AFDA Student-Directed Review/Enrichment

The following activities are related to topics that you have learned about earlier this year. You may choose to work your way through all of the activities in order, or to prioritize working on activities for topics that you don't remember as well or that you struggled with earlier in the year.

If you need extra support in any of these topics, log into Mathspace (https://bit.ly/fcpsmathspace) using your regular FCPS username and password, and navigate to the associated topic in the eBook. You will find explanations and videos there.

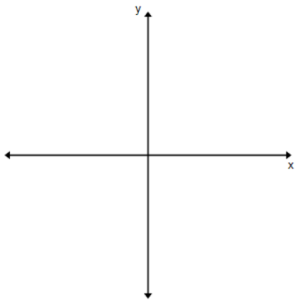
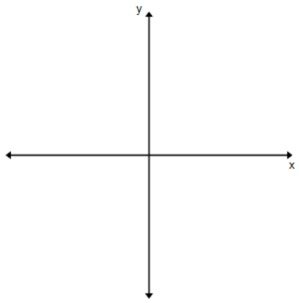
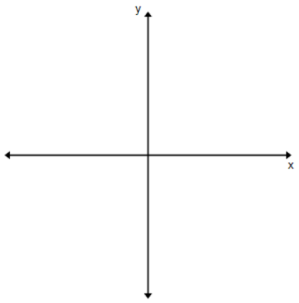
Contents of this Packet:

Function Transformations

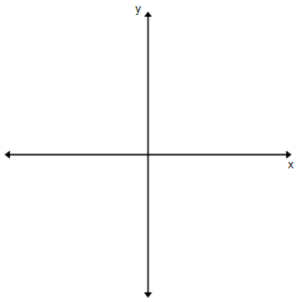
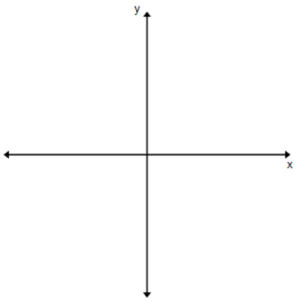
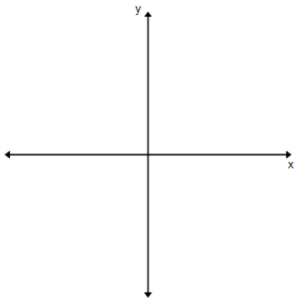
A ***reflection*** is a movement where a graph "flips" over an axis (or another designated line of reflection). It is called a reflection because it will be a mirror image of the original.

Sketch the graph of each function below on the given graph.

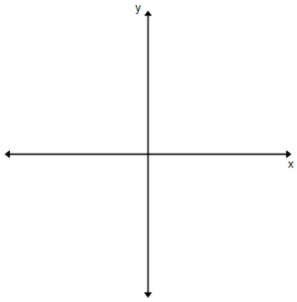
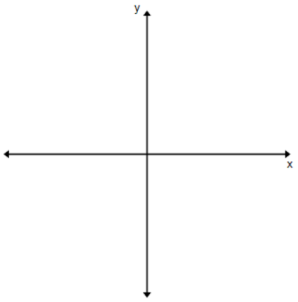
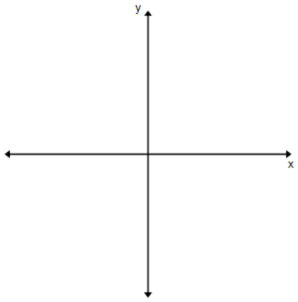
1. a) $y = x^2$ b) $y = -x^2$ c) $y = (-x)^2$

2. a) $y = e^x$ b) $y = -e^x$ c) $y = e^{-x}$

3. a) $y = \ln x$ b) $y = -\ln x$ c) $y = \ln(-x)$

What do you notice about the graphs of $-f(x)$ in each problem b above?

What do you notice about the graphs of $f(-x)$ in each problem c above?

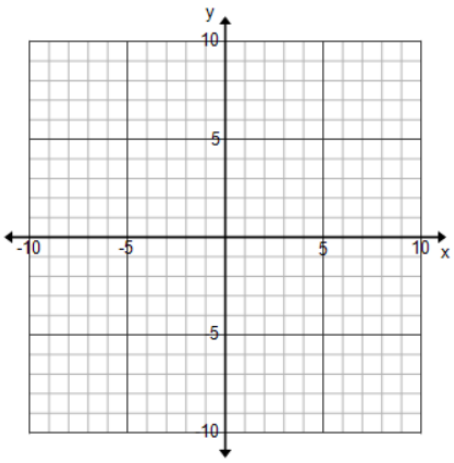
A ***dilation*** is a transformation that enlarges or shrinks a graph.

Graph each below on the same graph. Use different colored pencils to graph each, so you can compare your graphs.

4. a) $y = x^2$

   b) $y = 2x^2$

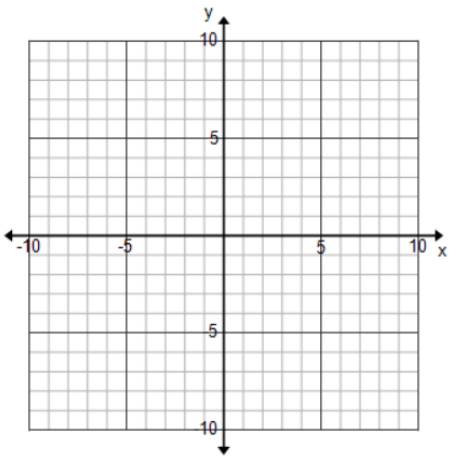
   c) $y = 0.5x^2$



5. a) $y = e^x$

   b) $y = 2e^x$

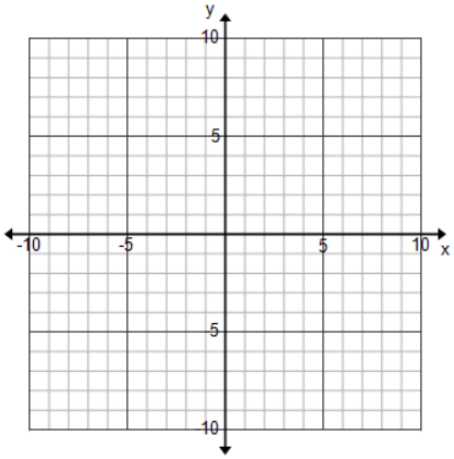
   c) $y = 0.5e^x$



6. a) $y = \ln x$

   b) $y = 2\ln x$

   c) $y = 0.5\ln x$



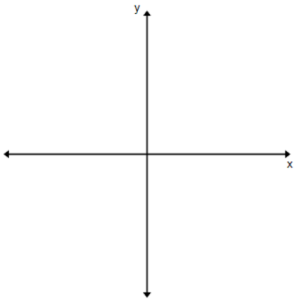
What do you notice about the graphs of $af(x)$ when $a > 1$, in each b above?

What do you notice about the graphs of $af(x)$ when $a < 1$, in each c above?

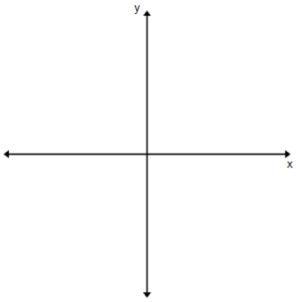
A ***translation*** is a transformation that involves sliding a graph vertically or horizontally.

Sketch the graph of each function below on the given graph.

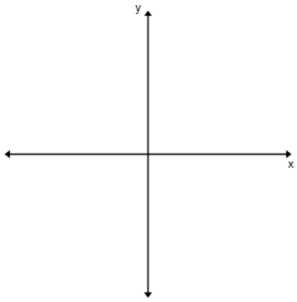
7. a) $y = x^2$



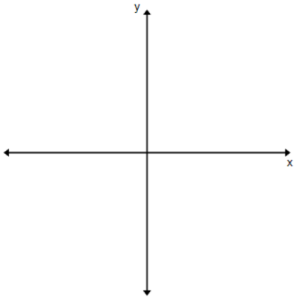
b) $y = x^2 + 3$



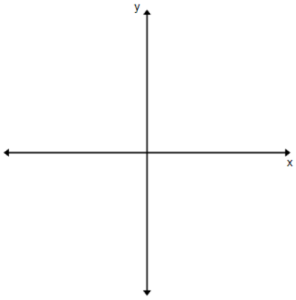
c) $y = x^2 - 3$



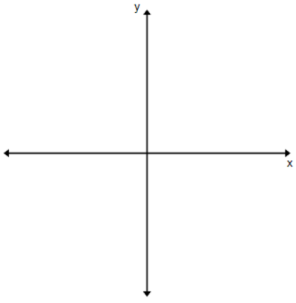
d) $y = (x-3)^2$



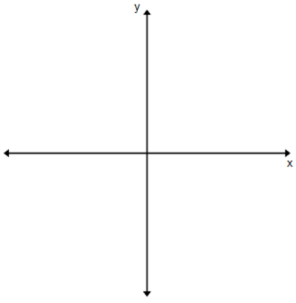
e) $y = (x+3)^2$



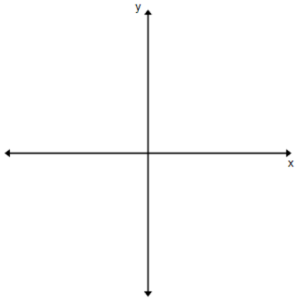
8. a) $y = e^x$



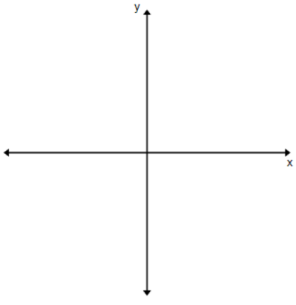
b) $y = e^x + 3$



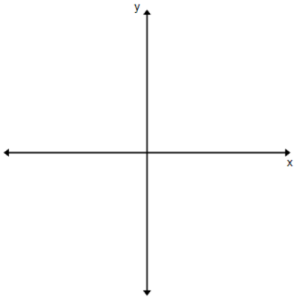
c) $y = e^x - 3$



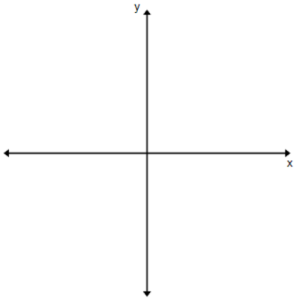
d) $y = e^{x-3}$



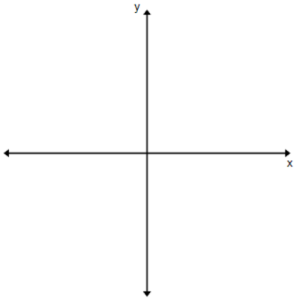
e) $y = e^{x+3}$



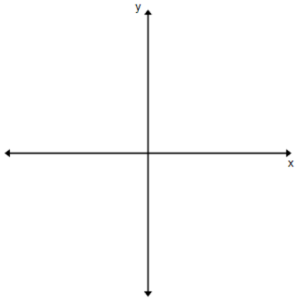
9. a) $y = \ln x$



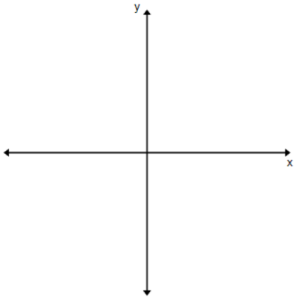
b) $y = \ln x + 3$



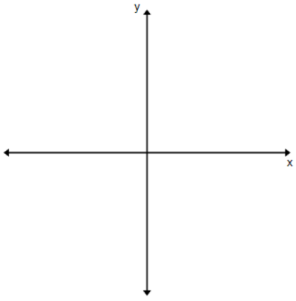
c) $y = \ln x - 3$



d) $y = \ln(x - 3)$



e) $y = \ln(x + 3)$



What do you notice about the graphs of $f(x) + k$ in b) and c) above?

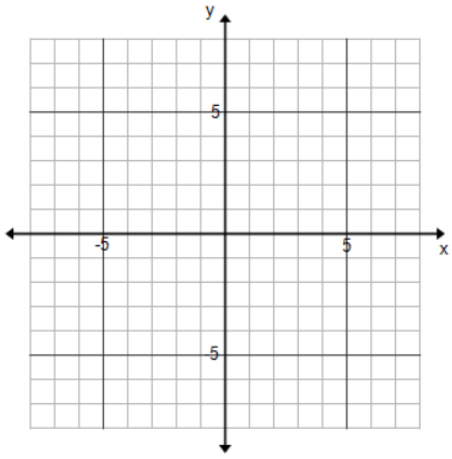
What do you notice about the graphs of $f(x - h)$ in d) above?

What about the graphs of $f(x + h)$ in e) above?

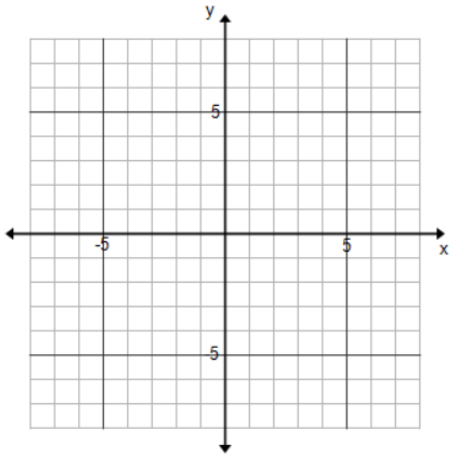
Transformations Practice

Describe the transformations of the parent function and sketch the graph.

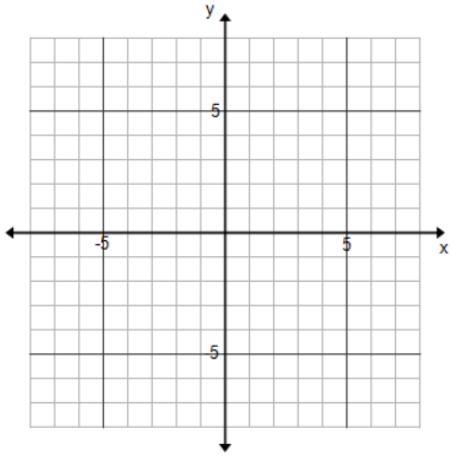
1. $y=(x-3)^2+4$



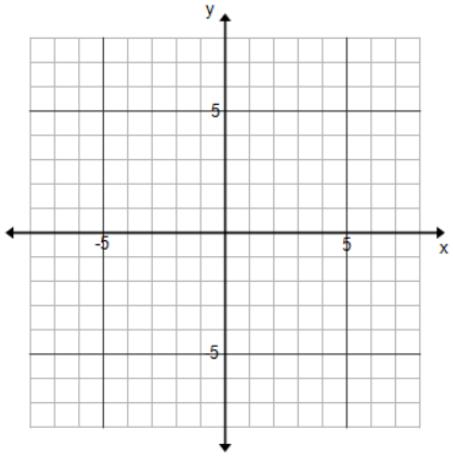
2. $y=2e^{x+4}$



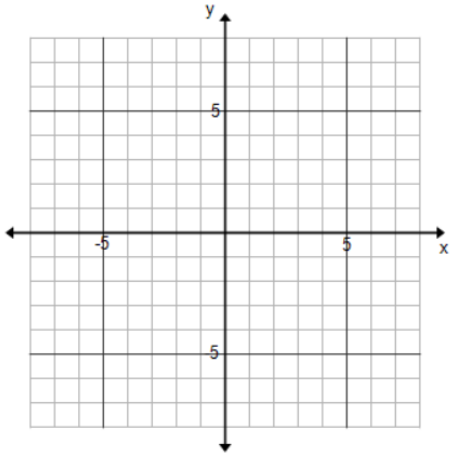
3. $y=-\ln(x-3)+1$



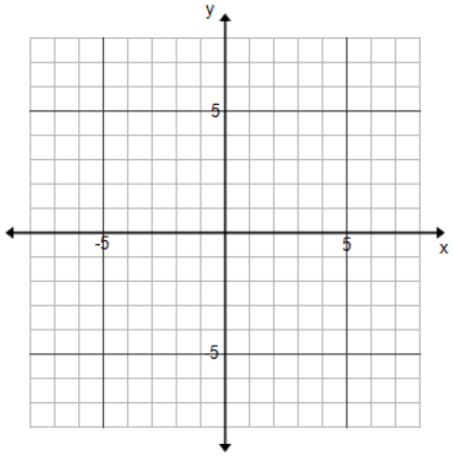
4. $y=\ln(-x)-4$



5. $y=0.5(x+4)^2-2$



6. $y=-x+3$



Write the equation of each function described below.

7. An exponential function reflected across the y-axis and translated up 3.

8. A quadratic function that is reflected across the x-axis, translated right 2 and down 4.

9. A logarithmic function dilated by a factor of 2 and translated left 1 and up 5.

10. A linear function translated right 2.

Quadratics Playground Exploration

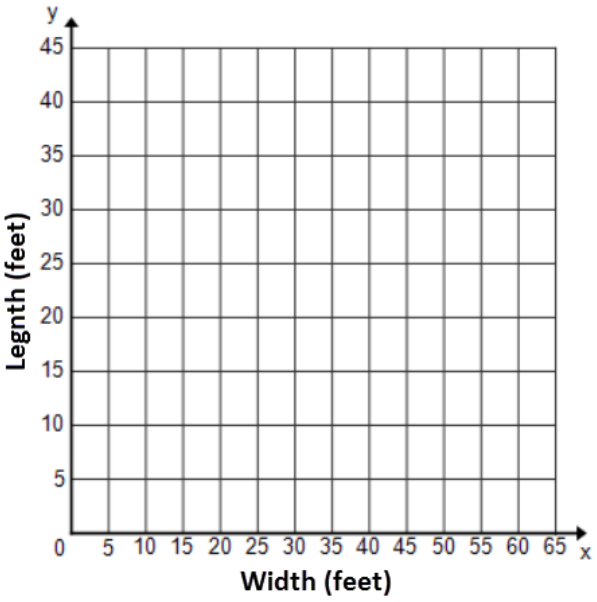
Mary Ellen wants to add a playground to the backyard of her home for her small children. For convenience and safety, she wants the playground to be enclosed with a fence, but one side of the play area will be bounded by the house. She went to the store and got a great deal on 60 feet of fencing. She is trying to determine the best dimensions for the playground but is frustrated by the task. She decides to create a chart with the data she has already derived. Using the chart and the corresponding graph will enable Mary Ellen to make a wise decision.

Collecting the Data

1. Complete the following table:

WIDTH	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
LENGTH											
PERIMETER											
AREA											

2. Graph the relationship between the width (in feet) and the length (in feet) of the playground.



   a. Describe the change in the playground by comparing the width (in feet) to the length (in feet).

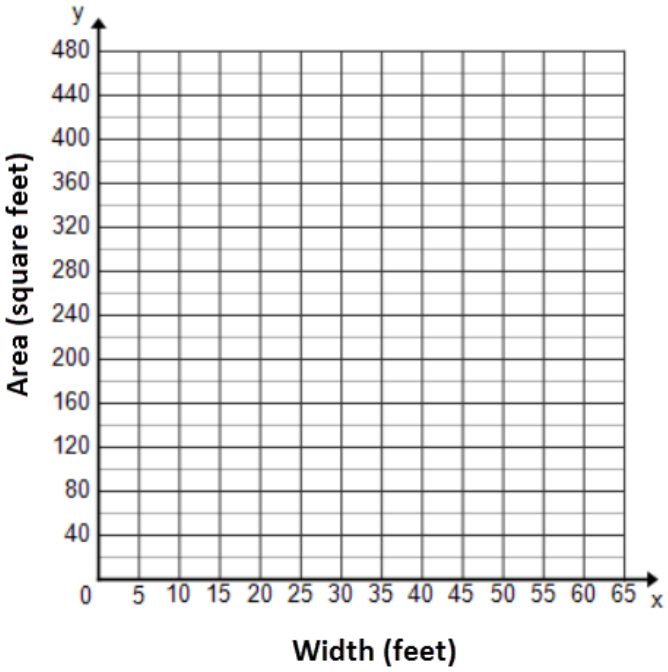
b. What type of function models the curve relating width to the length of the playground? Explain your reasoning.

c. Determine the function that describes the curve relating width to length. (Note: Use a graphing utility to help you.)

y = _____

d. In your own words, describe how the curve relates width to length.

3. Graph the relationship between width (in feet) of the playground to its overall area (in square feet).



a. Describe the change in the playground by comparing the width (in feet) to the overall area (in square feet).

b. What type of function models the curve relating width to the area of the playground? Explain your reasoning.

c. Determine the function that describes the curve relating width to the area of the playground. (Note: Use a graphing utility to help you.)

   y = _____

d. In your own words, describe how the curve relates width to the area of the playground.

4. You have made your decision about the best length and width of the playground. The maximum area will be _____, which is created using the following dimensions: _____.

5. Describe how you might determine the answers to maximize the area and determine the dimensions using the graphs.

6. Determine the following for the given scenario.
   a. Domain - _____; Range - _____

   b. Explain and state the equation written in (*h, k*) form that represents the data.

   c. What is the equation for the line of symmetry for the graph illustrating the scenario?

   d. Describe what is happening in the practical situation when the graph is increasing and/or decreasing.

   e. Describe the relationships between the data represented in the table, on the scatterplot, and as elements of the function.

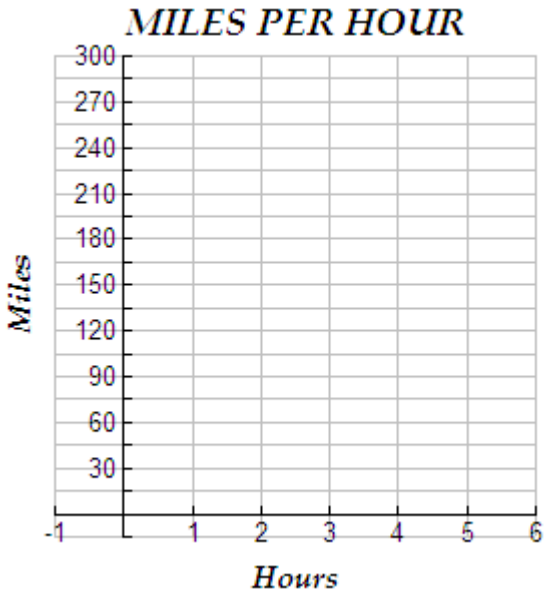
Up to Speed

Looking at the Data

1. Create a scatterplot using the data and coordinate plane provided below.
   a. What is the independent variable?

   b. What is the dependent variable?

Hours	Miles
0	0
1	64
2	118
3	178
4	241
5	298



2. Using a graphing utility, enter data into the lists. Graph the scatterplot in an appropriately sized window.
   a. What is the domain of the relation?
   b. What is the range of the relation?
   c. Is the relation continuous?
   d. Is the relation a function?
   e. What family of functions does the data most resemble?
   f. Write the general form of the equation that would represent the data.

3. What is the average rate of change in miles per hour for the entire trip?
   a. Show computations.

   b. Using your graphing utility's statistics function, determine the equation of the line of best fit using the general form of the equation representing the data. Record the equation for the line of best fit.

   $y =$ _____

c. What do you notice about your answers in parts 3a and 3b?

4. What is the rate of change in miles per hour when driving, according to the table, from time = zero to the end of the first hour?
   a. Show computations.

   b. Enter the data for the indicated hours and distance into a graphing utility. Readjust the window and graph. Using the graphing utility's statistics function, determine the equation of the line of best fit using the general form of the equation representing the data. Record the equation for the line of best fit.

      $y =$ _____

   c. What do you notice about your responses to parts 4a and 4b?

5. What is the rate of change in speed when driving, according to the table, from the 3rd to the 4th hour?
   a. Show computations.

   b. Enter the data for the indicated hours and distance into a graphing utility. Readjust window and graph. Using the graphing utility's statistics function, determine the equation of the line of best fit using the general form of the equation representing the data. Record the equation for the line of best fit.

      $y =$ _____

   c. What do you notice about your responses to parts 5a and 5b?

6. Compare each of the answers in 3c, 4c, and 5c. Explain what you noticed in the comparison.

7. What do you think the average rate of change in miles per hour was 2 hours after the start of the trip?

8. Calculate the distance traveled at
   a. 3 hours

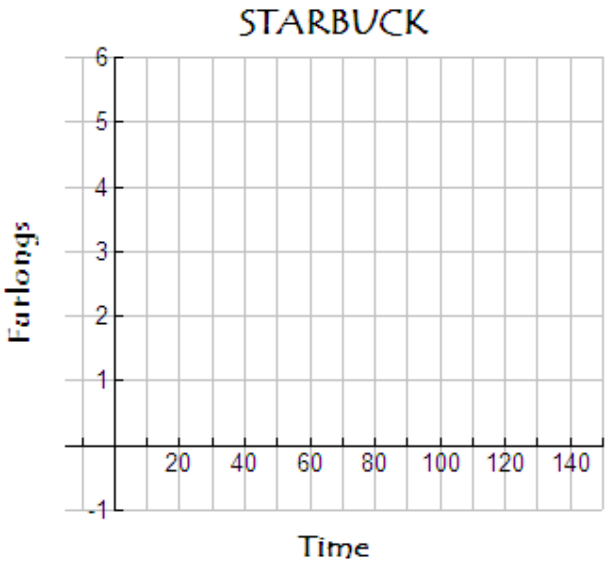
   b. 7 hours

   c. 1.5 hours

See Starbuck Run

Mike Millionaire is watching a 10-furlong steeplechase near Charles Town, West Virginia. He is doing some research during the steeplechase in anticipation of attending to watch his favorite horse, Starbuck, at some future date. As Starbuck passes a furlong (F) marker, Mike records the time (t) elapsed in seconds since the beginning of the steeplechase. The data are shown in the table below.

Furlong	Time
0	0
1	23
2	33
3	46
4	59
5	73
6	86
7	100
8	112
9	124
10	135



Looking at the Data

1. Create a scatterplot using the data and coordinate plane above.
   a. What is the independent variable?

   b. What is the dependent variable?

2. Using a graphing utility, enter data into the lists and graph in appropriately sized window.
   a. What is the domain of the relation?
   b. What is the range of the relation?
   c. Is the relation continuous?
   d. Is the relation a function?
   e. What family of functions does the data most resemble?
   f. Write the general form of the equation that would represent the data.

   g. What unit of measure would be appropriate for the average rate of change in furlongs over a given time?

3. How fast is Starbuck running from the start to the very end of his event?

4. How fast is Starbuck running from the exact moment he passes the 4th furlong marker to the moment he passes the 5th furlong marker?

5. How fast is Starbuck running from the moment he passes the 6th furlong marker to the moment he passes the 7th furlong marker?

6. How fast is Starbuck running during the last furlong?

7. How long does it take for Starbuck to finish the event?

8. Using a graphing utility, determine the equation of the line of best fit for the given data. Record the equation.

   $y =$ _____

   a. What does the ***a*** in the equation of the line of best fit represent?

   b. What does the ***b*** in the equation of the line of best fit represent?

9. How does the appearance of the data in this activity compare with the Up to Speed activity?

10. How does the equation of the line of best fit relate to the outcomes of questions 3 through 7? Explain.

11. What is the average rate of change when the horse was 46 seconds from the start of the steeplechase?

12. Calculate the total distance traveled at the end of:
    a. 46 seconds

    b. 150 seconds

    c. 90 seconds

Investigation

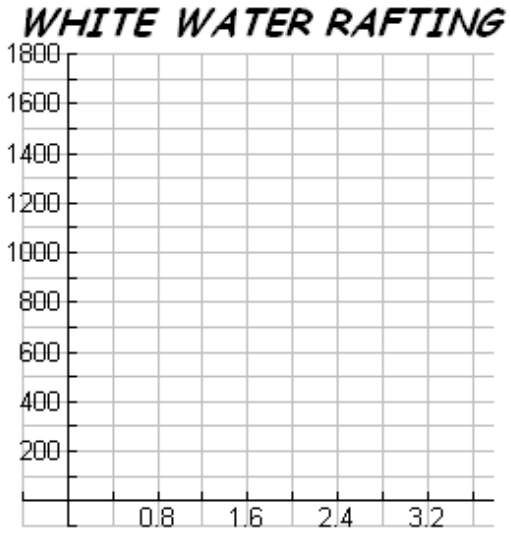
13. Between which two furlong markers is Starbuck running the fastest? Show your computations and explain in writing.

14. Compare the values recorded in the table with the graph, the average rate of change, and what is happening in the steeplechase. Explain what you notice in the comparison.

White-water Rafting on Silly Creek

White-water rafting enthusiasts in West Virginia enjoy a stretch of 3.60 miles on Silly Creek. A contour map of a section of the river shows a drop in elevation of more than 770 feet. Estimations of the elevations in feet (y) at various distances in miles down the creek (x) from the start of the rafting trip are shown in the table below.

Distance	Elevation
0	1575
0.55	1515
0.91	1445
1.2	1385
1.3	1321
1.42	1261
1.63	1199
1.73	1139
1.97	1041
2.24	997
2.45	931
2.78	862
3.6	801



Displaying the Data

1. Create a scatterplot using the above data and coordinate plane provided.
   a. What is the independent variable?

   b. What is the dependent variable?

2. Using a graphing utility, enter data into lists and graph in appropriately sized window.
   a. What is the domain of the relation?
   b. What is the range of the relation?
   c. Is the relation continuous?
   d. Is the relation a function?
   e. What family of functions does the data most resemble?
   f. Write the general form of the equation that would represent the data.
   g. What unit of measure would be appropriate for the average rate of change in elevation over a given distance?

3. Distance is measured in _____.

4. Elevation is measured in _____.

5. What unit of measure would be appropriate for the average rate of change in elevation for a given distance?

6. Calculate the total distance traveled. Show calculations.

7. Calculate the total change in elevation.

8. What is the average rate of change in the elevation over the distance traveled from the start to the very end of the trip for the white-water rafter?

9. Explain how your answers to questions 6 and 7 relate to your findings in question 8.

10. What is the rate of change in the elevation over the distance traveled from the start of the trip, 0 miles, to the time when the white-water rafter passes the 0.55 mile marker?

11. What is the rate of change in the elevation over the distance traveled from the time when the rafter passes the 1.73 mile marker to the time when she passes the 1.97 mile marker?

12. Using a graphing utility, determine the line of best fit using linear regression.

    $y =$ _____

    a. What does ***a*** in the equation of the line of best fit represent?
    b. How is ***a*** related to white-water rafting on Silly Creek?
    c. What does the ***b*** in the equation of the line of best fit represent?
    d. How is ***b*** related to white-water rafting on Silly Creek?

13. How does the data in this activity compare to the data in the Up to Speed activity and the See Starbuck Run activity?

14. Compare the equation of the line of best fit (question 12) to your results in questions 10 and 11. Explain.

15. Determine the average rate of change in the elevation over the distance traveled when the white-water rafters pass the 1.42 mile marker.

16. Calculate the elevation at the specified distances from the beginning of the trip:
    a. 1.3 miles

    b. 1.8 miles

    c. 3.75 miles

Investigation

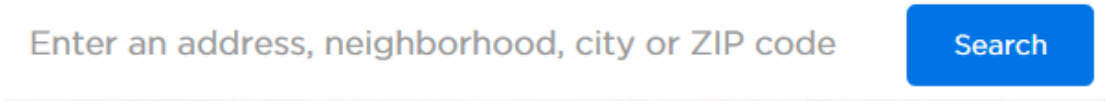
17. White-water rafting on Silly Creek will be most dangerous between which two points? Explain your reasoning.

18. Relate the values recorded in the table with the graph, the average rate of change in elevation over the distance traveled, and what the white-water rafters experience during their trip.

Find the Appropriate Model

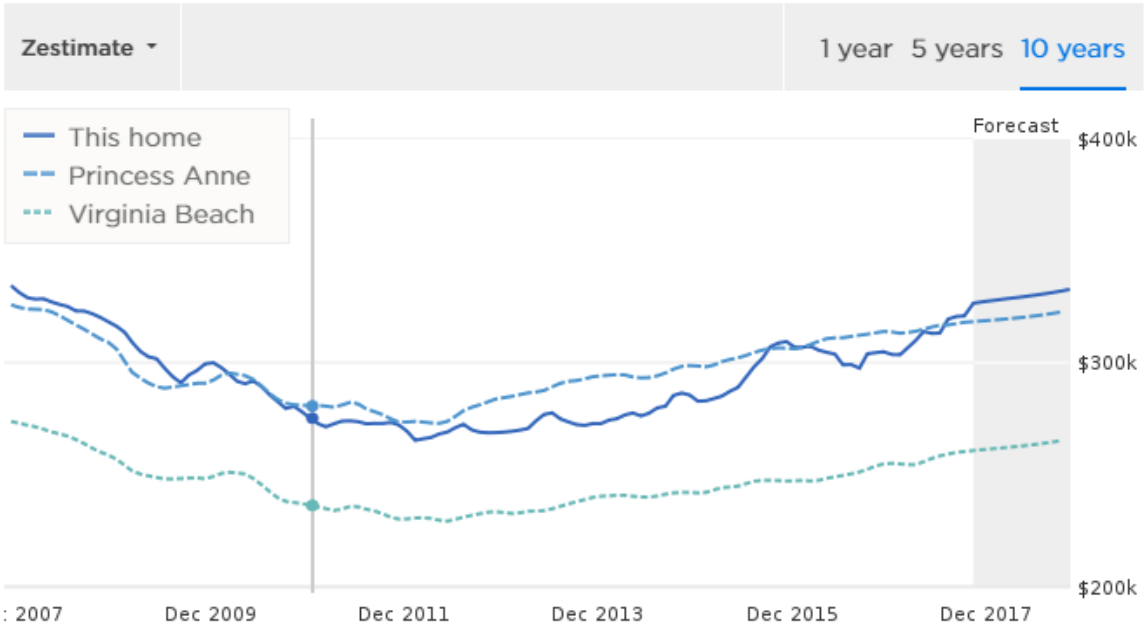
Direction: In this activity, you are expected to find a data set on the internet and present the data using graphs and tables. Determine an appropriate function model (linear, exponential, or quadratic) to find an equation for the curve of best fit, and use the equation to make predictions. Then, evaluate the reasonableness of the mathematical model.

1. Go to the Zillow.com website, then type a house address of your choice.



2. Scroll down the page and look for the price history of the house for the last 10 years by clicking this.

3. You will see a graph like the sample shown below. Drag the vertical line back and forth to see the price history of the house for the past 10 years. There is a price comparison between the house, the average price in the neighborhood, and the average price of the city/county.



4. If the price history is not available, use the tax assessment history for the past 10 years. Then, plot the points (year, tax assessment) and create a scatterplot of the data.

5. Complete the table below to indicate the estimated price of the house for the past 10 years.

Year	Price of this home	Average Price of the Neighborhood	Average Price of the City/County
2007			
2008			
2009			
2010			
2011			
2012			
2013			
2014			
2015			
2016			
2017			

6. Using a graphing utility, input the data, create a scatterplot, and determine an appropriate function that models the data.
   a. Model 1: Year vs. Price of the home _____

   b. Using the equation in Model 1, what could have been the estimated price of the house in 2009? _____
      2012? _____
      2015? _____

      Compare the estimate using the equation and the actual value from the table.
      How well does the equation fit the data set? Explain your thinking.

   c. Using the equation in Model 1, predict the value of the house in
      2019 _____
      2022 _____
      2025 _____
      Are the predicted values reasonable? Explain your answer.

   d. Do you think the equation in Model 1 can be used to predict the value of the house in the next 10 years? What are the limitations of the model?

Politics and Opinions

You have been hired by the School Board to answer this question about *all* of the students/teachers in your school: How much homework do teachers assign and/or do students do? Unfortunately, you cannot possibly get that from everyone, so you decide to take a sample and use the data from your sample to make conclusions about the entire school population.

Initial Questions

1. What types of quantitative questions do you think need to be asked?

2. What qualitative questions should be asked?

3. What type of demographic information might be useful to the School Board?

4. Because you are going to use a sample, which type of sampling strategy will get you the most accurate information? How many students need to be included in the sample?

5. What types of things could bias your sample in this survey that you have created? What steps can you take to reduce and address bias of those completing the survey?

6. Construct a five- to eight-question survey that contains quantitative and qualitative questions. Be sure to include the personal data you want as well.

Homework Survey

The purpose of the survey is to find out information requested by the School Board.

1.

2.

3.

4.

5.

6.

7.

8.

7. Describe the plan you have to gather the sample data. Include the number in your sample, your strategy, and timeline.

Sample Description