

Name: _____

Period: _____

Paragraphs: Relationship between Height and Width

In this activity, you will investigate: How does the height of the paragraph depend on the width?

Your task is to fit the data and find the function that describes the relationship.

Introduction

If you take a paragraph of text in your word processor, you can change the width of the text by changing the paragraph indents. This is something you may have explored before. If you make the block of text thinner, it gets taller. If you make it fatter, it gets shorter. There must be some sort of relationship here!

The data in this activity summarize the height and width of 7 paragraphs. The font type and font size are the same for all paragraphs.

- Open the Tuva dataset at: <https://tuva.la/2KNQEIo>.

1) Investigate: How does height depend on width?

Make a Prediction!

Before you begin graphing, try to describe what the graph between a paragraph's height and width would look like, or draw a sketch below. Explain your reasoning.

Now Graph it:

- Drag **Width** to the x-axis.
- Drag **Height** to the y-axis.

Explore your graph:

Q1: How does height change with width?

- ___ a. Height decreases as width decreases
- ___ b. Height decreases as width increases
- ___ c. Height does not change with width

Q2: How does the slope of the graph change as width increases?

- ___ a. It becomes less negative
- ___ b. It becomes more negative
- ___ c. It stay constant

Q3: The relationship between height and width is:

- ___ a. Positive, linear
- ___ b. Negative, linear
- ___ c. Positive, Non-linear
- ___ d. Negative, Non-linear
- ___ e. No clear relationship

2) Group Discussion:

- What function might be a good model to explain a paragraph's height and width, based on how the slope gets less negative as width increases, and how height and width are related?

★ *Tuva Tip: Hint* ★

- Consider that height increases when width decreases and it decreases when width increases
- Consider what aspect of the paragraphs stays constant (other than font size) when width and height change

3) Continue to Investigate: How does height depend on width?

Build Your Function

- Choose $f(x)$ from the toolbar located above the graphing area to open the Modeling Card.
- You can enter the function ($y = k/x$) in the editor.
- Notice that this is the same as $\text{height} = k/\text{width}$, with symbols for width and height.

Two things should happen:

1. Your function appears on the graph.
2. The parameter k appears as a slider below the function.

Explore the parameter

★ Tuva Tip: Tweaking the Parameter in Tuva ★

- You can change the value of a parameter by dragging the slider pointer or by typing in a new value and pressing enter. As you do this, the curve will move.
- The default value of k is 1. You can set the upper limit to a large number such as 100 and then move the slider up and down.
- You can tweak the maximum value of k on the slider by clicking on it and inputting the desired value in the box in the middle.

Q4: How does the function behave when you make k larger?

Q5: What happens to the function when you make k smaller but keep it positive?

Q6: Try to fit the data as closely as possible by manipulating k . What is a good value (or range of values) for k ?

Make Sense of the Parameter k

Now we look for meaning. The k you just found seems to work for this particular text.

Q7: If there were twice as much text in each of the paragraphs, how would that change the *relationship* between height and width?

- ___ a. The height will now be twice the width
- ___ b. The height will now be 4 times the width
- ___ c. The relationship will remain inversely proportional

★ *Tuva Tip: Hint for Q7* ★

- Consider what actually changes when you double the amount of text.
- One way to think about it is:
 - ◆ If width were kept constant, and the amount of text doubled, what would happen to height?
 - ◆ After doubling we get a new paragraph. If we vary the width (increase or decrease it), how would height respond?

Q8: If there were twice as much text in each of the paragraphs, how would that affect the value of k , if at all?

- ___ a. k will remain the same
- ___ b. k will double
- ___ c. k will be half of its original value

Q9: Solve your equation for k . What are its units?

- ___ a. cm
- ___ b. cm^2
- ___ c. cm^{-1}

Q10: Using the solution for k , and thinking about the situation, what does k actually mean (what does k represent)?

★ *Tuva Tip: Hint for Q10* ★

- Consider the units of k .

4) Group Discussion

- Why don't all the points fall exactly on the line?
- The inverse function $y = 1/x$ blows up at $x = 0$. Does that happen to the model in our situation? Does that make sense in the context of the paragraphs?