



RATIOS & PROPORTIONS TEACHER GUIDE

PACING GUIDE

This unit is designed to take about 2 to 3 hours of class time to complete. As with all lessons on Blackbird, this sequence has been designed to allow students to work at their own pace, so students will move through the content differently. Even so, here is a suggested implementation outline for instructors:

- Day 1 - 45-60 minutes:
 - Introduction to Blackbird and Guiding Question for the unit
 - Students complete lessons 1.1 and 1.2
 - Probing Questions 1 and 2 discussion
- Day 2 - 45-60 minutes:
 - Students complete lessons 1.3-1.5
 - Probing Questions 3 and 4 discussion
- Day 3 - 45-60 minutes:
 - Students complete the Guided Project - Unit Rate Calculator
 - Probing Questions 5 and 6 discussion

We have provided suggestions for support and extension in the Stage Guide that follows. The unit has been completed when students have successfully finished the 'Guided Project' activity.

UNIT GUIDE

An overview of major concepts introduced in the unit is listed below. Use the 'Guiding Question' at the start of the unit and 'Probing Questions' once students have finished the activities as a wrap-up discussion. Probing questions can facilitate conversations about what students learned to program, provide opportunities for questions, important concept review, and connection back to the math concepts they're learning and reviewing.

• Fractions and Computers - Unit Questions, Extensions, and Supports

○ Guiding Question:

- “How do computers evaluate fractions?”
- “How can I use computers to help me solve and visualize problems involving fractions?”

○ Probing Questions

- What is an *‘expression’* in computer programming? How do expressions in math class and programming compare?
 - Students might describe how variables need to be declared in a computer program before they can be used in a program. They might also mention the line-by-line nature of programs and the different operators used in programming, / for division for example.
- What does it mean to *‘evaluate’* an expression? How do computers evaluate expressions involving fractions?
 - ‘Evaluate’ in a math or programming setting means to carry out the operations in an expression to find a single value for the expression. When a computer evaluates a fractional expression, like $3 / 4$, it divides 3 by 4 and stores the result as a *decimal*.
- In the lesson ‘Proportional Shapes’ you shrunk the dimensions of a shape by multiplying the height by a variable named portion. Why did *multiplying* make the shape smaller?
 - We want students to make the connection between the value of portion ($\frac{1}{2}$) and the operation - multiplying a value by a number less than one results in a smaller value. This is an important concept for students to understand so they can create their own programs that alter the size of shapes or images by a fraction.
- Describe the *canvas* in your own words. Try to include the vocabulary words *pixels*, *width*, *height*, *browser window*, *coordinates*, and *origin* in your description.
 - The canvas is a graphical space that can be incorporated into every internet browser window. It, like all spaces on a computer screen, is made up of pixels, and these pixels are used to define the width and height of the space. The counting starts in the upper left corner at the ‘origin’. The number of pixels increases as you count down (along the y-axis) and right (along the x-axis). Using a coordinate pair (ie. 100, 100) you can position shapes and text anywhere you want on the canvas.

○ **Extension Ideas**

- At the end of each lesson there is an **'Extra Challenge'** for students to attempt. These challenges ask students to use the 'Work on' button to copy a student's work into a project in the Workshop where they tinker with the code they created within a lesson. Encourage students who finish early to try some of these Extra Challenges.
- Several programming techniques are introduced in this relatively short lesson sequence, and there are many, many more for students to learn about in the **Docs**.
 - Here are some suggestions for Docs you might have your students read, then try to incorporate into a Workshop project:
 - Concatenation
 - New shape objects in the Doc category 'Graphics objects' like 'Ovals' and 'Images'
 - New shape object properties in the Doc category 'Graphics object properties' like 'rotation' and 'font'.
 - Some students might be ready to try building conditional statements into their projects as well. Encourage them to try starting by reading the 'if statement' Doc.
- After students have completed the Guided Project for the stage, challenge them to think of another flag design they could build that uses fractions of the whole flag. Another option would be to challenge them to divide the canvas up into equal parts using shapes and fractions of the canvas. The result would be a checker or tile pattern on the canvas.

○ **Support Ideas**

- The bottom of most tasks have a **'Deep Dive'** button that students can press to see more information and explanations of the code they are typing. Remind students to slow down and read these sections as they can help them make sense of the work they are doing.
- The **'Debug'** button can be used at any time. There are places within lessons that step students through their programs, but making routine use of the Debug button can help students understand how their expressions are being evaluated, and how lines of code are being executed by the program.

LESSON NOTES

Please visit the Docs in Blackbird for more information about items listed in 'Important programming concepts introduced'.

● **Lesson 1.1 - Fractions & Computers**

- **What students have created at the end of the lesson:** A short program that adds two fractions.
- **Important programming concepts introduced:**
 - Assigning and declaring variables
 - Using operators like / and =
 - Using the Variables box to examine variable values

- **Important math concepts:**
 - Creating and evaluating expressions
 - Using variables in place of numbers in an expression
 - Adding fractions as decimals

- **Lesson 1.2 - Proportional shapes**
 - **What students have created at the end of the lesson:** A program that creates a shape, then changes the size of the shape by a fraction.

 - **Important programming concepts introduced:**
 - Shape objects
 - Mathematical operators like * and /

 - **Important math concepts:**
 - Multiplying whole numbers by fractions.
 - Proportionality

- **Lesson 1.3 - Fractions of the canvas**
 - **What students have created at the end of the lesson:** A program that creates shapes that are portions of the canvas space

 - **Important programming concepts introduced:**
 - The canvas dimensions
 - Using variables in place of numbers

 - **Important math concepts:**
 - Using fractions of coordinates to position objects in a coordinate plane

- **Lesson 1.4 - Any fraction you want**
 - **What students have created at the end of the lesson:** A program that asks users to enter a fraction, then fills a glass with water of the appropriate amount.

 - **Note:** This lesson has several tasks that purposely introduce bugs so students have an opportunity to walk through the debugging process.

 - **Important programming concepts introduced:**
 - Positioning shapes relative to each other
 - Debugging

 - **Important math concepts:**
 - Representing proportional relationships with equations.

- **Lesson 1.5 - Multiplying fractions**

- **What students have created at the end of the lesson:** A program that displays two fractions as a part of a unit. The students overlap them to show the result of multiplying the fractions.
- **Important programming concepts introduced:**
 - RGBA colors
- **Important math concepts:**
 - Multiplying fractions

- **Practice Lessons**

- We have included optional practice lessons for this pilot. These lessons are meant to provide more opportunities for your students to practice the programming skills they're learning and are not necessarily tied to math content.
- How you use these lessons throughout the pilot is up to you. Here are some ideas:
 - Require all students to complete them.
 - Use them as practice for students that get stuck on the Guided Project.
 - Have students complete them in pairs or groups, then use the 'Work on' button to make changes to the code in the Workshop

- **Guided Projects**

- The Guided Project for this pilot is a graphic on the canvas - the Colombian flag! Students use fractions of a shape to overlap rectangles to complete the design.
- While not all students will feel comfortable tackling the guided project, please encourage them all to try it. Their feedback about its accessibility will help us improve this unit in the future.

More to come with your help!

We're looking forward to hearing about your teaching experience with this short collection of lessons. Your feedback will guide our future lesson development efforts.

Thanks for all of your support of Blackbird!