

Homework 4

Read: page 18 (the section on a ratio as a multiplicative comparison) from the Lobato and Ellis book. Then skip to the Reflect 1.3 task on page 20; this time solving it on your own using multiplicative comparison reasoning. Then read page 20 and Figure 1.11 on page 21 for a solution.

Answer the following questions. Do **NOT** include your response to Question 2 when you submit the assignment; instead check your work against the sample drawing and response included at the end of this document.

1. In your own words, define or characterize what it means to form a ratio as a multiplicative comparison. Provide an example.
- 2-4. Solve each of following problems by reasoning with **multiplicative comparisons**. Create a **drawing** that you think would be appropriate to use with middle school students. **Explain** your thinking and the drawing in a way that you think would be effective with students. Think like a teacher. Don't use the proportion algorithm or any calculations, such as reducing fractions. If you do perform a calculation, it needs to be shown in the drawing. *Be careful not to fall into the use of composed unit reasoning. If you find a unit ratio, you likely have used a composed unit.*

2. A salad dressing recipe calls for 2 tablespoons of vinegar and 5 tablespoons of oil. If you want to make the recipe using 7 tablespoons of vinegar, how much oil should you use?

Solve this problem using a multiplicative comparison of **the amount of oil to the amount of vinegar**. Show in a **drawing** how many times more oil there is than vinegar. Then use this multiplicative comparison to make another drawing to solve the problem. Create well-labeled drawings. **Explain** your thinking.

[After you are done, check your work against the sample response at the end of this assignment.]

3. A salad dressing recipe calls for 3 tablespoons of vinegar and 10 tablespoons of oil. If you want to make the recipe using 12 tablespoons of vinegar, how much oil should you use?

Solve this problem using a multiplicative comparison of **the amount of oil to the amount of vinegar**. Show in a **drawing** how many times more oil there is than vinegar. Then use this multiplicative comparison to make another drawing to solve the problem. Create well-labeled drawings. **Explain** your thinking.


4. Reconsider the monkey chow situation from Homework 3. The zookeeper would like to make a larger batch of monkey chow that will taste the same as the original batch (of 4 cups of pumpkin and 9 cups of oatmeal). If she uses 10 cups of pumpkin, how much oatmeal should she use?

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Solve this problem using a multiplicative comparison of **oatmeal to pumpkin**. Show in a **drawing** how many times more oatmeal there is than pumpkin in the original recipe. Then use this multiplicative comparison to make another drawing to solve the problem. Create well-labeled drawings. **Explain** your thinking.

5. *Analyzing Student Reasoning: Manuel*

Below you will read what a Grade 7 student—Manuel—said in response to the following math task, when he was interviewed by a researcher:



Time in minutes	Amount of Water in gallons
0	0
3	6
5	10
9	18

Water is being pumped through a hose into a large swimming pool. The table shows the amount of water in the pool over time.

Do you think the water is being pumped equally fast over time or is it being pumped faster at certain times

Identify which type of reasoning Manuel is using: (a) univariate reasoning; (b) additive reasoning; (c) composed unit reasoning; or (d) multiplicative comparison reasoning. **Explain** how you know.

Manuel: Um, equally fast.
Interviewer: How do you know that?
Manuel: Because from 3 minutes to 5 minutes, it's going to raise up 2. From 6 gallons to 10 gallons, it's going to raise up 4. So the minutes is 2 and the gallons is 4. So every minute, it's going 2 gallons, right?
Interviewer: That's interesting
Manuel: So it would be 1 minute, there's 2 gallons. They didn't show you 1 minute, but that would equal 2. And then 2 minutes, that would equal 4 gallons. And 3 minutes, 6 gallons. 4 minutes, 8 gallons. 5 minutes, 10 gallons.


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6. Analyzing Student Reasoning: Wade

Below you will read what a Grade 7 student—Wade—said in response to the following math task, when he was interviewed by a researcher:

In the table below there are four batches of orange juice. Batch A is the same one you have been working with.

Batch	Cups of orange juice concentrate	Cups of water
A	2	3
B	8	12
C	4	6
D	14	21



Are these batches equally orangey or will one of them taste orangier or more watery than another one?

Identify which type of reasoning Wade is using: (a) univariate reasoning; (b) additive reasoning; (c) composed unit reasoning; or (d) multiplicative comparison reasoning. **Explain** how you know.

Interviewer: Okay, now are these batches equally orangey or does one of them taste orangier or more watery than another one?

Wade: I think they're equally orangey, because this one [points to the 8] is two-thirds of this number [points to the 12], so 8 out of 12 is two-thirds. Same with 4 out of 6 and 14 out of 21

Interviewer: How did you know that is 14 two-thirds of 21? Can you do that in your head?

Wade: Yeah, I just used, I just know that 7 times 2 is 14 so 7 must be multiplied, but 7 times 3 is 21.

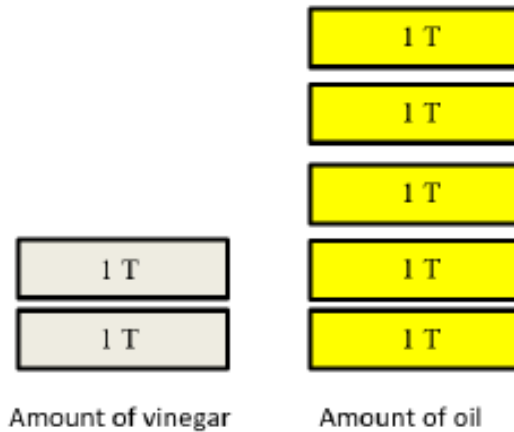
Interviewer: Hmm, that's really interesting. Okay so these are all equally orangey?

Wade: Uh huh

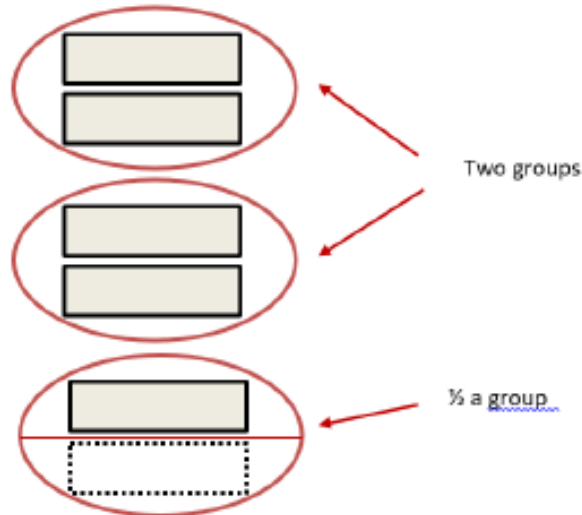
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Sample Response to Question 2

The salad dressing recipe calls for 2 tablespoons (T) of vinegar for every 5 tablespoons of oil:



To solve this problem, we begin by asking how many times more oil is there in the recipe than vinegar. One way to think about that is to figure out how many times 2 tablespoons (the amount of vinegar) will fit in 5 tablespoons (the amount of oil). We can think of the 2 T of vinegar as a group and see how many full groups and partial groups fit in the 5 T of oil.

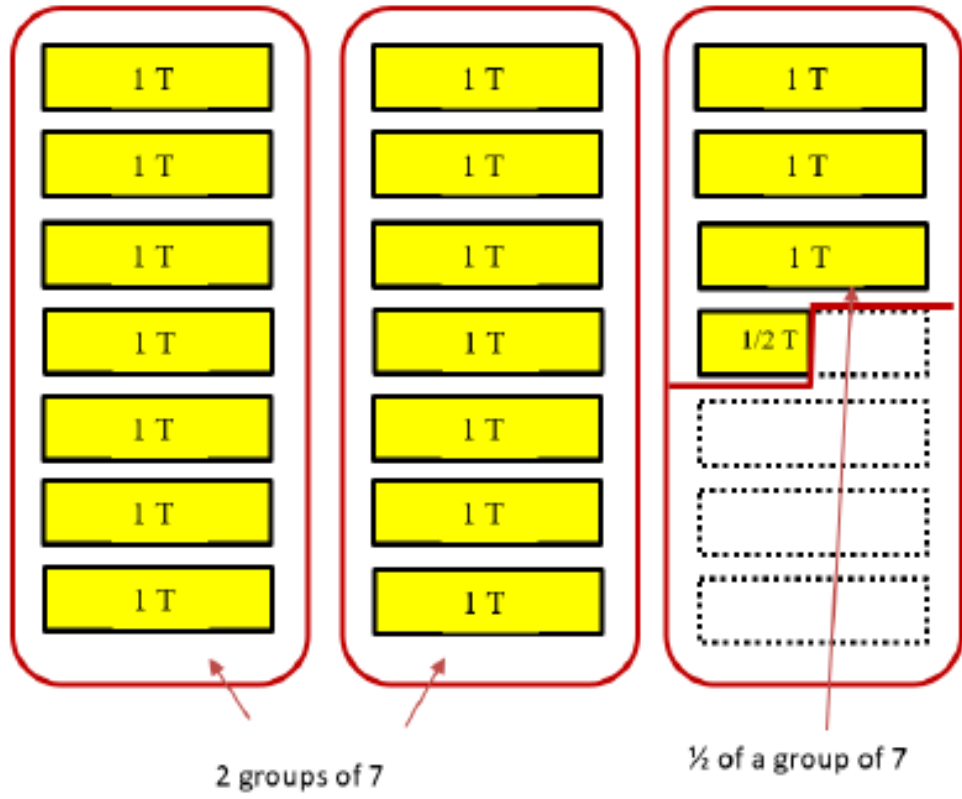


The picture shows that there is $2\frac{1}{2}$ times the amount of oil as vinegar (because there are $2\frac{1}{2}$ groups of the amount of vinegar in the amount of oil).

That means we also need $2\frac{1}{2}$ times the amount of oil as vinegar in the new batch, so that the batches of salad dressing will taste the same.

If we start with 7 T of vinegar, then we need $2\frac{1}{2}$ times as much oil. That means we need $2\frac{1}{2}$ groups, where each group has 7 T.

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The amount of oil is $7\text{ T} + 7\text{ T} + 3.5\text{ T}$, which is 21 T in total.