "One-sixth." Once I let her know that she was right, she figured out that $\frac{1}{2}$ of $\frac{1}{6}$ was $\frac{1}{12}$. (One-twelfth of 36 fl. oz. is 3 fl. oz., which is what she had reasoned was the amount of water in Mixture B.)

For Mixture C, everyone agreed that the mixture was very watery, but no one was able to accurately predict just how much water there was. I put on the board the ratio "4 oz. concentrate/28 oz. water." Terri explained her thinking again ($\frac{2}{3}$ to her represented $\frac{2}{3}$ of 36, which would be 24 fl. oz.—close). We then talked about how much of the total amount of water needed 28 fl. oz. represented. Terri drew a picture:



She then said, "28 is two whole cans of water (12 fl. oz. each) and four more of the 12-oz. can, which reduces to $\frac{1}{3}$."

*Donna Curry
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Keeping Things in Proportion

Reasoning with Ratios



STUDENT BOOK

LESSON 3



Tasty Ratios

What do ratios have to do with taste?

You can adjust a recipe to make a larger or smaller amount of food than the original recipe produces. When you change the amounts of ingredients in a recipe, it is important that you keep the ratios the same. If not, you may find that what you have created does not taste good or have the right texture.

pancakes

INGREDIENTS

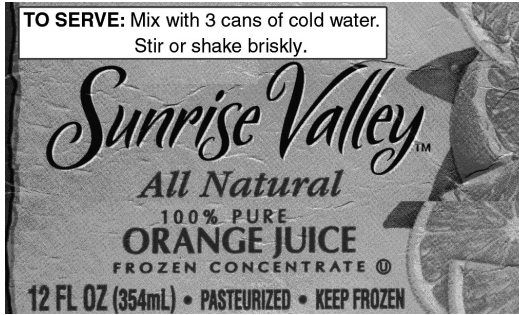
1 $\frac{1}{4}$ cups of sifted flour	1 tablespoon of baking powder
$\frac{1}{2}$ teaspoon of baking soda	4 teaspoons of sugar
1 egg, beaten	1 $\frac{1}{2}$ cup of buttermilk
2 tablespoons of melted butter	

In this lesson, you will use your senses (taste and sight) to guess the ratios of ingredients in orange juice **mixtures**. You will also use diagrams and the property of equal fractions to show how the ingredients are (or are not) in proportion.

Photo by Kampus Production from Pexels



Activity 1: Orange Juice Taste Test



Here is the label from the can used to make the orange juice. Describe how each of the orange juice mixtures tastes and looks. What do you imagine the ratio of water to frozen **concentrate** is in each mixture?

Mixture A

- 1a. Describe the taste.
- b. Describe the look.
- c. What do you think the ratio of water to concentrate might be?

Mixture B

- 2a. Describe the taste.
- b. Describe the look.
- c. What do you think the ratio of water to concentrate might be?

Mixture C

- 3a. Describe the taste.
- b. Describe the look.
- c. What do think the ratio of water to concentrate might be?



Activity 2: “Doctoring” the Orange Juice

Look at the recipes that were used to make the three orange juice mixtures.

For each mixture, write the actual ratio of water to frozen concentrate.

Now that you know the actual ingredients, how would you change, or “doctor,” Mixture B and Mixture C to taste like Mixture A without throwing any away?

Mixture	Actual Ratio of Water to Concentrate	How I Would “Doctor” the Mixture So It Tastes Like Mixture A
A		
B		
C		



Practice: How Does It Taste?

Look at the following proportions of ingredients in recipes. Place a check mark beside the description of how the adjusted recipe might turn out based on its new ratio.

c. = cup
tsp. = teaspoon
T. = tablespoon

1. *The Original Recipe*

The Adjusted Version

2 c. rice to 1 tsp. salt

4 c. rice to 4 tsp. salt

Too salty? _____ Just right? _____ Not salty enough? _____

2. *The Original Recipe*

The Adjusted Version

18 c. bread cubes to 3 eggs

6 c. bread cubes to 1 egg

Too dry? _____ Just right? _____ Too wet? _____

3. *The Original Recipe*

The Adjusted Version

2 T. lime juice to 3 T. sugar

6 T. lime juice to 6 T. sugar

Too sweet? _____ Just right? _____ Too sour? _____

4. *The Original Recipe*

The Adjusted Version

2 c. flour to $1\frac{1}{2}$ c. water

5 c. flour to 3 c. water

Too dry? _____ Just right? _____ Too watery? _____

5. *The Original Recipe*

The Adjusted Version

$\frac{3}{4}$ c. vinegar to 2 c. oil

$1\frac{1}{2}$ c. vinegar to $3\frac{1}{2}$ c. oil

Too oily? _____ Just right? _____ Too vinegary? _____



Practice: Lemonade for the Party



- 1a. How many cans of water are needed for each can of concentrate to make lemonade?
 - b. If you plan to serve each person 8 fl. oz. (1 cup), how many servings does a single can make?
 - c. What is the ratio of water to frozen lemonade concentrate?
_____ water to _____ lemonade concentrate
- 2a. You have invited 15 people to the party. How many cans of frozen concentrate would you need to buy for the party?
 - b. How much water would you need to add in all?
 - c. How much lemonade would you have?
3. If you were adding ice cubes that would melt over time, what adjustments would you make to the recipe?



Practice: Building a Set of Equal Ratios

Create a set of ratios that are equal to the first one.

Example:

$$\frac{1}{3} = \frac{5}{15} = \frac{10}{30} = \frac{50}{150} = \frac{100}{300}$$

$$1. \quad \frac{2}{5} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \frac{60}{150}$$

$$2. \quad \frac{1}{4} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \frac{200}{\hspace{1cm}}$$

$$3. \quad \frac{3}{4} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \frac{90}{\hspace{1cm}}$$

$$4. \quad \frac{4}{5} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \frac{120}{\hspace{1cm}}$$



Practice: Popcorn Party Mix

The recipe below makes about $2\frac{1}{2}$ quarts of party mix. How much of each ingredient would be needed for a triple batch?

1. Complete the following chart and then look at what happens to each of the numbers when you triple the amount.

Original Recipe	Triple the Recipe	Show How You Did It
2 qt. popcorn		
1 c. pretzels		
$1\frac{1}{2}$ c. cheese curls		
$\frac{3}{4}$ c. salted peanuts		
$\frac{1}{4}$ c. butter		
1 T. Worcestershire sauce		
$\frac{1}{2}$ tsp. garlic salt		

2. If the original recipe makes about $2\frac{1}{2}$ quarts of party mix, how many quarts would there be if you tripled the recipe?

Original Recipe	Triple the Recipe	Show How You Did It
$2\frac{1}{2}$ qt. party mix		

3. How does the amount of butter in the new recipe compare to the total amount of party mix in the new recipe? Show that the ratio is the same as in the original recipe.



Practice: Dressing It Up

Below are the basic ingredients for creamy garlic dressing.

- 1 c. mayonnaise
- 3 T. milk
- 2 T. cider vinegar
- 1 garlic clove

1a. Triple the recipe.

- _____ c. mayonnaise
- _____ T. milk
- _____ T. cider vinegar
- _____ garlic cloves

b. What is the ratio of mayonnaise to milk in the original recipe?

c. What is the ratio of mayonnaise to milk in the new recipe?

2a. Quadruple the original recipe.

- _____ c. mayonnaise
- _____ T. milk
- _____ T. cider vinegar
- _____ garlic cloves

b. What is the ratio of milk to vinegar in the original recipe?

c. What is the ratio of milk to vinegar in the quadrupled recipe?



Practice: Doctor This

Following are three stories about individuals who have problems with their recipes. Think about how you can help them to readjust their ingredients so that everything is still in balance.

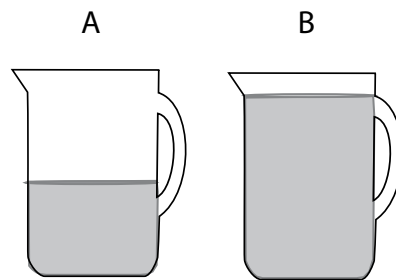
1. A recipe for a cake uses half a stick of butter and two eggs. Ingram was distracted and beat in 1 stick of butter and 3 eggs.
 - a. What should he do now to fix the proportions of the ingredients?
 - b. How will he have to adjust the remaining ingredients?
 - c. How many cakes will he end up making?
2. A brownie recipe calls for 2 cups of sugar and 3 cups of flour. Alexis discovers that he only has 1 cup of sugar.
 - a. How could he adjust the recipe to keep the ingredients in balance?
 - b. How will he have to adjust the remaining ingredients?
3. A recipe that makes 5 dozen cookies uses 3 eggs and 6 cups of flour. Kedian only has 2 eggs.
 - a. How could she adjust the recipe to keep the ingredients in proportion?
 - b. What will she have to do with the remaining ingredients?
 - c. About how many cookies will she end up making?



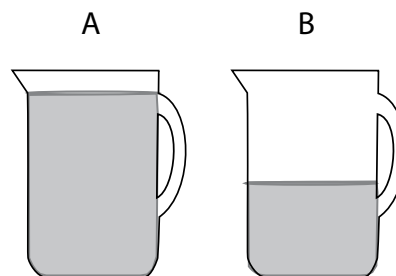
Extension: Reasoning with Ratios

You can make punch with strawberry syrup and water.

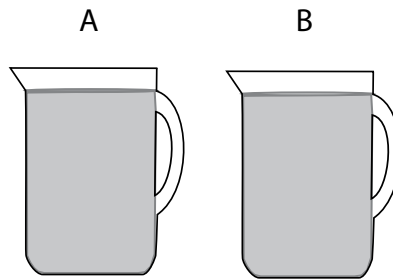
1. Pitcher A contains punch that has a stronger strawberry taste than the punch in Pitcher B. If one cup of strawberry syrup is added to Pitcher A and one cup of water is added to pitcher B, which pitcher will contain the punch with the stronger strawberry taste? Explain your reasoning.



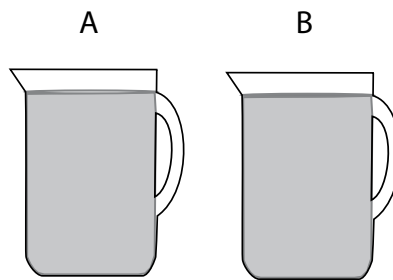
2. The punch in both Pitchers A and B has the same taste. If one cup of strawberry syrup is added to each pitcher, which pitcher will contain the punch with the stronger strawberry taste? Explain your reasoning.



3. Pitcher A contains punch with a stronger strawberry taste. If one cup of strawberry syrup is added to both pitchers, which pitcher will contain the punch with the stronger strawberry taste? Explain your reasoning.



4. Pitcher B contains punch with the stronger strawberry taste. If one cup of syrup is added to Pitcher A and one cup of water is added to Pitcher B, which pitcher will contain the punch with the stronger strawberry taste? Explain your reasoning.





Test Practice

1. A recipe calls for 2 cups of sugar to $\frac{1}{2}$ cup of lime juice. How much lime juice should be added if the new recipe uses 6 cups of sugar?
 - (1) 1 cup
 - (2) $1\frac{1}{2}$ cups
 - (3) 2 cups
 - (4) $2\frac{1}{2}$ cups
 - (5) 3 cups
2. A recipe uses $\frac{1}{2}$ cup of vinegar to $\frac{3}{4}$ cup of oil. How much vinegar should be added if the new recipe uses $1\frac{1}{2}$ cups of oil?
 - (1) $\frac{1}{4}$ cup
 - (2) $\frac{1}{2}$ cup
 - (3) $\frac{3}{4}$ cup
 - (4) 1 cup
 - (5) $1\frac{1}{2}$ cups
3. A recipe calls for 3 potatoes to serve 4 people. If Jacques is planning to serve a crowd of 20 people, how many potatoes should he use?
 - (1) 7 potatoes
 - (2) 12 potatoes
 - (3) 15 potatoes
 - (4) 60 potatoes
 - (5) 80 potatoes
4. A family recipe uses for 3 cups of water to serve 8 people. If Shaina is planning to serve 4 people, how many cups of water should she use?
 - (1) 1 cups
 - (2) $1\frac{1}{2}$ cups
 - (3) 2 cups
 - (4) 7 cups
 - (5) 12 cups
5. A party punch calls for 6 oz. of concentrate to 5 cups of water. If you only have 3 oz. of concentrate, how much water should you use?
 - (1) 2 cups
 - (2) $2\frac{1}{2}$ cups
 - (3) 3 cups
 - (4) $3\frac{1}{2}$ cups
 - (5) 4 cups
6. A muffin recipe uses 3 tsp. of baking powder to $\frac{1}{3}$ cup sugar. How many cups of sugar would be needed to triple the recipe?