True Color Murals: A Unit on Ratios

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Investigation 1: The Perfect Orange

Warm Up

1. Write 20 as the sum of two numbers. (In other words, write two numbers that add up to 20.) How many different ways can you do this?

Main

Introduction

Welcome to the True Colors Mural Company!

We make copies of beautiful paintings and reproduce them as murals on buildings. In our company, we buy only the primary colors: blue, yellow, and red. But by using the right mix of these primary colors, we can create almost any color we need.

You probably know that if you mix blue and yellow paint, you get green paint. But exactly which color of green depends on how much blue is used in relationship to how much yellow is used.

To make our murals, we have to match the colors in the original paintings. To help us make our colors before we start painting, we have Ratio Visualizer, a special online tool. This online tool uses ratios to make particular colors.

Your job will be to determine colors, compare colors, record how to make various colors, and figure out how much paint to make. Also, because we are a business, there are other matters for you to work on. The mathematical idea of ratio will be important in your work.
We have been hired to reproduce Mark Rothko’s painting *No. 14, 1960* on the side of a large building. We must make the same orange that is in the painting. We will use *Ratio Visualizer*, a set of online tools to make this color of orange using what we call “pips” of paint. Using Activity 1.2, click on the *Show Artwork* button to see a picture of the painting.

2. Using 20 total paint pips or fewer, create a color of orange. Notice how for each tap on the color bar, a pip of red or yellow paint is added. On the screen, re-label the color “Blend 1” with a name that you choose. My color is____________

Write down the recipe for the orange that you created:
Yellow pips _____ Red pips_____ 

3. Now let your partner(s) use the online tool. Create two more blends: one a color of orange that is *more yellow* than your first blend, and one that is *more red*. Click “Add new” to create more blends. Label your two new blends “more yellow” and “more red.”

Write down all the recipes for the different colors of orange that you created:

<table>
<thead>
<tr>
<th>Name</th>
<th>Yellow pips</th>
<th>Red pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blend 1:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Red</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Wrap Up

4. Compare the three blends of orange and their recipes.

A. Look at the numbers in the recipes. How do the numbers in the recipes show which blend is the most yellow? The most red?

B. Look at the marker on the spectrum. How do the blend markers show which blend is the most red? The most yellow?
Problem Solving

5. LaToya created a blend of green using 8 blue pips and 8 yellow pips. Complete the table to make two more blends of green: one that is more blue than LaToya’s blend and one that is more yellow.

<table>
<thead>
<tr>
<th>Name</th>
<th>Blue pips</th>
<th>Yellow pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>LaToya’s Blend</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>More Blue</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>More Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. From the table above, compare the three blends of green and their recipes. Look at the numbers in the recipes. How do the numbers in the recipes show which blend is the most blue? The most yellow?

7. Tony created a blend of purple with 1 blue pip and 1 red pip.

A. Complete the table and make two more blends of purple: one that is more blue than Tony’s blend and one that is more red.

<table>
<thead>
<tr>
<th>Name</th>
<th>Blue pips</th>
<th>Red pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tony’s Blend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Compare the three blends of purple and their recipes. Look at the numbers in the recipes. How do the numbers in the recipes show which blend is the most blue? The most red?
Investigation 2: Grayscale Murals

Warm Up

1. Evaluate.

   A. 14 doubled
   B. 10 doubled
   C. half of 40
   D. 40÷2
   E. 28•2
   F. 20•2

Main

We have another job where we need to reproduce the grayscale mural you see here. To create a shade of gray we will blend black paint and white paint. Your job is to use the computer to create the same gray with different numbers of paint pips.

Imagine a certain shade of gray that has 2 white pips and 9 black pips. What would that look like? Circle where in the mural you find that shade of gray.

Urban mural in Germany.
**Xenia’s Gray**

One of our co-workers, Xenia, makes a blend of gray paint using 10 pips of black and 14 pips of white. We can say—

*The ratio of black pips to white pips is 10 to 14.*
*We write it as “10:14.”*

2. Use Activity 2.1 to make Xenia’s gray using a black pip to white pip ratio of 10:14.
   Click “Container.” Make a container so that the black and white pips form two rows of equal size, with the same number of black pips and white pips in each. It should look like this.

   ![Container Image](image)

3. We want to create a second blend that is the same color as Xenia’s gray, but uses only 5 pips of black.

   A. **Predict.** How many white pips do you think we will need?

   B. **Check.** Create the blend that makes the same color. Use the spectrum to check that the two blends are the same color. Fill in—

   *The ratio of black pips to white pips is [ ] : [ ]*

   C. Click “Container” and form a single column with the black and white pips like this.

   ![Column Image](image)

   D. **Explain.** Examine this table with the drawings of both ratio’s containers. How do the containers for the two blends show us that both ratios give the same color?

<table>
<thead>
<tr>
<th>5:7</th>
<th>10:14</th>
</tr>
</thead>
</table>

   ![Table Image](image)
4. Make a third blend of paint that makes the same shade as Xenia’s gray using 20 pips of black.

In this blend—

*The ratio of black pips to white pips is* \[
\_
\]

5. Let’s use a table to compare all of the blends.

A. Complete the third blend in the table:

<table>
<thead>
<tr>
<th>Xenia’s gray</th>
<th>Black pips</th>
<th>White pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Blend</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>2nd Blend</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>3rd Blend</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>4th Blend</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. **Predict.** Fill in the table. Try to create a fourth blend that will make Xenia’s gray using different amounts of pips.

In the fourth blend—

*The ratio of* \[
\_
\] *to* \[
\_
\] *is* \[
\]

C. **Check.** Use the spectrum and blend bars to check whether you are right.

D. **Explain.** How do you know that the fourth blend is the same color of gray as the other blends?
Wrap Up

6. Explain to a muralist joining the group how to use your new strategies for making blends that are the same shade of gray.
Problem Solving

7. Another co-worker, Liam, made a blend of a different shade of gray paint by mixing 4 black pips with 10 white pips. We want to make a few blends of Liam’s gray, but using different amounts of white pips.

A. Complete the table:

<table>
<thead>
<tr>
<th></th>
<th>Black pips</th>
<th>White pips</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Liam’s Gray</td>
<td>4</td>
<td>10</td>
<td>4 : 10</td>
</tr>
<tr>
<td>Half</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Double</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Double Again</td>
<td></td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

B. Use a drawing of two containers and numbers to explain how you know you made the same shade for Liam’s gray and the Double Again blend.

8. A recipe for noodle soup calls for 2 cups of noodles and 4 cups of chicken broth.

A. To make half the recipe, how much of each ingredient should you use?

   [ ] cups noodles     [ ] cups chicken broth

B. To make double the recipe, how much of each ingredient should you use?

   [ ] cups noodles     [ ] cups chicken broth
C. Write the ratios for cups of noodles to cups of chicken broth for all of the recipes above.

<table>
<thead>
<tr>
<th>noodles (cups)</th>
<th>chicken broth (cups)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Gina made a bird feed mix of 4 cups sunflower seeds to 12 cups of corn. We want to make a few blends of Gina’s bird feed mix but using different amounts of sunflower seeds.

A. Complete the table:

<table>
<thead>
<tr>
<th>Sunflower seeds (cups)</th>
<th>Corn (cups)</th>
<th>Sunflower seeds : Corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gina’s Mix</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Half</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Double</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Double Again</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

B. Explain how you know you made the same mix of bird feed as Gina.
Investigation 3: It’s Great to Be Green

Warm Up

1. Based on the ratio given in the first row, complete the table so that each row makes the same color.

<table>
<thead>
<tr>
<th>Yellow pips</th>
<th>Red pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Main

In the previous Investigations, you used doubling and halving to make different blends of the same color paint. There are more ways to use ratio to get the same color paint, and you will learn about them in the Investigations to come.

A Sunday on La Grande Jatte, Georges Seurat.
Palm Green

2. The blends of blue and yellow in this table are all supposed to make Palm Green. Each row represents a ratio. (Don’t fill in the blank row until later.)

<table>
<thead>
<tr>
<th>Blue pips</th>
<th>Yellow pips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>21</td>
</tr>
</tbody>
</table>

A. **Predict.** Look at the table. Do you think that all of the rows in this table make the same color?

B. **Check.** Use Activity 3.1. Make blends for each row of the table.

C. **Explain.** How do the spectrum, the blend bars, or the pips show that the blends all make Palm Green?

D. **Explain.** When the ratios all make the exact same color paint, we can say they are **equivalent ratios.** How can you tell from the numbers in the table that the ratio for each row will make Palm Green, or that the ratios are equivalent?
E. Write a rule so that anyone can create a blend that results in Palm Green paint.

For every [ ] blue pip, there are [ ] yellow pips.

F. Rewrite your rule as a blue to yellow ratio in the top blank row of the table.

G. Use your rule and create another ratio that makes Palm Green.

Ways to Describe Ratios

For example, we can describe the Palm Green ratio like this:

- The ratio of blue pips to yellow pips is 1 to 3.
- The ratio of blue pips to yellow pips is 1 : 3.
- Blue pips and yellow pips are in the ratio 1 to 3.
- The blend is 1 blue pip to 3 yellow pips.
- The ratio 1:3 is equivalent to the ratio 2:6.

Wrap Up

3. Joey creates a blend of orange with a ratio of 4 red pips to 20 yellow pips. Write a rule using ratio language so that anyone using more or fewer than 4 red pips can create a blend of paint that results in Joey’s orange.
Problem Solving

People’s Purple

4. Grace, Jake, and Nina have each mixed one batch of purple paint using the numbers of blue pips and red pips shown in the table below. You may use Activity 3.2 to check your work.

<table>
<thead>
<tr>
<th></th>
<th>Red pips</th>
<th>Blue pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grace</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Jake</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>Nina</td>
<td>15</td>
<td>75</td>
</tr>
</tbody>
</table>

A. How can you tell that Jake’s and Nina’s purples are the same as Grace’s, using the numbers?

   Sample answers: Both Jake’s, Nina’s, and Grace’s purples have 5 blue pips for every 1 red pip. Also, Jake uses 4 times as many red pips and 4 times as many blue pips as Grace.

B. How can you tell from the numbers that Nina’s paint amount is 5 times as much as Grace’s?

   Sample answer: Nina uses 5 times as many red pips and 5 times as many blue pips as Grace. Using Activity 3.2 you can use the container. Grace’s ratio has one row of 3 red pips and five rows of blue pips. There are 3 pips in each row. For Nina, keeping the number of rows the same, there are 15 pips in each row, which is 5 times more.

5. At True Colors, we play games to keep our creativity flowing. One game is called Tip, Tap, Top. One rule is that for every 6 tips there are supposed to be 24 tops. Fill in the table for this relationship to show equivalent ratios. Some numbers are given to you.

<table>
<thead>
<tr>
<th>Tips</th>
<th>Tops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>
6. Represent the following situations with a ratio in different ways (using a colon, “for every” language, or “__times as many” language):

<table>
<thead>
<tr>
<th>Situation</th>
<th>Colon notation</th>
<th>For every _____ there are _____</th>
<th>There are _____ times as many</th>
</tr>
</thead>
<tbody>
<tr>
<td>The color Blue Raspberry is made with 5 red pips for every 20 blue pips of paint.</td>
<td>The ratio of red to blue pips is 5:20</td>
<td>For every 1 red pip, there are 4 blue pips.</td>
<td>There are 4 times as many blue pips as red pips.</td>
</tr>
<tr>
<td>The color Sky Purple is made with 4 red pips for every 28 blue pips of paint.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fred’s fizzy punch is made by mixing 12 quarts of lemonade for every 20 quarts of sparkling water.</td>
<td></td>
<td></td>
<td>Challenge:</td>
</tr>
<tr>
<td>Anu’s pancake recipes calls for 7 cups of pancake mix for every 3 cups of milk.</td>
<td></td>
<td></td>
<td>Challenge:</td>
</tr>
</tbody>
</table>

7. Challenge: There are 9 red marbles and some yellow marbles. There are a total of 15 marbles. Write the ratio of the number of red marbles to the number of yellow marbles. Use a complete sentence with colon notation.
Investigation 4: Helping Out

Warm Up

1. Evaluate.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>B.</td>
<td>C.</td>
<td>D.</td>
</tr>
<tr>
<td>27 ÷ 9</td>
<td>2 • ___ = 6</td>
<td>___ • 7 = 28</td>
<td>4 • 4 =</td>
</tr>
<tr>
<td>E.</td>
<td>F.</td>
<td>G.</td>
<td></td>
</tr>
<tr>
<td>1 ÷ 3</td>
<td>3 • ___ = 1</td>
<td>___ • 3 = 10.5</td>
<td></td>
</tr>
</tbody>
</table>

Main

Running True Colors Murals as a company means solving math problems. Please help out. Make tables and use ratios as needed.

Clouds and Water, Arthur Dove.
2. True Colors is hosting an art event for elementary school students. Amira is making clay from salt and flour. She knows that the ratio of the amount of flour to the amount of salt should be 3:1. Use Activity 4.1 to model these ratios.

A. Complete the table below. (Leave the blank rows blank, for now.)

<table>
<thead>
<tr>
<th>Flour (cups)</th>
<th>Salt (cups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

3. Use Graph to show the graph representation of the clay blends.

A. Explain what each point means.

B. Use Lines to show the graph lines. Why are the points all on the same line?

C. Using the graph, determine the amounts of flour and water needed to create two new blends of the same clay. Write the ratios of the two new blends in the table above.
4. When True Colors muralists go to paint a mural, they bring 7 brushes for every 2 palettes so that they have enough brushes for mixing different colors.

A. Use Activity 4.3 to show the 7:2 brush to palette ratio in a blend bar.

B. Estrella wants to take 6 palettes to her mural site. How many brushes should she take? Create another blend bar to show how many brushes she should take. Explain your answer in words and numbers.

C. Sometimes Estrella needs to bring as many as 12 palettes to a mural site. Fill in the table so that she can easily know how many brushes to bring to each job.

<table>
<thead>
<tr>
<th>Number of brushes</th>
<th>Number of palettes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

D. Challenge: Jacob wants to carry 3 palettes. Estrella isn’t sure how many brushes to send along with him. Advise Jacob as best you can and explain your advice.
Wrap Up

5. A recipe for a gazpacho (a cold soup) uses 3 cups of cucumbers and 4 cups of tomatoes. Describe how to use a ratio to determine how many cups of cucumbers to use with 1 cup of tomatoes.
Problem Solving

6. True Colors donates murals to communities. For every 9 murals sold, True Colors donates 2 murals for free.

A. If we have 27 sold murals, how many donated murals do we need to keep the same 9:2 ratio?

B. Explain in words the relationship between the 9:2 ratio and the ratio you created using the 27 sold murals.

7. True Colors is working with the parks department, which has some problems to solve.

The parks department created a graph using ratios of park benches to basketball hoops in 3 different parks. They are now building a new park and want to keep the same bench to hoop ratio.

A. If there are 16 park benches in the new park, how many hoops should the park have to keep the same bench to hoop ratio?
B. Explain in words the relationship between the existing parks’ bench to hoop ratio and the ratio you found for the new park.

8. The parks department found in their existing park that 5 maple trees can shade 7 picnic tables. They are now building a new park and have bought 45 maple trees. Assume that the new trees will shade the picnic tables in the same ratio as in the old park.

How many picnic tables can be shaded by these maple trees? You can make a ratio table to help you find out.

<table>
<thead>
<tr>
<th>Maple Trees</th>
<th>Picnic Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. The new park will also have a lake with boats. Each boat can fit 2 adults and 3 children. There are 20 children going on a boating field trip. How many adults can go on the boats with them? (Hint: Remember that you might need to round as you did in problem 3. You can use a table to organize your thinking.)

10. The park wants to paint their picnic tables Ecological Green, which is made in the ratio of 5 buckets of blue paint to 2 buckets of yellow paint. If you only have 1 bucket of blue paint, how many buckets of yellow paint do you need to make Ecological Green?
Investigation 5: Starry Night

Warm Up

1. Fill in the blanks.

   A. 3 multiplied by \( \underline{\quad} \) is 21
   B. 5 multiplied by \( \underline{\quad} \) is 35
   C. 1 multiplied by \( \underline{\quad} \) is 7
   D. 21 divided by \( \underline{\quad} \) is 35
   E. 35 divided by 3 is \( \underline{\quad} \)
   F. 7 divided by 1 is \( \underline{\quad} \\

2. Determine the greatest common factor of

   A. \(28\) and \(12\)  
   B. \(35\) and \(15\)  

Main

Starry Night Over the Rhone is a famous painting by Vincent Van Gogh. If you look at the dark blue water, you’ll notice the color has small amounts of a bluish purple. We call this Plum Blue. True Colors is trying to make Plum Blue for this painting, as well as other colors.

In this investigation we will learn what it means to find the simplest form of a ratio.
**Plum Blue**

Our newest paint color, Plum Blue, can be made with 21 blue pips for every 3 red pips in the mix. Terrance is trying to make the same color, but he accidentally put 5 red pips in his mixer.

3. **How can Terrance make Plum Blue using equivalent ratios?**

   A. **Predict.** Since he already has 5 red pips, how many blue pips do you think Terrance needs to make Plum Blue?

   B. **Check.** Use Activity 5.1 to make Terrance’s blend of Plum Blue.

C. **Explain.** Contain the pips for Terrance’s blend and for Plum Blue. Explain how the containers show that Terrance’s blend and Plum Blue have the same red to blue ratio.

D. **Explain.** How can containing the pips help you figure out how to make a batch of the same color, but with different amounts of paint?

4. **Fill in the table to show how many blue pips you need for different amounts of Plum Blue paint.**

<table>
<thead>
<tr>
<th>Number of red pips</th>
<th>Number of blue pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
5. The ratio 1:7 is the called the simplest form of 3:21 and 5:35. It is equivalent to both. Explain why 1:7 would be called "simplest form."

6. Use Graph to show the graph representation of the two blends. Use Lines to show the graph lines. Why are the points all on the same line?

Cherry Tomato
For the color Cherry Tomato, the ratio of red pips to yellow pips is 28 to 12.

7. Use Activity 5.2 to view Cherry Tomato and contain the pips. What is the simplest form of 28:12?

8. Connor wants to make Cherry Tomato using 35 red pips. How many yellow pips does he need to use? Why?

Wrap Up

9. Julian makes Sky Green using 30 blue pips and 12 yellow pips. What are two ways to find the simplest form of the Sky Green recipe’s ratio?
Problem Solving

10. Rewrite the ratios in simplest form. [Hint: Some may already be in simplest form.]

A. 35:5 is equivalent to ___

B. 13:26 is equivalent to ___

C. 132:121 is equivalent to ___

D. 11:5 is equivalent to ___

E. 12:9 is equivalent to ___

F. 48:16 is equivalent to ___

G. 15:60 is equivalent to ___

H. 168:224 is equivalent to ___

I. 37:3 is equivalent to ___

J. 24:16 is equivalent to ___

11. A garden has 20 rose bushes for every 15 tulip plants. What is the ratio of the number of rose bushes to the number of tulip plants in simplest form?

12. A garden has 15 red rose bushes for every 18 white rose bushes. What is the ratio of the number of red rose bushes to the number of white rose bushes in simplest form?
13. Ivy used the measuring tape below to measure the wall for a mural. Some of the numbers on the tape have worn off.

Ivy can see that there are 9 feet in 3 yards. She writes this using the ratio 9:3.

A. Write Ivy’s ratio in simplest form.

B. Fill in the two missing numbers on the measuring tape in the boxes.
## Investigation 6: Water Lilies

### Warm Up

1. The blends of paint below have different color ratios. Label the pips to match the ratios given.

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Pips</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:2 (yellow:blue)</td>
<td><img src="https://via.placeholder.com/150" alt="Pips" /></td>
</tr>
<tr>
<td>1:5 (red:blue)</td>
<td><img src="https://via.placeholder.com/150" alt="Pips" /></td>
</tr>
<tr>
<td>2:3 (red:yellow)</td>
<td><img src="https://via.placeholder.com/150" alt="Pips" /></td>
</tr>
<tr>
<td>2:1 (blue:red)</td>
<td><img src="https://via.placeholder.com/150" alt="Pips" /></td>
</tr>
</tbody>
</table>
Main

We want to make a yellowish green for use in our mural based on part of Claude Monet’s *Water Lilies, Evening Effect*. You will learn to compare the total amount of paint to the amount of each color using ratios.


Yellowish Green

Cecilia needs yellowish green to use in her mural of the Water Lilies. She asks you to make yellowish green for her.

2. Use Activity 6.1 to make yellowish green using exactly 10 pips total and exactly 6 yellow pips. Yellowish green has more yellow in it than blue.

A. Give the color a name and write the ratio.

   *The name of my color is ____________________.*

   *In a blend with 10 total pips there will be _____ blue pips and 6 yellow pips.*

B. Write the ratio in simplest form.

   *The ratio of blue to yellow is _____:_____*
C. Create a table that shows how to produce different total amounts of your yellowish green paint. Each pip of paint contains 1 fluid ounce.

<table>
<thead>
<tr>
<th>Ounces of blue</th>
<th>6</th>
<th>12</th>
<th>20</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ounces of yellow</td>
<td>6</td>
<td>9</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>Ounces of blue + yellow = Total ounces</td>
<td>10</td>
<td>40</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>

D. Explain how the total ounces row in your table is related to the ounces of blue and yellow rows.

E. Write the ratio of blue pips to total pips in simplest form.

The ratio of ounces of blue to total ounces is _____ : _____

F. Write the ratio of yellow pips to total pips in simplest form.

The ratio of ounces of yellow to total ounces is _____ : _____

G. Explain how the first column in your table is related to every other column.

H. Make blends in the software for each of the rows in the table above. Show the graph. How does the graph show the ratios? How are they related on the graph?
3. Jaxon wants you to give him a table for Pretty Purple, showing how many pips to use for batches of different total amounts. The ratio of blue pips to red pips in Pretty Purple is 4:5.

A. Fill in the following table.

<table>
<thead>
<tr>
<th>Ounces of blue</th>
<th>Ounces of red</th>
<th>Ounces of blue + red = Total ounces</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>

B. Use Activity 6.2 to create the batches represented in your table. Using the graph, explain how you know that all the rows in your table make Pretty Purple.

**Wrap Up**

4. Jaxon notices a pattern in Pretty Purple in the ratios of ounces of blue to total ounces, and wonders if they are all equivalent. Write a note to Jaxon explaining the relationship between the ratios of ounces of blue to total ounces for all the batches of Pretty Purple. Use ratio language and what you know about the graph, the spectrum, the numbers, and the blend bars.
Problem Solving

1. Jordan has two containers of Cherry Tomato paint with the batches shown in the table below. Make up your own container of Cherry Tomato and put it in the table.

<table>
<thead>
<tr>
<th></th>
<th>Ounces of red</th>
<th>Ounces of yellow</th>
<th>Total ounces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large container</td>
<td>28</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Medium container</td>
<td>14</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Small container</td>
<td></td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Your own container</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. The ratio of boys to girls in a class is 2:3. Fill in the missing numbers in the table.

| Number of boys | 2 | 4 | 8 | 6 |
| Number of girls| 3 |   | 12|   |
| Total number of students | 10 | 20 | 15 |  

3. Sonya made some lemonade with the original recipe below. She doesn’t have enough lemonade for the party, so she adds 4 more ounces of lemon juice and 4 more ounces of water to the jar. Sonya will add sugar later.

<table>
<thead>
<tr>
<th></th>
<th>Ounces of lemon juice</th>
<th>Ounces of water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original recipe</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>New recipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your recipe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Fill in the “new recipe” in the second row of the table.

B. Does the new recipe taste the same?
C. Create your own recipe for Sonya’s lemonade that makes more lemonade, but tastes the same as her first recipe.

4. Tina made some berry soda with the original recipe below. She doesn’t have enough, so she adds 1 more ounce of cranberry juice and 1 more ounce of sparkling water to the jar.

<table>
<thead>
<tr>
<th></th>
<th>Ounces of cranberry juice</th>
<th>Ounces of sparkling water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original recipe</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>New recipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your recipe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Fill in the “new recipe” in second row in the table.

B. Does the new recipe taste the same as the original?

C. Create your own recipe for Tina’s berry soda that makes more berry soda, but tastes the same as her original recipe.
Investigation 7: Reddish Orange

Warm Up

1. Evaluate.

<table>
<thead>
<tr>
<th></th>
<th>A.</th>
<th>B.</th>
<th>C.</th>
<th>D.</th>
<th>E.</th>
<th>F.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2•4</td>
<td>5•4</td>
<td>4•5</td>
<td>5•5</td>
<td>8•3</td>
<td>5•3</td>
</tr>
</tbody>
</table>

2. Choose the blend that is the reddest (closest to pure red) purple.

<table>
<thead>
<tr>
<th></th>
<th>50 blue pips to 40 red pips</th>
<th>2 blue pips to 20 red pips</th>
<th>20 blue pips to 30 red pips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 blue pips to 40 red pips</td>
<td>2 blue pips to 20 red pips</td>
<td>20 blue pips to 30 red pips</td>
</tr>
<tr>
<td></td>
<td>20 blue pips to 30 red pips</td>
<td>7 yellow pips to 20 red pips</td>
<td>30 yellow pips to 30 red pips</td>
</tr>
</tbody>
</table>

3. Choose the blend that is the reddest (closest to pure red) orange.

20 blue pips to 30 red pips
Main

4. Carlos makes a green color that he calls Glowing Green with 8 blue pips for every 18 yellow pips.

Vanessa makes a green color with 2 blue pips for every 5 yellow pips. Vanessa says that her color is more yellow than Glowing Green.

A. **Predict.** Do you think that Vanessa’s green is more yellow than Glowing Green?

B. **Check.** Use Activity 7.1 to create Vanessa’s blend.

C. **Explain.** Using both the blend bars and the spectrum, describe how you know which green is more yellow.

D. Rewrite the ratio for Vanessa’s green to complete the table.

<table>
<thead>
<tr>
<th></th>
<th>Blue pips</th>
<th>Yellow pips</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glowing Green</td>
<td>8</td>
<td>18</td>
<td>8:18</td>
</tr>
<tr>
<td>Vanessa’s</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Vanessa’s</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E. **Explain:** Compare the two greens using the numbers of their ratios. Explain how you know whether Vanessa’s green was more yellow.
5. Sara makes an orange color called Sunglow using 4 red pips for every 5 yellow pips. Larry makes a color called Tangerine using 20 red pips for every 26 yellow pips. Larry says that Tangerine is more reddish than Sunglow because he used more red pips than Sara.

A. Use Activity 7.2 to create Sunglow and Tangerine. Compare them, using the container and the spectrum.

B. Explain why Larry is correct or incorrect. Provide a diagram and calculation in your explanation.

Wrap Up

6. True Colors buys snacks for the muralists to take on the road. Monet’s Mix has 5 chocolate bits for every 8 nuts. Van Gogh’s Mix has 8 chocolate bits for every 16 nuts. We want to know which mix has a greater chocolate to nut ratio. Elli says to compare mixes we should always double one of the recipes. Explain how Elli’s strategy might or might not always work.
Problem Solving

7. The bagel shops in town are competing to see who can make the cheesier bagel. Better Batch Bakery makes 7 cheese bagels for every 14 ounces of cheese. The Cheese House makes 21 cheese bagels for every 36 ounces of cheese. The bagels are exactly the same, except for the amount of cheese used. Who makes cheesier bagels?

8. True Colors muralists are playing Tip, Tap, Top again. Taps and tops can be used in different ratios. Cassat’s team played 9 taps for every 14 tops. Moriset’s team played 8 taps for 7 tops. Which team played a “tappier” game of Tip, Tap, Top?

9. Each day, a deli buys 27 pounds of sandwich meat and 21 pounds of cheese.
   A. What is the ratio of pounds of meat to pounds of cheese in simplest form?
   B. The deli makes sandwiches that contain pounds of meat to pounds cheese in a ratio of 10:7. Assume that the deli sells only sandwiches. Will the deli run out of meat or cheese first? Use a picture to help you solve.
10. Vanessa makes a green color with 2 blue pips and 5 yellow pips. Her classmates claim their greens are more yellow than Vanessa’s green. Are their claims true or false?

A. Jenny’s mixture is made of 6 blue pips and 15 yellow pips.

B. Teddy’s mixture is made of 3 blue pips and 6 yellow pips.

C. Raj’s mixture is made of 5 blue pips and 15 yellow pips.

D. Ali’s mixture is made of \( \frac{5}{2} \) blue pips and 1 yellow pip.

E. Josh’s mixture is made of 1 blue pips and \( \frac{5}{2} \) yellow pips.

F. Torus’s mixture is made of 7 blue pips and 18 yellow pips.
Investigation 8: Just Tell Me How Many

Warm Up

1. Evaluate.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>12 ÷ 3</td>
<td>6 ÷ 4</td>
<td>150 ÷ 30</td>
<td>1 ÷ 4</td>
</tr>
<tr>
<td>E</td>
<td>F</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>4 ÷ 16</td>
<td>40 ÷ 160</td>
<td>2 ÷ 3</td>
<td></td>
</tr>
</tbody>
</table>

Main

The recipe for Eggplant Purple is 12 ounces of red paint for every 3 ounces of blue paint. Our artist, Ying, is tired of working with ratios such as 12:3. “Just tell me how many ounces of red you need for every ounce of blue, please,” she requests.

Ying is asking for a unit rate—the number of ounces of red paint per one ounce of blue. For the ratio of red to blue, 12:3, the unit rate is 4 ounces of red per 1 ounce of blue.

[Image: Woman with a Flower, by Paul Gauguin.]
2. Use Activity 8.1 to make one blend of Eggplant Purple with 12 red and 3 blue.

   A. Make a second blend showing the unit rate.

   B. Use the Container tool to compare the ratio and the unit rate.

   C. Draw diagrams of the Container tool that shows the relationship between the ratio and unit rate.

   Ratio container
   Unit rate container

   D. Explain how your diagrams show this relationship.

3. Ying makes another purple called Iris using a ratio of 6 red to 4 blue. She rewrites the ratio in simplest form as 3 red to 2 blue. She thinks Iris has a unit rate of 1.5 ounces red per 1 ounce blue. She draws the diagram below. Explain how the diagram shows the relationship of the ratio and the unit rate forms of Iris.

   The diagram of 6:4 and the diagram of 3:2 each use rows of 3 red to 2 blue. The bottom diagram shows that the 3 red and 2 blue could be divided in half so that for every 1 blue there are 1.5 red. So the diagrams show that a unit rate of 1.5 red per 1 blue is equivalent to a red to blue ratio of 3:2, which is equivalent to a red to blue ratio of 6:4.

   The video in Activity 8.2 helps show how a ratio and a unit rate are related.
A. If Ying is using 3 ounces of blue paint to make Iris, how many ounces of red paint does she need?

B. If Ying is using 15 ounces of blue paint to make Iris, how many ounces of red paint does she need?

4. Unit rates can help us to compare. The following table shows several different colors of purple that Ying created. She needs to figure out which are more red and which are more blue (less red) than Eggplant Purple.

A. Determine the red per blue ounce (oz.) unit rate for each color. You can round to the nearest 100th.

<table>
<thead>
<tr>
<th>Color name</th>
<th>Ratio of red oz. to blue oz.</th>
<th>Unit rate red per 1 blue oz.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggplant Purple</td>
<td>10:5</td>
<td></td>
</tr>
<tr>
<td>Iris</td>
<td>6:4</td>
<td></td>
</tr>
<tr>
<td>Lavender</td>
<td>32:16</td>
<td></td>
</tr>
<tr>
<td>Lyla</td>
<td>40:160</td>
<td></td>
</tr>
<tr>
<td>Orchid</td>
<td>150:30</td>
<td></td>
</tr>
<tr>
<td>Violet</td>
<td>20:30</td>
<td></td>
</tr>
</tbody>
</table>

B. Which colors, if any, are more red than Eggplant Purple?

C. How do you know that these colors are more red?

D. Which colors, if any, are more blue than Eggplant Purple?
E. How do you know that these colors are more blue?

Wrap Up

5. Explain how unit rates can help us to compare ratios.
Problem Solving

6. Our last mural measured 56 square feet. We used 14 containers of paint to complete this mural. How many square feet per container were painted?

\[
\frac{56}{14} = 4
\]

4 square feet per container

7. We have to choose which of two customers to work for. The total amount they offer to pay us and the number of hours it will take us to complete the project for each project are shown in the table below. Which customer is offering a better pay rate per hour?

<table>
<thead>
<tr>
<th></th>
<th>Pay</th>
<th>Number of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diego Rivera Middle School</td>
<td>$315</td>
<td>15</td>
</tr>
<tr>
<td>Ruth Auger Elementary School</td>
<td>$276</td>
<td>12</td>
</tr>
</tbody>
</table>

Diego Rivera Middle School offers $21/hour.
Ruth Auger Elementary School offers $23/hour.
So Ruth Auger Elementary School offers the better rate.

8. At their practices, the volleyball team ran a total of 10 miles in 14 days. The tennis team ran a total of 8 miles in 7 days. Which team ran more miles per day?

The tennis team ran more miles per day. The tennis team ran \(\frac{8}{7}\) (or about 1.1) miles per day. The volleyball team ran \(\frac{10}{14}\) (or about 0.7) miles per day.
9. Find and use the unit rate.

A. There are 2 packs of cucumbers are sold for $4. What is the price for each pack?

B. There are 2 bundles of green onion are sold for $1. What is the price (in dollars) per bundle? At that rate, what is the cost of 7 bundles?

C. Josh typed 280 words in 10 minutes. How many words might Josh type per minute?

D. Jamal typed 525 words in 15 minutes. How many words might Jamal type per minute? At that rate how many words would he type, if he typed for 10 minutes?

E. In Store A, downloading 5 songs costs $2.50. What is the cost (in dollars) per song?

F. In Store B, downloading 15 songs costs $9.75. What is the cost (in dollars) per song? At that rate, what is the cost of 18 songs?

Challenge: How many songs can you buy for 20.00?
Optional Investigation 9: Walls of Metal and Wood

Warm Up

1. Evaluate.

   A. \(220 \div 10\)  
   B. \(200 \div 5\)  
   C. \(450 \div 10\)  
   D. \(160 \div 8\)  

   E. \(125 \div 5\)  
   F. \(675 \div 15\)

Main

SunBay Studios, Hollywood’s fastest rising movie studio, has asked us for help in designing a movie set for its new superhero movie. In the movie set, one backdrop is a wall made of 24 panels. In this task, you will be asked to design the wall, calculate ratios, make predictions, and calculate costs.

The following types of panels can be purchased. Panels can be bought individually, but the pricing is given for the whole pack.

<table>
<thead>
<tr>
<th>Metal Panels</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="example" alt="Type A - Solid Panel" /></td>
<td>Type A – Solid</td>
<td>$450 for a pack of 10 panels</td>
</tr>
<tr>
<td><img src="example" alt="Type B - Striped Panel" /></td>
<td>Type B – Striped</td>
<td>$675 for a pack of 15 panels</td>
</tr>
<tr>
<td><img src="example" alt="Type C - Checkerboard Panel" /></td>
<td>Type C – Checkerboard</td>
<td>$200 for a pack of 5 panels</td>
</tr>
</tbody>
</table>
Wooden Panels

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type D</td>
<td>Light</td>
<td>$220 for 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>panels</td>
</tr>
<tr>
<td>Type E</td>
<td>Medium</td>
<td>$160 for 8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>panels</td>
</tr>
<tr>
<td>Type F</td>
<td>Dark</td>
<td>$125 for 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>panels</td>
</tr>
</tbody>
</table>

Designing the Wall

The new movie’s villain, Aluminum Joe, kills trees by coating them in metal so that photosynthesis cannot take place.

2. The director wants to see two wall designs for Aluminum Joe’s lair. Make each with 24 panels using the boxes below. You can use any combination of metal and wood panels. Put the letter for a type of panel in each box.

Design 1

Design 2
3. Describe each design in terms of ratios for the director. Write ratios in their simplest form.

A. In my first design,

   the ratio of metal to wood panels is: [Blank]

   the ratio of metal to total panels is: [Blank]

B. In my second design,

   the ratio of metal to wood panels is: [Blank]

   the ratio of metal to total panels is: [Blank]

The first/second design is more metallic because: [Blank]

Calculating the Costs

Cost matters too, as well as the ratio of wood to metal. You can use unit rates to help you calculate costs.

4. Tell the director the total cost of each of your two walls and show how you got those totals, so the director understands.

A. For your first design:

   Calculate the unit rate of each type of panel used and write them in order.

   Type A = $45/panel
   Type F = $25/panel
   Type B = $45/panel
   Type D = $22/panel
   Type C = $40/panel
   Type E = $20/panel

   Calculate the total cost using the unit rates and the number of panels you used of each type. Count only the panels you actually used.

   Total cost: [Blank]
B. For your second design:

Calculate the unit rate of each type of panel used and write them in order.

Type A = $45/panel
Type F = $25/panel
Type B = $45/panel
Type D = $22/panel
Type C = $40/panel
Type E = $20/panel

Calculate the total cost using the unit rates and the number of panels you used of each type. Count only the panels you actually used.

Total cost:

5. The director likes both walls but cannot decide which to use. Choose one wall design to recommend for the Aluminum Joe’s lair. Explain your choice by cost and by how the wood to metal ratio works for the Aluminum Joe’s lair. Give other reasons why your design should be chosen. Write your explanation in a paragraph.
Optional Investigation 10: Sunflowers

One of our muralists, Astrid, needs you to mix a variety of yellowish oranges for a mural based on Van Gogh’s Sunflowers. Use Activity 10.1 and create the following red to yellow blends: 1:1, 1:2, and 1:3.

1. **Predict.** Make a sketch to predict where in the spectrum the red to yellow mixtures 1:4, 1:5, and 1:6 will be.

2. **Check.** Check your prediction by making these red to yellow mixtures.

3. **Explain.** Is your prediction right? Explain whether your prediction was correct or not and why.

4. Choose three different colors for Astrid to use in the mural, name them, and write their ratios.

Sunflowers, by Vincent Van Gogh.
1. Predict
   - Estimate!
   - Sketch!
   - Make your best guess.
   - Be creative.
   - Work quickly.
   - Listen actively to other people's predictions.
   - Predictions don't have to be correct.
   - Do mental calculations as needed.

2. Check
   - Use the technology or make a calculation to see if your prediction was correct.

3. Explain
   - Use the representations to support your reasoning.
   - Was your prediction correct? Explain how you know.
   - Was your prediction incorrect? Explain why.
   - Describe how to get the correct answer.
   - Were you surprised? What did you learn?
   - Maybe, make a new prediction!