SCALE DRAWINGS

A Middle School Lesson About Ratios and Scale Drawings

LESSON PLAN

Whole Class / Partners

- Discuss <u>scale drawing</u>. Consider showing a map and its scale as an example.

Student Page Using a Ratio Strip

- Students cut out the ratio strip from the bottom of the page, or make copies for the entire class. Ask students what they think this tool might be used for.

  In what ways is this ratio strip like a ruler? One of the edges of the strip is marked and labeled in centimeters.

  In what ways is a ratio strip like a double number line? One line is marked in centimeters and the other is marked in feet. Corresponding ratios line up.

  What does the ratio 2 cm : 9 ft mean? Are these measurements the same? No, it means that for every 2 cm on a drawing or picture, the actual measurement is 9 ft.

  If you measured a picture that was 4 cm long, how many feet would that represent in real life? 18 ft.

- Have students fill in the missing measures on their ratio strip, measure the dimensions of the garden, and fill in the first table.

  What are the side length ratios for the scale drawing to the actual garden? For the length, 2 cm : 9 ft, and for the width 6 cm : 27 ft. ***How do the values of these ratios compare?*** They are equal ($\frac{2}{9} = \frac{6}{27}$).

  What is the ratio of the area of the scale drawing to the actual area of the garden? 12 cm^2 : 243 ft^2. ***What is the value of this ratio?*** $\frac{12}{243} = \frac{4}{81}$.

  How does the ratio of the areas compare to the ratio of the lengths? In other words, how do values $\frac{2}{9}$ and $\frac{4}{81}$ compare? The ratio of the areas has a value that is the square of the value of the ratio of the lengths. That is, $\frac{4}{81} = \left(\frac{2}{9}\right)^2$.

- Students complete the page.

Student Page A Floor Plan

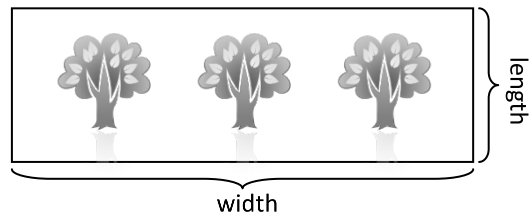
- Students use the ratio strip to read a floor plan. Some students may find it convenient to locate and label odd centimeter tick marks (1 cm, 3 cm, 5 cm, …) and their corresponding measurements in feet on the strip. Share and discuss results as desired.

USING A RATIO STRIP

In a <u>scale drawing</u>, all lengths are multiplied by the same scale factor. If the scale factor is greater than 1, the figure is expanded, and if the scale factor is between 0 and 1, the figure is reduced in size.

Sometimes the scale in a drawing is described using a ratio. A <u>ratio strip</u> is a double number line where equivalent ratios can be easily identified. You will use the ratio strip to interpret drawings using a <u>scale</u> of 2 cm : 9 ft.

1. Here is a drawing of a garden that was created using the scale 2 cm : 9 ft. Use the ratio strip to determine the actual dimensions and area of the garden.



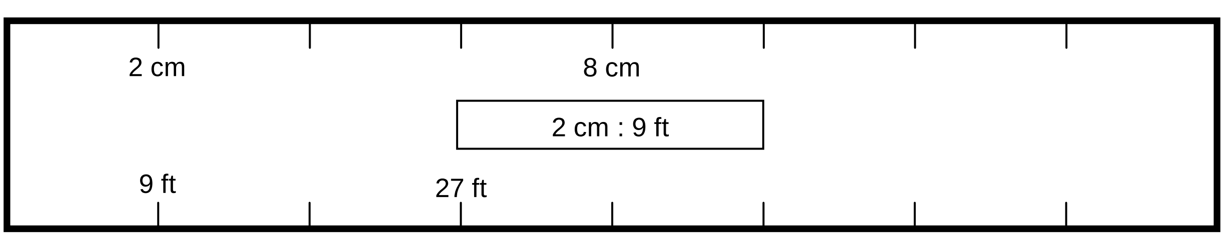
	Drawing dimensions	**Drawing area**	**Garden dimensions**	**Garden area**
Length				
Width				

Use the data from the table above to complete the table below.

		Ratios of measurements drawing : garden	**Value of the ratio**
2.	**Length**		
3.	**Width**		
4.	**Area**		

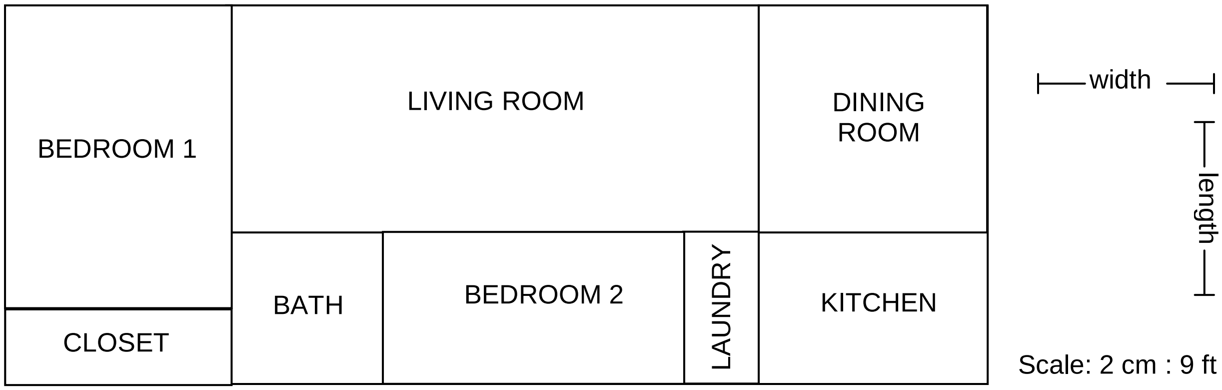
5. Consider the ratio used to create the scale drawing (2 cm : 9 ft), and the ratios found in problems 3 and 4 above. How do the values of these ratios compare?

6. Consider the ratio used to create the scale drawing and the ratio of the areas found in problem 5 above. How do the values of these ratios compare?



A FLOOR PLAN

Architects often use scale drawings to represent actual building floor plans. Use the Ratio Strip to measure some scale drawings of rooms and determine their actual dimensions.



	Room	Drawing length	Drawing width	Actual length	Actual width
1.	Bath	________ cm	________ cm	________ ft	________ ft
2.	Bedroom 2				
3.	Laundry				
4.	Dining Room	3 cm			
5.	Bedroom 1			18 ft	
6.	Living Room				

7. If the length and width of the dining room in the scale drawing were increased by 2 cm each, what would be the new actual dimensions of the dining room?

NOTES FROM THE TEACHER GUIDE

Strategies for a Variety of Learners (From Grade 7, Packet 15)
To benefit some English learners or special needs learners: • (Make concepts clear with visuals. Use hands-on activities.) A ratio strip gives students a hands-on and visual way to make sense of situations involving proportional reasoning. Consider color-coding the ratio strip so that the "actual" and "scale" sides of the strip are in different colors. The same color coding strategy can be used with the table. For enrichment: • Near the end of the lesson and after students have some knowledge about scale, discuss a 1 : 1 scale. ***Why might a 1 : 1 scale not be useful for making scale drawings?*** Because the drawing will be just as big as the object! For example, a 1 : 1 scale drawing of a house that is 50 feet by 30 feet would require a sheet of paper that big! Likewise, a 1 : 1 scale drawing of a flea would not be useful either since the drawing would be just as small as the flea. Scale drawings are useful if they help us shift perspective to see details that we could not see before. As a follow up, ask, ***Is 1 ft : 1 in a 1 : 1 scale?*** No, one could consider it a 12 in : 1 in scale. • Have students use scales on local maps to estimate familiar distances (home to school, home to park, school to a mall), and then check their estimates using technology, such as Google Maps. Students can also explore the Google Maps scale feature in the bottom right corner that changes automatically as the map is resized.

Ratios and Rates – Then and Now (An Excerpt From Grade 7, Packet 6)

Many definitions in mathematics have metamorphosed over time. Originally, the definition of "rectangles" did not include "squares," but it has become standard to include squares as a subset of the rectangle family because it makes many properties easier to explain. To complicate the picture even more, some mathematical terms are defined differently in different textbooks and in different parts of the world. For example, some books define a trapezoid as a quadrilateral with exactly one pair of parallel sides, while others define it as a quadrilateral with at least one pair of parallel sides.

Here we observe changes in the definitions of ratio and rate, as a result of the Common Core State Standards in Mathematics (CCSS-M). In the first column are samples of definitions that have been used in the past.

Before CCSS-M (Some Examples)	Definitions Based on CCSS-M
A ratio is a comparison of two numbers by division. The ratio of a to b is denoted by $a : b$ (read "a to b"), or by $\frac{a}{b}$, where $b \neq 0$. Example: The ratio of 3 to 2 may be denoted by $3 : 2$ or by $\frac{3}{2} = 1.5$.	A ratio is a pair of nonnegative numbers, not both zero, in a specific order. The ratio of a to b is denoted by $a : b$ (read "a to b," or "a for every b"). Example: If there are 3 coins and 2 paperclips in your pocket, then the ratio of coins to paperclips may be denoted 3 to 2 or $3 : 2$. The value of a ratio $a : b$ is the number $\frac{a}{b}$, $b \neq 0$. Example: The value of the ratio of $3 : 2$ is $\frac{3}{2} = 1.5$.