

**LEARNING OBJECTIVE:** We will construct linear functions based on verbal descriptions of data and identify the rate of change and initial value. (G8M6L1)

**ACTIVATING PRIOR KNOWLEDGE**

We can find the equation for a line if we know two points that it passes through.

<p>Find the equation for the line that passes through the two points <math>(-1, 5)</math> and <math>(2, 14)</math></p> <p><math>x_1, y_1</math>      <math>x_2, y_2</math></p> $m = \frac{14-5}{2-(-1)} = \frac{9}{3} = 3$ $y = mx + b$ $14 = 3 \cdot 2 + b$ $14 = 6 + b$ $8 = b$ $y = 3x + 8$	<p>Find the equation for the line that passes through the two points <math>(4, 6)</math> and <math>(-2, 9)</math>.</p> $\frac{9-6}{-2-4} = \frac{-3}{-6} = \frac{1}{2} = m$ $y = \frac{1}{2}x + b$ $9 = \frac{1}{2}(-2) + b$ $9 = -1 + b$ $b = 10$ $y = \frac{1}{2}x + 10$
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**CONCEPT DEVELOPMENT**

We can construct linear functions from verbal descriptions and stories. There is a structure and method to creating these functions.

Example:

**Story:** Serena just purchased a new smartphone, and she is considering different wireless plans from Verizon, AT&T, and others. Text messaging is very important to Serena, and her wireless carrier must have a competitive plan. Verizon charges a monthly service charge PLUS an amount for each text Serena sends or receives...but their advertising does not say how much the monthly service charge is. On the Verizon website, she does see that her total charges for the month if she sends 300 texts would be \$18.00, if she sends 400 texts, it would be \$21.00, and if she sends 500 texts, it would be \$24.00.

**Graph:** If we were to try to graph these data points, what variable would be on the x-axis?

texts

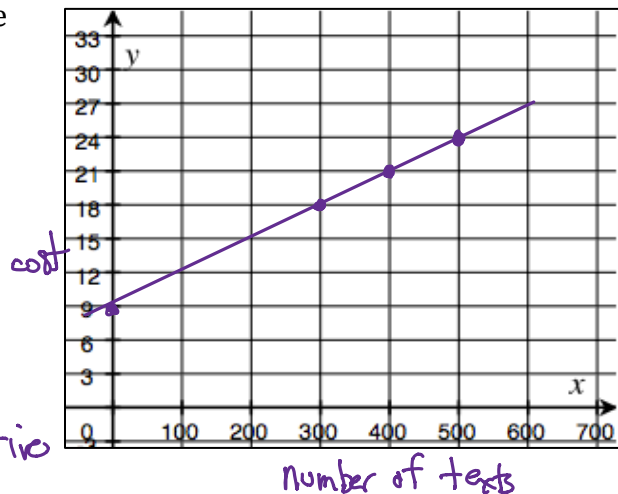
What variable would be on the y-axis?

cost

Why do we only need to graph the problem in quadrant 1?

"CONTEXT"

You can't send negative texts



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**Table:** Can we use a table to help define our function?

Number of Texts (x)	Total Cost for Texting (y)
0	9.00
100	12.00
200	15.00
300	\$18.00
400	\$21.00
500	\$24.00
600	\$27.00
700	\$30.00

How much does it cost to send each text message?

\$0.03 RATE OF CHANGE

How much is monthly service charge? This is the price when you have not sent any text messages.

\$9.00 INITIAL VALUE

**RATE OF CHANGE:** This is the slope of the line and describes change in the values of  $y$  for every one unit increase in the values of  $x$ . It is the coefficient of  $x$ . (in this case, how the price changes depending on the number of texts)

When the rate of change is **positive**, the linear function is **increasing**.

When the rate of change is **negative**, the linear function is **decreasing**.

**INITIAL VALUE:** This is the  $y$ -intercept of the line. It is a constant value of  $y$  when  $x$  is 0. This is the value of  $y$  when  $x$  has no impact.

**Equation:** We can now build an equation if know the rate of change and initial value. The equation that represents the linear function will be in the form  $y = mx + b$ .

$$y = (\text{rate of change})x + \text{initial value}$$

What is the linear equation that models the relationship between the cost Serena pays and the number of text messages she sends and receives?

$$y = .03x + 9$$

**GUIDED PRACTICE****Steps for Modeling Linear Relationships**

1. Read the story carefully.
2. Create a table of values and/or graph the points on a coordinate plane.
3. Identify the rate of change and the initial value.
4. Create an equation to represent the function.

A band is paid a flat fee for playing at a concert. Additionally, they get a fixed amount of money for every ticket sold. If 40 tickets are sold, they will be paid \$200, and if 80 tickets are sold, they will be paid \$280.

- a. Create a table of values

Tickets Sold	Money paid to band
0	\$120
20	\$160
40	\$200
60	\$240
80	\$280

- b. Determine the rate of change. What does the rate of change MEAN in the context of the story?

$$\frac{280-200}{80-40} = \frac{80}{40} = 2$$

The band makes \$2 for every ticket sold

- c. Determine the initial value. What does the initial value MEAN in the context of the story.

Flat fee the band gets  
\$120

Thinking about the example on pages 1 and 2, Serena is also considering AT&T's plan. Like Verizon, AT&T charges a monthly service charge and a per text fee. AT&T's plan would cost \$36.00 for 600 text messages, \$40.00 for 700 texts, and \$44.00 for 800 texts.

- a. Fill in the table of values below.

Number of texts	Total cost for texting
0	12.00
600	36.00
700	40.00
800	44.00
400	28.00
500	32.00

- b. Determine the rate of change. What does that MEAN in the context of the story?

\$0.04 Cost of a text

- c. Determine the initial value. What does it MEAN in the context of the story.

$$y = .04x + b$$

$$36 = .04(600) + b$$

$$36 = 24 + b$$

$$b = 12$$

AT&T Flat fee is \$12.

- d. Is Verizon better than AT&T?

VERIZON.

A rental car company offers a rental package for a mid-size car. The cost is comprised of a fixed \$30 administrative fee for cleaning and maintenance of the car, plus the rental cost of \$35 per day.

a. Write a linear function to represent this situation. What does the slope MEAN in the context of the story? What does the y-intercept MEAN in the context of the story?

$$Y = 35x + 30$$

*cost per day*      *admin. fee*

b. The same company is advertising a deal on compact car rentals. The linear function  $y = 15 + 30x$  can be used to model the relationship between the number of days ( $x$ ) and the total cost ( $y$ ) of renting a compact car.

What is the fixed administrative fee?

\$15

What is the rental cost per day?

\$30

When someone purchases a new car and begins to drive it, the resale value of the car (in dollars) goes down each year. This is called depreciation. Let  $x$  represent the number of years since purchase and  $y$  represent the resale value of the car (in dollars). The linear function that models this situation is  $y = 20000 - 1200x$ .

a. Identify and interpret the rate of change.

-1200 \$ you lose each year

b. Identify and interpret the initial value.

\$20000 New car price

c. Is the function increasing or decreasing? What does this mean in the context of the story?

decreasing

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Paid music download services like iTunes are a great way to enjoy lots of music. One service, iLoveMusic offers downloads of individual songs with the following price structure: a \$3 fixed fee for monthly subscription plus a fee of \$0.25 for each song you download. Another service, PinkUnicornMusic, has a competing offer that charges a fixed fee of only \$2 for monthly subscription, but they charge \$0.40 for each download.

a. Write a linear equation that represents the costs for each music service.

b. What does the “initial value” and “rate of change” refer to in this situation?

c. When is it better to subscribe to PinkUnicornMusic? How do you know? Graph the functions on a coordinate plane, or create tables that show the total costs for each subscription.

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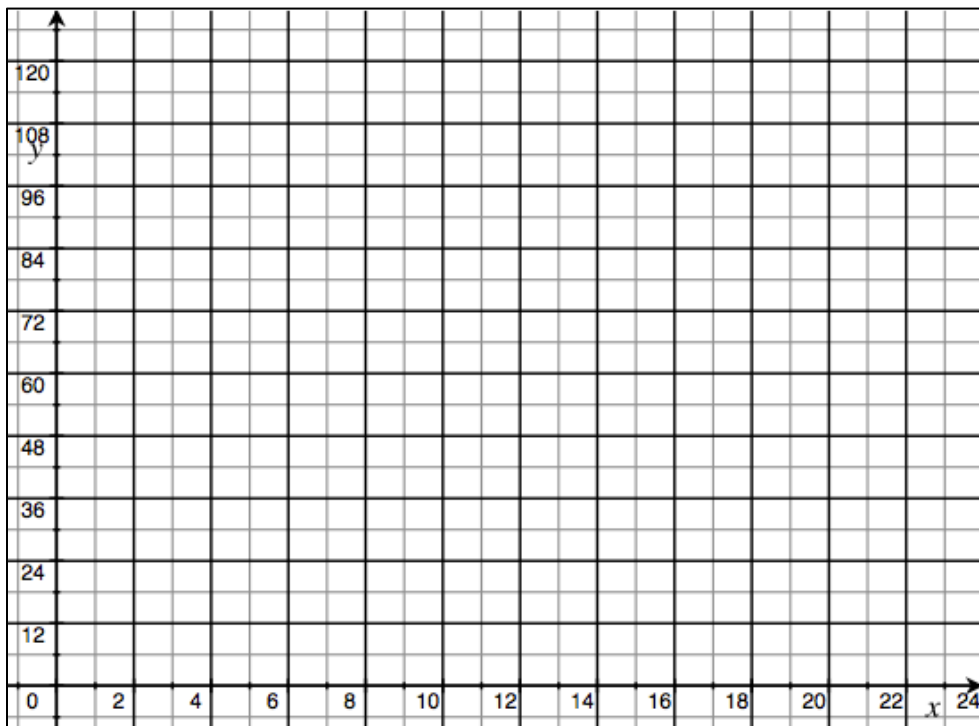
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A new amusement park is opening up and has three different options for its customers to consider in terms of pricing. Option A has patrons paying one price at the entrance gate, \$95.00 and getting on all rides for free. Option B involves paying nothing at the entrance gate, but then having to pay \$6 to get on each ride. Option C asks patrons to a reduced entrance fee of \$30, but then pay \$4 for each ride.

a. Let  $x$  be the number of rides you go on, and let  $y$  be the total cost for your entertainment. Write linear equations for each of the pricing options.

b. Explain what the slope means in this story. Which line has the steepest slope?

c. Graph each equation in the space provided, and indicate when you would purchase which option.



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## INDEPENDENT PRACTICE

Problem set from lesson 2 can be Independent practice and HW.

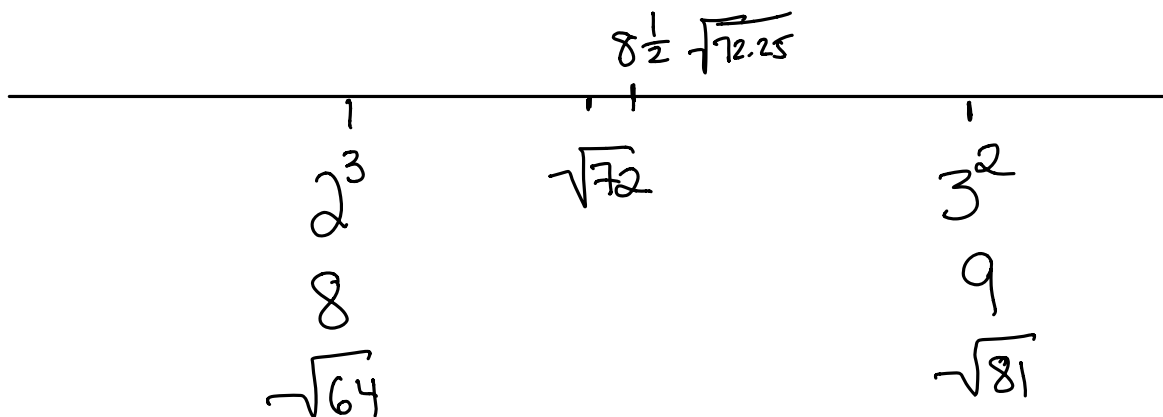
## CLOSURE

Give out exit ticket for lesson 2.

## NOTES

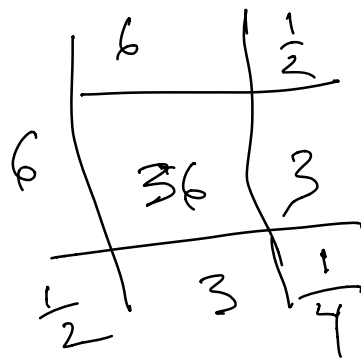
Which two numbers are closer?

$$2^3, 3^2, \sqrt{72}$$

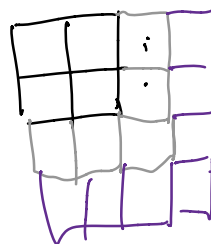


72 is closer to 64 than 81  
 $\therefore \sqrt{72}$  is closer to  $\sqrt{64}$  than  $\sqrt{81}$

$$\begin{array}{ccc} 6 & 6.5 & 7 \\ \sqrt{36} & \sqrt{42.5} & \sqrt{49} \end{array}$$



1	1
2	4
3	9
4	16
5	25
6	36
7	49



$$\begin{aligned} 36 - 25 &= 6 + 5 \\ 49 - 36 &= 7 + 6 \end{aligned}$$