

POSTER PROBLEMS



The Intensity of Chocolate Milk

Sixth Grade Poster Problem

Ratios and Proportional Relationships

This problem is designed to help students use ratio language and concepts by focusing on a single compelling problem context – making chocolate milk. Questions in this problem use both part-to-part ratios and part-to-whole ratios.

Learning Objectives:

- Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.
- Use ratio and rate reasoning to solve real-world and mathematical problems.

Common Core State Standards for Mathematics:

[6.RP.A.1 and 3](#)

Teacher Tune Up:

- [What's the difference between a ratio and a fraction, and why should I care?](#)

The way this works: one lesson in six phases

LAUNCH

Teachers set the stage by leading an introductory discussion that orients students to the context of the problem.

POSE A PROBLEM

Teachers introduce a mathematical way of thinking about the context and engage students in a preliminary approach that opens the door to the workshop phase.

WORKSHOP

The workshop starts with a more challenging and more open-ended extension of the problem. In teams, students plan and produce mathematical posters to communicate their work.

POST, SHARE, COMMENT

Teams display their posters in the classroom, get to know other teams' posters, and attach questions/comments by way of small adhesive notes (or similar).

STRATEGIC TEACHER-LED DISCUSSION

Teachers then compare, contrast, and connect several posters. In the process they highlight a progression from a more basic approach to a more generalizable one. In doing so, teachers emphasize standards-aligned mathematics using student-generated examples.

FOCUS PROBLEM: SAME CONCEPT IN A NEW CONTEXT

Serving as a check for understanding, this more focused problem gives teachers evidence of student understanding.

Day 1

FLEXIBLE

Day 2

I. LAUNCH

Directions for teacher:

Show **Slide #1**.

Ask students: "Have you ever made chocolate milk at home? How did you do it?" Allow one or two students to describe how they make chocolate milk by mixing the chocolate syrup and milk.

Engage students in a discussion about making chocolate milk. Lead the discussion to elicit ideas about the following.

- Different ways of making chocolate milk that result in more or less "chocolaty" final product
- Amount of milk or chocolate syrup used

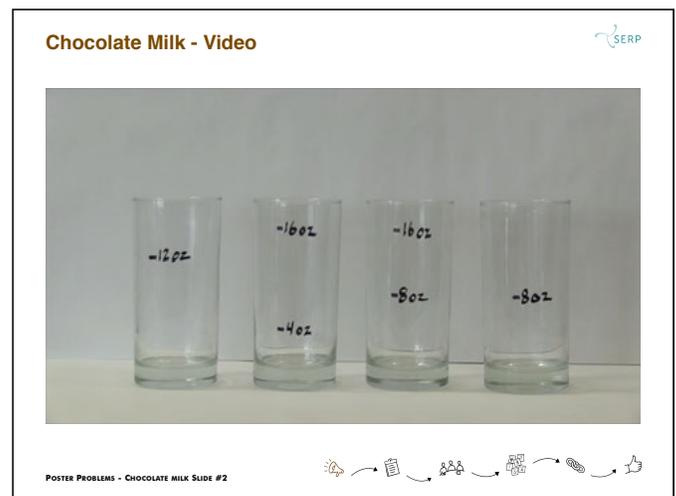


Slide #1

Tell students that they are about to watch a video showing two different recipes used to make chocolate milk.

Before you start the video, set up the discussion that will follow by asking:

- How are these recipes the same?
- How are they different?
- Which is better?



Slide #2

2. POSE A PROBLEM

Directions for teacher:

Show **Slide #3**.

We know that the main ingredients of chocolate milk are chocolate syrup and milk. But how much of each ingredient should you use? Steven is an “expert” at making chocolate milk that he thinks is “just right.”

Discuss Steven's recipe.

Show **Slide #4** as you ask these questions and check the appropriate boxes to highlight the parts and whole.

Ask students:

- What are the parts in Steven's recipe? **Answer: chocolate syrup, milk**
- What is the whole? **Answer: chocolate milk**

Ask students:

- Does Steven's recipe tell you exactly how much (quantities) chocolate syrup and milk to use? **Answer: No, it gives the ratio of the two ingredients**
- Can you use Steven's recipe to make a single glass of chocolate milk? **Answer: Yes**
- Could you use this recipe to make enough for all of the students at your school? **Answer: Yes**

Show **Slide #5**.

Ask students:

- Is Steven's recipe more intense, less intense, or the same as the two recipes from the video? **Answer: Steven's recipe is more intense than the recipe on the left side of the video, but less intense than the recipe on the right**

Steven's Award Winning Chocolate Milk Recipe 

Mix:

1 part Chocolate Syrup 

2 parts Ice Cold Milk 

POSTER PROBLEMS - CHOCOLATE MILK SLIDE #3 

Slide #3

What are the parts in Steven's recipe? What is the whole? 

Chocolate Milk part whole

Milk part whole

Syrup part whole

POSTER PROBLEMS - CHOCOLATE MILK SLIDE #4 

Slide #4

How does Steven's recipe compare to these two recipes? 



4 oz

8 oz

POSTER PROBLEMS - CHOCOLATE MILK SLIDE #5 

Slide #5



2. POSE A PROBLEM, CONT.

Directions for teacher:

Distribute **Handout #1**.

Answers to Handout #1:

1)

Chocolate Syrup **4 oz**

Milk **8 oz**

Chocolate Milk **12 oz**

Ratio of Chocolate Syrup to Milk **4:8 = 1:2**

Ratio of Chocolate Syrup to Chocolate Milk **4:12 = 1:3**

Ratio of Milk to Chocolate Milk **8:12 = 2:3**

2)

Chocolate Syrup **1/2 quart**

Milk **1 quart**

Chocolate Milk **1 1/2 quart**

Ratio of Chocolate Syrup to Milk **1/2 : 1 = 1:2**

Ratio of Chocolate Syrup to Chocolate Milk **1/2 : 1 1/2 = 1:3**

Ratio of Milk to Chocolate Milk **1 : 1 1/2 = 2:3**

3)

Chocolate Syrup **2 gallons**

Milk **4 gallons**

Chocolate Milk **6 gallons**

Ratio of Chocolate Syrup to Milk **2:4 = 1:2**

Ratio of Chocolate Syrup to Chocolate Milk **2:6 = 1:3**

Ratio of Milk to Chocolate Milk **4:6 = 2:3**

What parts of this table always stay the same? Why do they stay the same? **The simplified ratios of chocolate syrup: milk, syrup: chocolate milk, and milk : chocolate syrup all stay the same. This is true because each time we follow Steven's recipe, we vary the amounts of each ingredient, but the ratios remains the same.**

Student Name: _____

The Intensity of Chocolate Milk

Steven's Recipe - Handout 1

Steven's Award Winning Chocolate Milk Recipe

Instructions

Steven made chocolate milk three times this week. He always followed his recipe, but changed the amount of chocolate milk. The first time he used 4 ounces of syrup. The second time he used 1 quart of milk. The third time (for the party) he made a total of 6 gallons of chocolate milk. Complete the table for the missing parts.

Mix:
1 part chocolate syrup
2 parts cold milk

Steven's Recipe

	Chocolate Syrup	Milk	Chocolate Milk	Ratio Syrup: Milk	Ratio Syrup: Chocolate Milk	Ratio Milk: Chocolate Milk
1	4 oz					
2		1 quart				
3			6 gallons			

Work Area

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Handout #1

3. WORKSHOP

Directions for teacher:

Show **Slide #6**.

Tell students:

In this workshop, your group will create a recipe for chocolate milk - you can choose the intensity. The intensity of your recipe should be different from Steven's.

You will then make a poster that describes how much chocolate syrup and how much milk to use for three different situations.

For Situation A and Situation B, use the same recipe. Situation C asks you to modify your recipe for someone who likes less intense chocolate milk.

Situation A: Chocolate milk for just yourself: Use your recipe to make one 8-ounce glass of chocolate milk.

Situation B: Chocolate milk for a group: Use your recipe to make four 6-ounce glasses chocolate milk.

Situation C: Lastly, answer the following question: your grandma likes very weak (not intense) chocolate milk. How would you change your recipe to make a glass of chocolate milk for your grandma? Show how you would change your recipe to make 8 ounces of chocolate milk for your grandma.

Distribute **Handout #2**.

Tell students:

After you choose your recipe, make a poster.

Your poster should include mathematical representations (mathematical drawings, diagrams, tables, equations, or graphs) to show how you used your recipe in each situation. Include both the ratio of chocolate syrup and milk, and the number of ounces of each ingredient for your recipe. Show all your steps and consider your quantities carefully—some numbers will be easier to with than others.

SERP

Create Your Own Chocolate Milk Recipe

Chocolate milk for just yourself.
Use your recipe to make one 8-ounce glass of chocolate milk.

Situation A

Chocolate milk for a group.
Use your recipe to make four 6-ounce glasses of chocolate milk.

Situation B

Chocolate milk for your grandma.
She likes very weak (not intense) chocolate milk. Change your recipe to make an 8-ounce glass of chocolate milk for your grandma.

Situation C

POSTER PROBLEMS - CHOCOLATE MILK SLIDE #6

Slide #6

Student Name: _____

The Intensity of Chocolate Milk

Create your own Recipe - Handout 2

Instructions

Create your own recipe for chocolate milk with your group-mates. The intensity of your recipe should be different from Steven's recipe.

Recipe A:
Chocolate milk for just yourself.
Use your recipe to make one 8-ounce glass of chocolate milk.

Recipe B:
Chocolate milk for a group.
Use your recipe to make four 6-ounce glasses of chocolate milk.

Recipe C:
Chocolate milk for your grandma.
She likes very weak (not intense) chocolate milk. Change your recipe to make an 8-ounce glass of chocolate milk for your grandma.

Recipe A	Recipe B	Recipe C

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Handout #2



4. POST, SHARE, COMMENT

Directions for teacher:

Have students post their posters around the classroom.

Encourage students to travel around to view the posters created by other groups. Students should be encouraged to write questions for other groups by attaching a small adhesive notes.

During this time, teachers should be reviewing all the posters and considering which to highlight to **Phase 5**.

Sample Posters:

Poster A shows a group whose recipe was 2 parts chocolate syrup to 6 parts milk. These numbers are “friendly” because the parts add to 8. The group’s poster shows a bar diagram for each situation. This representation is very useful for showing how the ratio is constant even as the recipe “scales” up and down.

Poster B shows the work of a group whose recipe was 1 part chocolate syrup and 7 parts milk. That ratio works easily for the 8-ounce glass, but the group had to do some calculations for the four 6-ounce glasses. The 1:7 ratio is not “friendly” for a whole of 6 ounces. However, it does scale up nicely for the total of $4 \times 6 = 24$ ounces.

Poster C used a ratio of 3:2 (VERY intense chocolate milk!). The numbers in this ratio are more difficult to work with because the whole is 5 parts. The totals of 8 or 24 are not evenly divisible by 5, so you cannot use additive solutions like in Poster 1. These students used a ratio table to tame this ratio.

Chocolate Milk A

2 parts chocolate
6 parts Milk Ratio: 2:6
 or
 1:3

a) 8 oz
The big 8 oz, 2 oz, 6 oz, 12 oz, 18 oz

Recipe for 1 glass
2 oz of chocolate syrup
6 oz of Milk

b) 24 oz
6 oz 3x6 = 18 oz 6 oz + 18 oz = 24 oz total

Recipe for 4 glasses (24 oz total)
6 oz chocolate
18 oz Milk

c) Grandma would want less chocolate in her chocolate milk. Her recipe would use less than 2 oz of chocolate syrup.

Chocolate Milk B

1 part chocolate syrup
7 parts Milk
 1:7

a) 8 oz
7 oz Milk 8 parts total
1 oz choc Syrup 1 part chocolate + 7 parts Milk = 8 parts of chocolate Milk

b) 6 oz 6 oz 6 oz 6 oz
3 parts 24 oz + 6
 24 oz total

Recipe
3 oz chocolate
21 oz Milk

c) Grandma would want less chocolate in her chocolate milk. Her recipe would use less than 1 oz of chocolate syrup.

C

Our Recipe: 3 parts chocolate syrup and 2 parts milk

Situation A

	Syrup	Milk	Total
ratio	3	2	5
total ounces	$3 \times 1.6 = 4.8$	$2 \times 1.6 = 3.2$	8

Situation B

	Syrup	Milk	Total
ratio	3	2	5
total ounces	$3 \times 1.6 = 4.8$	$2 \times 4.8 = 9.6$	24

x 1.6 x 4.8

Situation C
Since Grandma likes weak chocolate milk, we will reverse the recipe: 2 parts syrup to 3 parts milk

5. STRATEGIC TEACHER-LED DISCUSSION

Directions for teacher:

Facilitate a discussion that uses the students' work to highlight some critical mathematical concepts and the representations that can be used. Here we have gathered three possible samples of student work, showing different levels of sophistication. Some students who pick "unfriendly" numbers will struggle. Rather than hide this difficulty, take the time to show students examples that didn't work perfectly, and why.

What to look for when choosing numbers for the ratios:

Situations A and B are easier to solve when the parts in the ratio add to 2, 4, or 8. Some students may figure this out and intentionally choose numbers that make the computations easy. Choosing numbers that simplify calculations (when that is an option) is an important practice to highlight. Here is how some easy ratios will scale for Situation A.

1:3 → 2 oz chocolate and 6 oz milk

1:1 → 4 oz chocolate and 4 oz milk

3:5 → 3 oz chocolate and 5 oz milk

Solving for the number of ounces is much more challenging when the parts in the ratio do not add to 2, 4, or 8. For example, if the ratio is 2:3 then you have to multiply each part by $\frac{8}{5}$ to make a total of 8 ounces of chocolate milk.

The results are:

2:3 → $16/5 = 3.2$ oz chocolate and $24/5 = 4.8$ oz milk (see sample poster 3).

What to look for in terms of diagrams:

The types of diagrams will also be uneven in their level of sophistication. The least sophisticated diagrams do not use a scale. More sophisticated diagrams might not even look like cups anymore, but will preserve the relative sizes of the parts.

Least sophisticated: Drawings of cups not to scale

More sophisticated: Diagrams correctly showing proportions

Most sophisticated: Stacked bar graphs showing part:part or part:whole (as in Poster A)

What to look for in terms of solution strategies:

Less sophisticated: Repeated adding

More sophisticated: Scaling

Most sophisticated: Setting up equations and solving. But check for understanding; some students get good at symbols but lose their connection to the situation.

6. FOCUS PROBLEM: SAME CONCEPT IN A NEW CONTEXT

Directions for teacher:

Distribute **Handout #3**.

The Focus Problem challenges students to use the ratio reasoning developed in "The Intensity of Chocolate Milk" to solve a problem involving a ratio with four parts.

Answers to Handout #3:

1. orange : pear **3:4**
2. pineapple : grape **6:3 = 2:1**
3. fraction of pear in fruit salad = $\frac{4}{16} = \frac{1}{4}$
4. 2 lbs of fruit salad requires: **$\frac{1}{2}$ lb pears, $\frac{3}{8}$ lb oranges, $\frac{3}{4}$ lb pineapple and $\frac{3}{8}$ lb grapes**
5. With only 1 lb grapes, you need: **1 $\frac{1}{3}$ lbs pears, 2 lbs pineapple, and 1 lb oranges**

Student Name: _____

The Intensity of Chocolate Milk

From Chocolate Milk to Fruit Salad - Handout **3**

The Seesaw County Fair: Award-Winning Fruit Salad

Instructions

Felicia made the winning fruit salad at the Seesaw County Fair. In her recipe, she used 4 pounds of pear, 3 pounds of grapes, 6 pounds of pineapple, and 3 pounds of orange. Answer the following questions using Felicia's winning fruit salad recipe.



1. What is the ratio of orange to pear?
2. What is the ratio of pineapple to grape?
3. What fraction of the fruit salad is pear?
4. Jorge wants to bring 2 pounds total of this fruit salad to a potluck dinner. How much of each ingredient should he use?
5. Shawna only has 1 pound of grapes. How much of the other ingredients should she use?

Work Area

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Handout #3