11.1: Introducing Double Number Line Diagrams

Lesson

Let's use number lines to represent equivalent ratios.

Exercise 11.1.1: Number Talk: Adjusting Another Factor

Find the value of each product mentally.

$(4.5) \cdot 4$

$(4.5) \cdot 8$

$\frac{1}{10} \cdot 65$

$\frac{2}{10} \cdot 65$

Exercise 11.1.2: Drink Mix on a Double Number Line

The other day, we made drink mixtures by mixing 4 teaspoons of powdered drink mix for every cup of water. Here are two ways to represent multiple batches of this recipe:

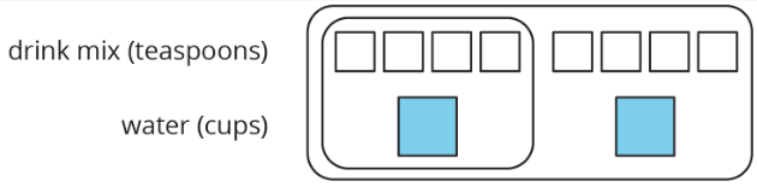

Figure 11.1.1: A discrete diagram for two quantities labeled drink mix, in teaspoons and water in cups. For the number of teaspoons of drink mix, there are 8 small squares. For the number of cups of water, there are 2 large squares. Two groups of 4 small squares and 1 large square are indicated and one group of 4 small squares and 1 large square is circled.

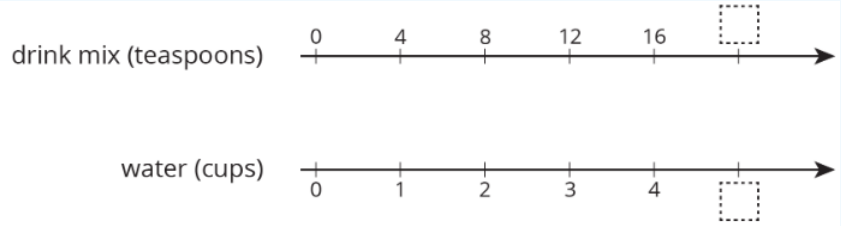

Figure 11.1.2: A double number line with 6 evenly spaced tick marks. The top number line is labeled Drink mix, in teaspoons& and the numbers 0, 4, 8, 12, and 16 are indicated. The last tick mark is blank. The bottom number line is labeled Water, in cups and the numbers 0, 1, 2, 3, 4 are indicated. The last tick mark is blank.

1. How can we tell that $4 : 1$ and $12 : 3$ are equivalent ratios?
2. How are these representations the same? How are these representations different?
3. How many teaspoons of drink mix should be used with 3 cups of water?
4. How many cups of water should be used with 16 teaspoons of drink mix?
5. What numbers should go in the empty boxes on the **double number line diagram**? What do these numbers mean?

Are you ready for more?

Recall that a *perfect square* is a number of objects that can be arranged into a square. For example, 9 is a perfect square because 9 objects can be arranged into 3 rows of 3. 16 is also a perfect square, because 16 objects can be arranged into 4 rows of 4. In contrast, 12 is not a perfect square because you can't arrange 12 objects into a square.

1. How many whole numbers starting with 1 and ending with 100 are perfect squares?
2. What about whole numbers starting with 1 and ending with 1,000?

Exercise 11.1.3: Blue Paint on a Double Number Line

Here is a diagram showing Elena's recipe for light blue paint.

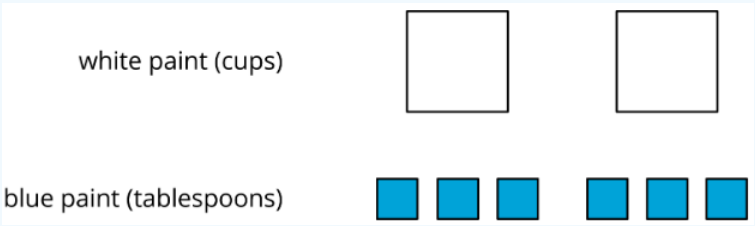

Figure 11.1.3: A discrete diagram of squares that represent the amount of paint. The top row is labeled white paint, in cups and contains 2 large squares. The bottom row is labeled blue paint, in tablespoons and contains 6 small squares.

1. Complete the double number line diagram to show the amounts of white paint and blue paint in different-sized batches of light blue paint.

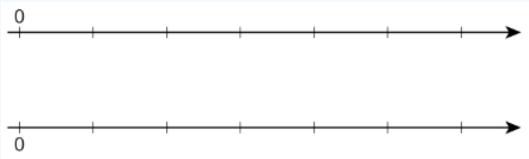

Figure 11.1.4

2. Compare your double number line diagram with your partner. Discuss your thinking. If needed, revise your diagram.
3. How many cups of white paint should Elena mix with 12 tablespoons of blue paint? How many batches would this make?
4. How many tablespoons of blue paint should Elena mix with 6 cups of white paint? How many batches would this make?
5. Use your double number line diagram to find another amount of white paint and blue paint that would make the same shade of light blue paint.
6. How do you know that these mixtures would make the same shade of light blue paint?

Summary

You can use a **double number line diagram** to find many equivalent ratios. For example, a recipe for fizzy juice says, "Mix 5 cups of cranberry juice with 2 cups of soda water." The ratio of cranberry juice to soda water is $5 : 2$. Multiplying both ingredients by the same number creates equivalent ratios.

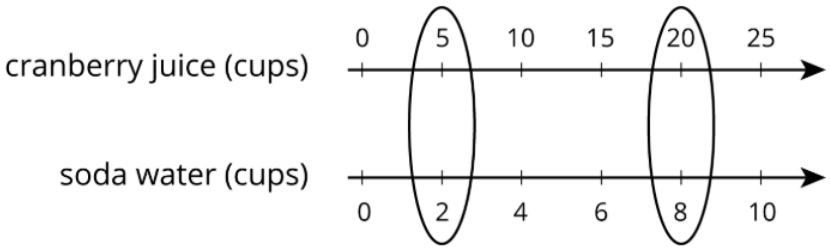

Figure 11.1.5: A double number line with 6 evenly spaced tick marks. The top number line is labeled cranberry juice, in cups and the numbers 0, 2, 4, 6, 8, and 10 are indicated. The bottom number line is labeled soda water, in cups and the numbers 0, 2, 4, 6, 8, and 10 are indicated. There is a circle drawn around the 5 and the 2 and another circle drawn around the 20 and the 8.

This double number line shows that the ratio $20 : 8$ is equivalent to $5 : 2$. If you mix 20 cups of cranberry juice with 8 cups of soda water, it makes 4 times as much fizzy juice that tastes the same as the original recipe.

Glossary Entries

Definition: Double Number Line Diagram

A double number line diagram uses a pair of parallel number lines to represent equivalent ratios. The locations of the tick marks match on both number lines. The tick marks labeled 0 line up, but the other numbers are usually different.

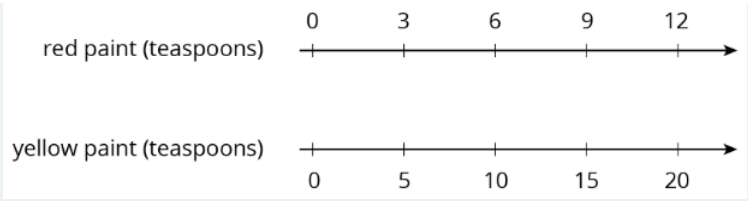

Figure 11.1.6

Practice

Exercise 11.1.4

A particular shade of orange paint has 2 cups of yellow paint for every 3 cups of red paint. On the double number line, circle the numbers of cups of yellow and red paint needed for 3 batches of orange paint.

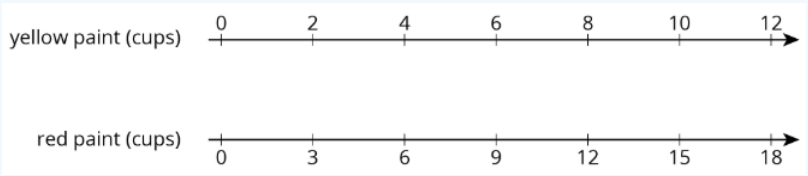

Figure 11.1.7

Exercise 11.1.5

This double number line diagram shows the amount of flour and eggs needed for 1 batch of cookies.

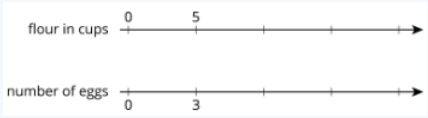

Figure 11.1.8: Double number line, 5 evenly spaced tick marks. Top line, flour, cups. Beginning at first tick mark, labels: 0, 5, blank, blank, blank. Bottom line, number of eggs. Beginning at first tick mark, labeled 0, 3, blank, blank, blank.

1. Complete the diagram to show the amount of flour and eggs needed for 2, 3, and 4 batches of cookies.
2. What is the ratio of cups of flour to eggs?
3. How much flour and how many eggs are used in 4 batches of cookies?

1. How much flour is used with 6 eggs?
2. How many eggs are used with 15 cups of flour?

Exercise 11.1.6

Here is a representation showing the amount of red and blue paint that make 2 batches of purple paint.

1. On the double number line, label the tick marks to represent amounts of red and blue paint used to make batches of this shade of purple paint.

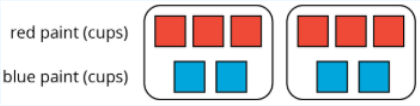

Figure 11.1.9: A discrete diagram for two quantities labeled red paint, cups and blue paint, cups. For the number of cups of red paint, there are 6 red squares. For the number of cups of blue paint, there are 4 blue squares. Two groups of 3 red squares squares and 2 blue squares are circled.

1. How many batches are made with 12 cups of red paint?
2. How many batches are made with 6 cups of blue paint?

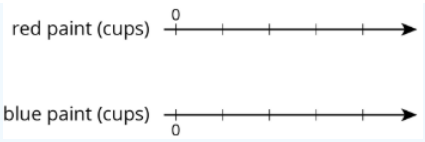

Figure 11.1.10

Exercise 11.1.7

Diego estimates that there will need to be 3 pizzas for every 7 kids at his party. Select **all** the statements that express this ratio.

A. The ratio of kids to pizzas is $7 : 3$.
B. The ratio of pizzas to kids is 3 to 7.
C. The ratio of kids to pizzas is $3 : 7$.
D. The ratio of pizzas to kids is 7 to 3.
E. For every 7 kids there need to be 3 pizzas.

(From Unit 2.1.1)

Exercise 11.1.8

1. Draw a parallelogram that is not a rectangle that has an area of 24 square units. Explain or show how you know the area is 24 square units.

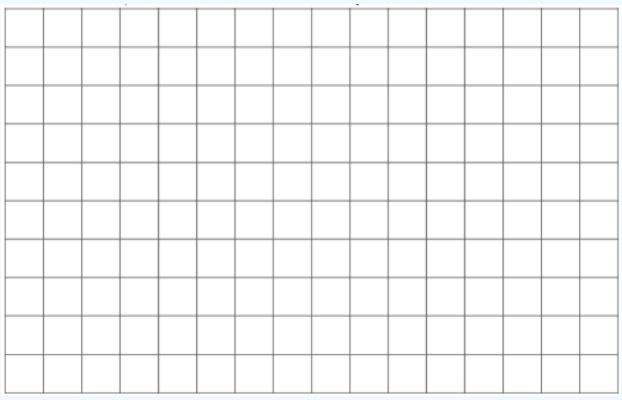

Figure 11.1.11

2. Draw a triangle that has an area of 24 square units. Explain or show how you know the area is 24 square units.

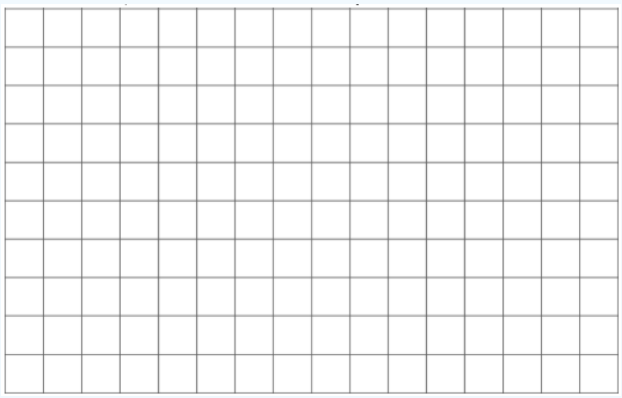

Figure 11.1.12

(From Unit 1.2.3)