

TASK 1.3.1: CHANGING PERIMETER — TEACHER ACTIVITY**Solutions**

On a sheet of grid paper create one set of axes. Label the axes for this situation – perimeter vs. multiplier. Graph your prediction data for changing the x values in red, graph the data for changing the y values in blue, and graph the data for changing both the x and y values in green.

Share your prediction graph with another group and complete the following:

1. Compare the range and domain for each situation.

The domains for all three situations are the same. The ranges differ:

- the range when both x and y are changed is 0 to ∞
- the range when only the x is changed is m (the total of the y values when x is 0) to ∞
- the range when only the y is changed is n (the total of the x values when y is 0) to ∞ where $m > n$.

2. Discuss the similarities and differences in the graphs.

All three graphs are linear with different y -intercepts and slopes. They all pass through the point $(1, p)$ where p is the original perimeter.

3. Describe proportion in your own words. Give an example of what a proportion looks like in geometry, when using fractions, and represented graphically.

Answers may vary, but make sure that similar figures and dilations are mentioned in relation to proportional situations.

4. Describe dilation in your own words.

Answers will vary, but should include changing all dimensions of a figure by the same scale factor.

5. Describe in your own words a direct variation.

Answers will vary, but participants may say a linear graph going through the origin. Include a group discussion on why the graph must go through the origin.

6. What is the slope-intercept equation for a line? What is the equation for a direct variation? Discuss the similarities and differences in each equation.

The two equations are $y = mx + b$ and $y = kx$. If $b = 0$ then both the equations become $y = mx$ and $y = kx$. Discuss the similarities and differences between k and m .

(Note: the slope is $m = \Delta y / \Delta x$; the constant of proportionality is $k = \Delta y / \Delta x = y/x$)

For example,

Algebra I: Strand 1. Foundations of Functions; Topic 3. Changing Perimeter; Task 1.3.1

$$y = 2x$$

x	y
1	2
2	4
3	6
4	8

$$y = 2x + 1$$

x	y
1	3
2	5
3	7
4	9

$$y = 2x \quad \Delta y / \Delta x = 2 = 2/1 = 4/2 = 6/3 = 8/4$$

$$y = 2x + 1 \quad \Delta y / \Delta x = 2 \neq 3/1 \neq 5/2 \neq 7/3 \neq 9/4$$

For an example, consider a rectangle and a square – all squares are rectangles but not all rectangles are squares. All k 's are slopes, but not all slopes are constants of proportionality.

7. Are any of the three situations in the previous exercises dilations, proportional relationships, or direct variations? Justify your answer by using the tables, equations, and the graphs of the situations.

Answers will vary.

8. How do dilations, proportions, and direct variation relate?

Answers will vary.

Teaching notes

- Allow participants to work in pairs. When they finish, pairs of participants should join together to form a group of 4.
- At the beginning of the task, ask participants to record their definition of direct variation on their paper.
- Make sure that participants make a prediction graph first. The discussion of how and why their predictions do not match their actual results will help clarify participants' understanding of dilations, similar figures, and proportions.

Math notes

Textbooks many times put direct variation at the end of the book in order to link direct to inverse variation. Direct variation is a functional expression of a proportional relationship. This is rarely mentioned in standard texts. The standard explanation for recognizing direct variation is usually limited (the linear graph goes through $(0, 0)$ and $b = 0$). Many teachers have not made the connection between the relationship of k (constant of proportionality) and m (the slope).

TASK 1.3.1 CHANGING PERIMETERS: TEACHER ACTIVITYPart 1 Perimeter vs. x Multiplier

1. Look at the polygon below. Each vertex represents a coordinate point on a grid.
2. Change the polygon by multiplying each x value in the polygon's coordinates by 2. Predict how the perimeter will be affected.
3. Change the original polygon again by multiplying the x value in the coordinates by 3. Predict how the perimeter will be affected.
4. Change the original polygon by multiplying the x value in the coordinates by 4. Predict how the perimeter will be affected.
5. Change the original polygon by multiplying the x value in the coordinates by 5. Predict how the perimeter will be affected.



Part 2 Perimeter vs. y Multiplier

1. Look at the polygon below. Each vertex represents a coordinate point on a grid. Estimate the perimeter of the figure.
2. Change the polygon by multiplying each y value in the polygon's coordinates by 2. Predict how the perimeter will be affected.
3. Change the original polygon again by multiplying the y value in the coordinates by 3. Predict how the perimeter will be affected.
4. Change the original polygon by multiplying the y value in the coordinates by 4. Predict how the perimeter will be affected.
5. Change the original polygon by multiplying the y value in the coordinates by 5. Predict how the perimeter will be affected



Part 3 – Perimeter vs. both x and y multiplier

1. Look at the polygon below. Each vertex represents a coordinate point on a grid. Estimate the perimeter of the figure.
2. Change the polygon by multiplying each x and y value in the polygon's coordinates by 2. Predict how the perimeter will be affected.
3. Change the original polygon again by multiplying the x and y values in the coordinates by 3. Predict how the perimeter will be affected.
4. Change the original polygon by multiplying the x and y values in the coordinates by 4. Predict how the perimeter will be affected.
5. Change the original polygon by multiplying the x and y values in the coordinates by 5. Predict how the perimeter will be affected.

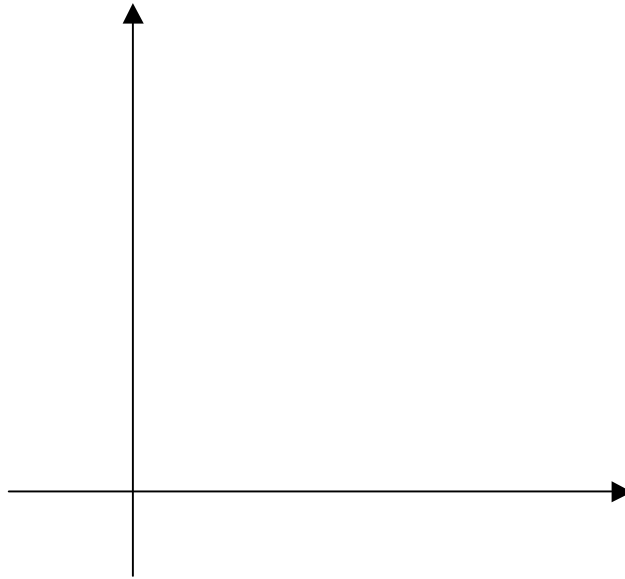
Create a table of values showing the perimeter vs. multiplier. Draw a graph of the possible data (be sure to label the axis) and generate an equation based on your prediction. Record below.



Algebra I: Strand 1. Foundations of Functions; Topic 3. Changing Perimeter; Task 1.3.1

Analysis:

Using the axes provided, sketch your prediction for the changes in the perimeter. Label the axes for this situation – perimeter vs. multiplier. Graph your prediction data for changing the x values in red, graph the data for changing the y values in blue, and graph the data for changing both the x and y values in green.



Share your prediction graph with another group and complete the following:

1. Compare the range and domain for each situation.
2. Discuss the similarities and differences in the graphs.
3. Describe proportion in your own words. Give an example of what a proportion looks like in geometry, when using fractions, and represented graphically.
4. Describe dilation in your own words.
5. Describe in your own words a direct variation.
6. What is the slope-intercept equation for a line? What is the equation for a direct variation? Discuss the similarities and differences in each equation.

