**Unit 1- Lesson 1- Ratios**

**Outcomes**

* Students understand that a *ratio* is an ordered pair of non-negative numbers, which are not both zero. Students understand that a ratio is often used instead of describing the first number as a multiple of the second.
* Students use the precise language and notation of ratios ($e.g., 3:2$, $3$ to $2$). Students understand that the order of the pair of numbers in a ratio matters and that the description of the ratio relationship determines the correct order of the numbers. Students conceive of real-world contextual situations to match a given ratio.
* Students reinforce their understanding that a ratio is an ordered pair of non-negative numbers, which are not both zero. Students continue to learn and use the precise language and notation of ratios (e.g., 3:2, 3 to 2). Students demonstrate their understanding that the order of the pair of numbers in a ratio matters.
* Students create multiple ratios from a context in which more than two quantities are given. Students conceive of real-world contextual situations to match a given ratio.

**Lesson Notes**

A ratio is always a pair of numbers, such as $2:3$ and never a pair of quantities such as $2$cm:$3$sec. Keeping this straight for students will require teachers to use the term ratio correctly and consistently.”. Students will be required to separately keep track of the units in a word problem. To help distinguish between ratios and statements about quantities that define ratios, we use the term *ratio relationship* to describe a phrase in a word problem that indicates a ratio. Typical examples of ratio relationship descriptions include “$3$ cups to $4$ cups,” “$5$ miles in $4$ hours,” etc. The ratios for these ratio relationships are $3:4$ and $5:4$, respectively.

**Direct Instruction**

Read the example aloud.

Example 1

The coed soccer team has four times as many boys on it as it has girls. We say the ratio of the number of boys to the number of girls on the team is $4:1$. We read this as “four to one.”

* Let’s create a table to show how many boys and how many girls on are on the team.

Create a table like the one shown below to show possibilities of the number of boys and girls on the soccer team. Have students copy the table into their student packet.

|  |  |  |
| --- | --- | --- |
| # of Boys | # of Girls | Total # of Players |
| 4 | 1 | 5 |

* So, we would have four boys and one girl on the team for a total of five players. Is this big enough for a team?
	+ *Adult teams require* $11$ *players, but youth teams may have fewer. There is no right or wrong answer; just encourage the reflection on the question, thereby connecting their math work back to the context.*
* What are some other options that show $four$ times as many boys as girls or a ratio of boys to girls of $4$ to $1$?
	+ *Have students add each option given to their table.*

|  |  |  |
| --- | --- | --- |
| # of Boys | # of Girls | Total # of Players |
| 4 | 1 | 5 |
| 8 | 2 | 10 |
| 12 | 3 | 15 |

* From the table, we can see that there are four boys for every one girl on the team.

Read the example aloud.

Suppose the ratio of number of boys to number of girls on the team is $3:2$.

Create a table like the one shown below to show possibilities of the number of boys and girls on the soccer team. Have students copy the table into their student packets.

|  |  |  |
| --- | --- | --- |
| # of Boys | # of Girls | Total # of Players |
| 3 | 2 | 5 |

* What are some other options that show that there are three boys for every two girls on the team?

|  |  |  |
| --- | --- | --- |
| # of Boys | # of Girls | Total # of Players |
| 3 | 2 | 5 |
| 6 | 4 | 10 |
| 9 | 6 | 15 |

* I can’t say there are $3$ times as many boys as girls. What would my multiplicative value have to be? There are
 as many boys as girls.

Encourage the students to articulate their thoughts, guiding them to say there are $\frac{3}{2}$ as many boys as girls.

* Can you visualize $\frac{3}{2}$ as many boys as girls?
* Can we make a tape diagram (or bar model) that shows that there are $\frac{3}{2}$ as many boys as girls?

Boys

Girls

* Which description makes the relationship easier to visualize: saying the ratio is $3$ to $2$ or saying there are $3$ halves as many boys as girls?
	+ *There is no right or wrong answer. Have students explain why they picked their choices.*

Example 2 (8 minutes): Class Ratios

Discussion (4 minutes)

Direct students:

* Find the ratio of boys to girls in our class.
* Raise your hand when you know: What is the ratio of boys to girls in our class?
* How can we say this as a multiplicative comparison without using ratios? Raise your hand when you know. *Allow for choral response when all hands are raised.*
* Write the ratio of number of boys to number of girls in your student packet under Example 2, Question 1.
* Compare your answer with your neighbor’s answer. Does everyone’s ratio look exactly the same?
	+ Allow for discussion of differences in what students wrote. Communicate the following in the discussions:
		- 1. It is ok to use either the colon symbol or the word ‘to’ between the two numbers of the ratio.
			2. The ratio itself does not have units or descriptive words attached.
* Raise your hand when you know: What is the ratio of number of girls to number of boys in our class?
* Write the ratio down in your packet as number 2.
* Is the ratio of number of girls to number of boys the same as the ratio of number of boys to number of girls?
	+ *Unless in this case there happens to be an equal number of boys and girls, then no, the ratios are not the same. Indicate that order matters.*
* Is this an interesting multiplicative comparison for this class? Is it worth commenting on in our class? If our class had $15$ boys and $5$ girls, might it be a more interesting observation?

For the exercise below, choose a way for students to indicate that they identify with the first statement (e.g., standing up or raising a hand). After each pair of statements below, have students create a ratio of the first statement to the second statement verbally, in writing, or both. Consider following each pair of statements with a discussion of whether it seems like an interesting ratio to discuss. Or alternatively, when you have finished all of these examples, ask students which ratio they found most interesting.

Students record a ratio for each of the examples you provide:

1. You traveled out of state this summer.
2. You did not travel out of state this summer.
3. You have at least one sibling.
4. You are an only child*.*
5. Your favorite class is math.
6. Your favorite class is not math.

**Partner practice**

Exploratory Challenge (30 minutes)

Have students read and study the description of the data in the chart provided in their student materials. Ask students to explain what the chart is about (if possible, without looking back at the description). This strategy encourages students to really internalize the information given as opposed to jumping right into the problem without knowing the pertinent information.

* Based on the survey, should the company order more pink fabric or more orange fabric?
* What is the ratio of the number of bolts of pink fabric to number of bolts of orange fabric you think the company should order?
* Someone said 5 to 3, and another person said (or my friend said) it would be 3 to 5. Are those the same? Is a ratio of 3 to 5 the same as a ratio of 5 to 3?

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* Write a statement that describes the ratio relationship of this 3 to 5 ratio that we’ve been talking about.

Review the statements written by the students, checking and reinforcing their understanding that the ordering of the words in the description of the ratio relationship is what determines the order of the numbers in the ratio.

Allow students to work individually or in pairs to complete Exercises 2 and 3 for this Exploratory Challenge.

Exploratory Challenge

A t-shirt manufacturing company surveyed teen-aged girls on their favorite t-shirt color to guide the company’s decisions about how many of each color t-shirt they should design and manufacture. The results of the survey are shown here.

|  |
| --- |
| **Favorite T-Shirt Colors of Teen-Aged Girls Surveyed** |
|  |  |  | X |  |  |  |
|  |  |  | X |  |  |  |
|  |  |  | X | X |  |  |
|  | X |  | X | X |  | X |
|  | X |  | X | X | X | X |
|  | X | X | X | X | X | X |
| X | X | X | X | X | X | X |
| Red | Blue | Green | White | Pink | Orange | Yellow |

Exercises for Exploratory Challenge

1. Describe a ratio relationship, in the context of this survey, for which the ratio is 3: 5.

The number of girls who answered orange to the number of girls who answered pink.

1. For each ratio relationship given, fill in the ratio it is describing.

|  |  |
| --- | --- |
| **Description of the Ratio Relationship****(Underline or highlight the words or phrases that indicate the description is a ratio.)** | **Ratio** |
| For every 7 white t-shirts they manufacture, they should manufacture 4 yellow t-shirts. The ratio of number of white t-shirts to number of yellow t-shirts should be… | ***7:4*** |
| For every 4 yellow t-shirts they manufacture, they should manufacture 7 white t-shirts. The ratio of number of yellow t-shirts to number of white t-shirts should be… | ***4:7*** |
| The ratio of number of girls who liked a white t-shirt best to number of girls who liked a colored t-shirt best was… | ***7:19*** |
| For each red t-shirt they manufacture, they should manufacture 4 blue t-shirts. The ratio of number of red t-shirts to number of blue t-shirts should be… | ***1:4*** |
| They should purchase 4 bolts of yellow fabric for every 3 bolts of orange fabric. The ratio of number of bolts of yellow fabric to number of bolts of orange fabric should be… | ***4:3*** |
| The ratio of number of girls who chose blue or green as their favorite to the number of girls who chose pink or red as their favorite was … | ***6:6*** |
| Three out of every 26 t-shirts they manufacture should be orange. The ratio of number of orange t-shirts to total number of t-shirts should be… | ***3:26*** |

1. For each ratio given, fill in a description of the ratio relationship in could describe, using the context of the survey.

|  |  |
| --- | --- |
| **Description of the Ratio Relationship****(Underline or highlight the words or phrases that indicate your example is a ratio.)** | **Ratio** |
| ***They should make 4 yellow t-shirts for every 3 orange t-shirts. The ratio of number of yellow t-shirts to number of orange t-shirts should be…*** | **4 to 3** |
| ***They should make 3 orange t-shirts for every 4 blue t-shirts. The ratio of number of orange t-shirts to number of blue t-shirts should be…*** | **3:4** |
| ***For every 19 colored t-shirts, there should be 7 white t-shirts. The ratio of number of colored t-shirts to number of white t-shirts should be…*** | **19:7** |
| ***7 out of 26 t-shirts should be white. The ratio of white t-shirts to total t-shirts should be…*** | **7 to 26** |

If time permits, allow students to share some of their descriptions for the ratios in Exercise 3.

Closing (5 minutes)

* Are the ratios 2:5 and 5:2 the same? Why or why not?

Lesson Summary

* Ratios can be written in two ways: $A$ to $B$ or $A:B$.
* We describe ratio relationships with words such as: to, for each, for every.
* The ratio $A:B$ is not the same as the ratio B:A (unless $A$ is equal to $B$).

**Unit 1- Lesson 1- Ratios Partner Practice Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

 **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Classwork**

**Exercise 1**

Come up with two examples of ratio relationships that are interesting to you.

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|  |
| --- |
| **Favorite T-Shirt Colors of Teen-Aged Girls Surveyed**X |
|  |  |  | X |  |  |  |
|  |  |  | X | X |  |  |
|  | X |  | X | X |  | X |
|  | X |  | X | X | X | X |
|  | X | X | X | X | X | X |
| X | X | X | X | X | X | X |
| Red | Blue | Green | White | Pink | Orange | Yellow |

**Exercises for Exploratory Challenge**

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\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| The ratio of number of girls who liked a white t-shirt best to number of girls who liked a colored t-shirt best was… |  |
| For each red t-shirt they manufacture, they should manufacture 4 blue t-shirts. The ratio of number of red t-shirts to number of blue t-shirts should be… |  |
| They should purchase 4 bolts of yellow fabric for every 3 bolts of orange fabric. The ratio of number of bolts of yellow fabric to number of bolts of orange fabric should be… |  |
| The ratio of number of girls who chose blue or green as their favorite to the number of girls who chose pink or red as their favorite was … |  |
| Three out of every 26 t-shirts they manufacture should be orange. The ratio of number of orange t-shirts to total number of t-shirts should be… |  |

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|  |  |
| --- | --- |
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|  | 4 to 3 |
|  | 3:4 |
|  | 19:7 |
|  | 7 to 26 |

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**Problem Set**

1. Using the floor tiles design shown below, create 4 different ratios related to the image. Describe the ratio relationship and write the ratio in the form $A:B$ or the form $A$ to $B$.
2. Billy wanted to write a ratio of the number of cars to the number of trucks in the police parking lot. He wrote 1: 3. Did Billy write the ratio correctly? Explain your answer.

**Unit 1- Lesson 1- Ratios Exit Ticket/ HW Name:**

1. Write a ratio for the following description: Kaleel made three times as many baskets as John during basketball practice.

2. Describe a situation that could be modeled with the ratio 4:1.

3. Write a ratio for the following description: For every 6 cups of flour in a bread recipe, there are 2 cups of milk.

4. Give two different ratios with a description of the ratio relationship using the following information: There are 15 male teachers in the school. There are 35 female teachers in the school.

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