Assignment

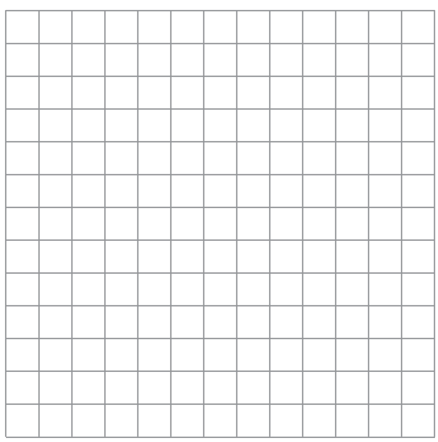
Name ______________________________ Date ____________________

Human Growth
Multiple Representations of Relations and Functions

The table shows the average shoe size recorded in a survey for given age groups of children.

Age (years)	Average Shoe Size (in.)
1	6
2	6.5
3	7
4	7.5
5	8
6	8
7	8.5
8	8.5
9	9
10	9
11	9.5
12	10.5

1. Create a scatter plot of the relation between age and average shoe size for the data on the grid shown.



2. Does it make sense to connect the points of the scatter plot? Why or why not? If so, connect the points.

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3. Describe the shape of the graph.

4. What are the domain and range of the relation?

5. Is the relation a function? Explain.

6. The relation only includes ages up to 12 years.

   a. Using the graph, what would you predict as the increase in average shoe size from the ages of 13 to 18 years?

   b. Using this prediction, what would you predict as the shoe size of an 18 year old?

   c. Does this prediction make sense? Why or why not?

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A shoe store uses a formula to calculate the size of a shoe according to the shoe's "last." A last is a template that is used to make the shoe. To determine the size of a child's shoe, the matching last is found, and the last length is multiplied by three. Then 12 is subtracted from the product. The lasts are measured in inches in multiples of one third.

7. What size is the shoe that fits a child's foot whose matching last is

a. 7 inches long?

b. 5 inches long?

c. 6 inches long?

8. What is the last length matching a shoe of

a. size 12?

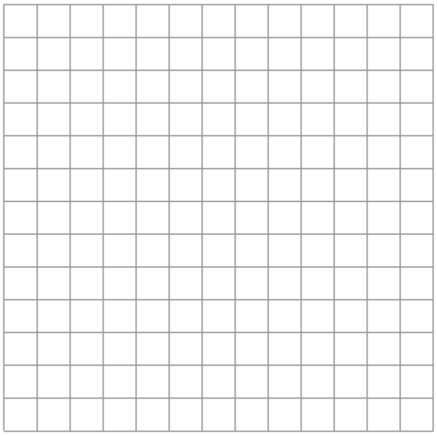
b. size 0?

9. Explain how to calculate the last length for a given shoe size.

10. Enter the values you determined in Questions 7 and 8 in the table.

Last Length (in.)	Shoe Size (children's)

11. Create a scatter plot of the relation between the last lengths and the shoe sizes in your table.



12. Does it make sense to connect the points of the scatter plot? Explain.

13. What are the domain and range of the relation?

14. Is the relation a function? Explain.

15. What are the variable quantities in this situation? Define a variable to represent each quantity.

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16. Which variable represents the independent quantity? Which represents the dependent quantity? What are the constant quantities in this situation?

17. Use the variables from Question 15 to write an algebraic equation for converting from last length to children's shoe size.

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Down and Up
Linear and Absolute Value Functions

In Elsie's house, the heating is controlled by a thermostat. When the temperature in the house is below 60ºF, the heat turns on. It increases the temperature by 2 degrees per hour, until it reaches 70ºF. Then the heat shuts off. The house cools at a rate of 2 degrees per hour.

1. Suppose that the heat has just turned off, and the temperature is now 70ºF. Elsie starts her stopwatch at zero. What will the temperature be after

a. 30 minutes?

b. 45 minutes?

c. 2 hours 15 minutes?

2. How long after the heat turns off will it take for the temperature to be

a. 64ºF?

b. 61.5ºF?

c. 60ºF?

3. Once the temperature reaches 60ºF, the heat turns on again. Elsie is still counting time on her stopwatch. What will the temperature be after

a. 6 hours?

b. 7 hours 30 minutes?

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4. How much time will have passed on the stopwatch when the temperature once again reaches

   a. 66°F?

   b. 69.5°F?

5. What are the variable quantities in this situation? Which is the independent quantity? Which is the dependent quantity?

6. Use the values from Questions 1 through 4 to complete the following table.

Independent Quantity	Dependent Quantity

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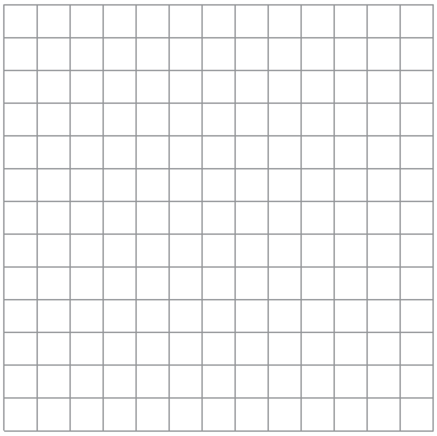
7. Create a scatter plot of the relation between time and temperature in Elsie's house over a 10-hour period.



8. Connect the points of the scatter plot. Why does it make sense in this situation to connect the points?

9. Describe the shape of the graph.

10. What are the domain and range of this relation?

11. Is the relation a function? Explain.

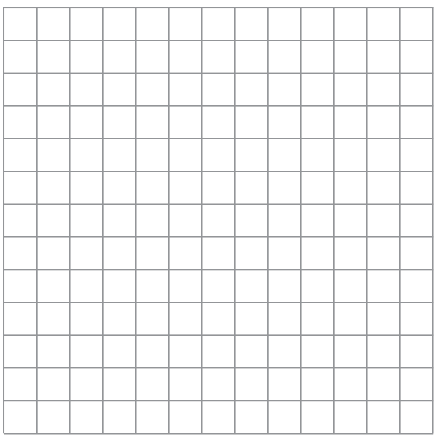
12. Does the graph have a maximum point or points? If so, which point or points? Explain.

13. Does the graph have a minimum point or points? If so, which point or points? Explain.

14. Look at the part of the graph where the domain is between 0 and 5 hours. This portion of the graph resembles a linear function. What is the slope of this portion of the function?

15. Look at the part of the graph where the domain is between 5 and 10 hours. This portion also resembles a linear function. What is its slope?

16. Use a graphing calculator to graph the equation $y = 60 + |-2x + 10|$ for $0 \leq x \leq 10$. Sketch the graph on the grid.



17. How does the graph in Question 16 compare to the graph in Question 7?

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18. The equation $y = 60 + |-2x + 10|$ is an absolute value function that models the temperature function in Elsie's house within the domain $0 \leq x \leq 10$. Write the equation of the line of symmetry for this function.

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1

Assignment

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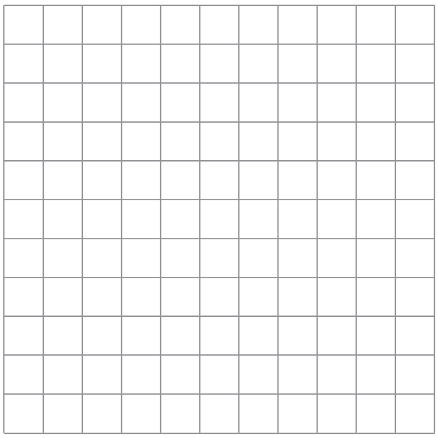
Let's Take a Little Trip!
Every Graph Tells a Story

The graph shows the relation between time in minutes and Bobby's speed in miles per hour as he rides his bicycle to run errands. Use the graph to answer the questions.



1. Is the relation between Bobby's time and his speed a function? Explain.

2. Identify any extrema in the graph. What do these points represent in the situation?

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3. What are the domain and range of the relation?

4. How fast was Bobby moving after

   a. 2 minutes?

   b. 8.5 minutes?

   c. 30 minutes?

5. During which times was Bobby moving

   a. 5 mph?

   b. 8 mph?

6. Write a paragraph about Bobby's bicycle trip. Include and explain any intervals of increase and intervals of decrease you see on the graph.

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The height of a projectile affected only by gravity near the Earth's surface can be modeled by a quadratic function. Hazel throws a beanbag straight up. An equation that can be used to model the height of the beanbag over time is $y = -16x^2 + 60x + 4$, where x represents the time after she throws the beanbag in seconds, and y represents the height of the beanbag in feet.

7. Complete the table of values using the equation modeling the beanbag.

Time (seconds)	Height (feet)
0	
0.25	
0.5	
0.75	
1	
1.25	
1.5	
1.75	
2	
2.25	
2.5	
2.75	
3	
3.25	
3.5	
3.75	

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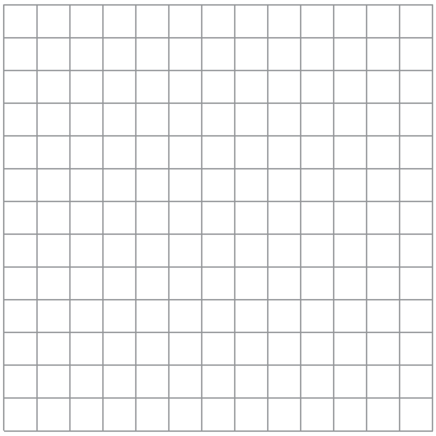
8. Use the table to create a graph showing the relation between time and the height of the beanbag.



9. Describe the shape of the graph. Does the graph's shape describe the path of the beanbag? Explain.

10. What was the beanbag's average speed and direction

a. during the first 0.25 second?

b. between 0.25 and 0.5 second?

c. between 0.5 and 0.75 second?

d. between 1.5 and 1.75 seconds?

e. between 1.75 and 2 seconds?

f. between 2 and 2.25 seconds?

11. What do you notice about the average speed and direction of the beanbag over time? Based on your experience, does this situation make sense? Explain.

12. Identify the domain, range, extreme points, intervals of increase and decrease, and line of symmetry for the function modeling Hazel's beanbag.

Domain:

Range:

Extreme point:

Interval of increase:

Interval of decrease:

Line of symmetry:

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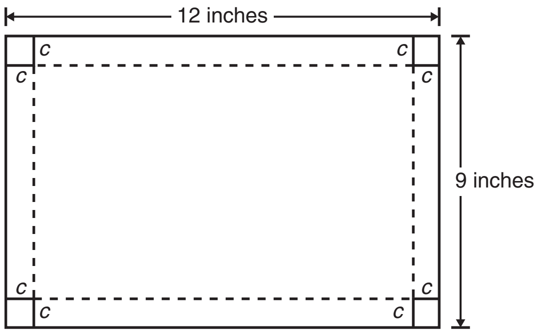
Building a Better Box
Cubic and Indirect Variation Functions

Carol has a stack of construction paper that she plans to make into craft boxes. Each piece of paper measures 9 inches by 12 inches. To make the boxes, Carol will cut out squares at each corner and fold up the sides into an open box shape. She will tape the sides of the box together and use the remaining paper to make tops to match the open boxes.



1. What height, length, and width of a craft box result if the length of each side of each corner square is

   a. 1 inch?

   b. 2 inches?

   c. 3 inches?

   d. 4 inches?

2. What is the largest size of corner square that Carol can cut out to make a box?

3. Write a formula for the volume of a craft box.

4. What is the volume of the box that results if Carol cuts corner squares with side lengths of

   a. 1 inch?

   b. 2 inches?

   c. 3 inches?

   d. 4 inches?

5. Use your answers from Questions 1 through 5 to complete the table. Fill in the new values as well.

Side Length of Square (inches)	Height of Box (inches)	Length of Box (inches)	Width of Box (inches)	Volume of Box (cubic inches)
0				
0.5				
1				
1.5				
2				
2.5				
3				
3.5				
4				
4.5				

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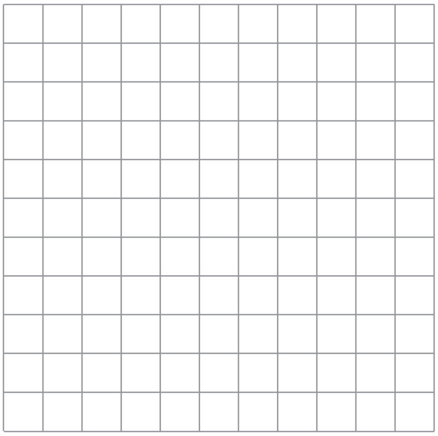
6. Use the table to create a scatter plot for the relation between the side length of the corner squares and the volume of the craft box.



7. Draw a smooth curve connecting the points. Why does it make sense to connect the points?

8. Is the relation a function? Explain.

9. Use the graph to estimate the maximum volume of the craft box. What is the length of each side of each corner square that Carol would need to cut to get the craft box with the largest volume?

10. What are the domain and range of the function?

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11. If Carol cuts a side length for each corner square of c inches, what are the resulting height, length, and width of the craft box?

12. If Carol cuts a side length for each corner square of c inches, what is the resulting volume of the craft box?

13. Write a cubic equation to describe the volume of one of Carol's craft boxes, v, in cubic inches, in terms of the side length of the corner square, c, in inches.

In Sonia's class, the teacher plans to hand out an equal number of colored pencils to each student. The teacher has 300 pencils.

14. How many colored pencils will each student receive if there are

a. 5 students?

b. 10 students?

c. 20 students?

d. 50 students?

15. Does the question make sense if there are more than 300 students? Explain.

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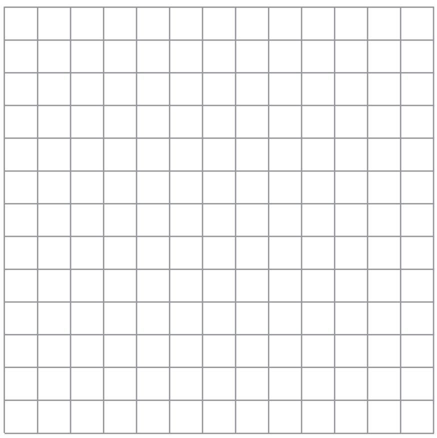
16. Complete the following table using your answers from Question 15. Fill in the new values as well.

Number of Students	Number of Pencils per Student
1	
5	
6	
10	
15	
20	
30	
50	
60	
300	

17. Use the table to create a scatter plot of the relation between the number of students and the number of colored pencils per student.



18. Does it make sense to connect these points in a smooth curve? Explain.

19. Is the relation a function? Explain. If so, what type of function describes this situation?

20. Define variables for the number of students and the number of pencils per student. Use the variables to write an equation to describe the situation.

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Assignment

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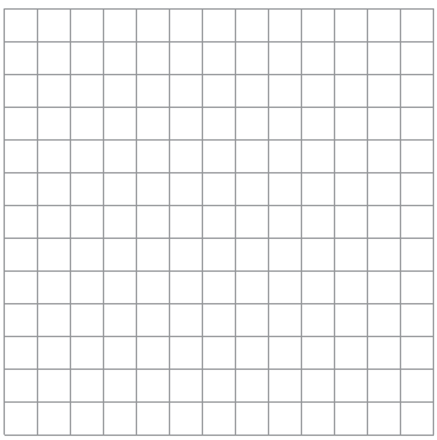
How Far Can You See?
How Many Ancestors?
Square Root and Exponential Functions

Nate is making a pedestal in the shape of a rectangular prism for the base of a table. Its height will be 3 feet. Its width and length will be equal, so that the pedestal's top and bottom faces are squares. He is trying to decide on a side length for the square faces. The table shows some of the possible volumes for the pedestal, and the corresponding dimensions.

Volume of Pedestal (cubic feet)	Length and Width of Pedestal (feet)
0.75	0.5
3	1
6.75	1.5
12	2
18.75	2.5
27	3

1. Create a scatter plot of the relation between the volume of the pedestal and its length and width. Use the volume as the independent quantity and the length and width as the dependent quantity.



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2. Connect the points on the graph with a smooth curve. Why does it make sense to connect the points?

3. Describe the shape of the graph.

4. Can you use the graph to predict the length and width of a pedestal with a volume of 48 cubic feet? Explain.

5. Can you use the graph to predict the length and width of a pedestal with a volume of 300 cubic feet? Explain.

6. Is this relation a function? Explain. If so, what type of function?

7. The equation that models this function is $s = \sqrt{\frac{1}{3}v}$, where s represents the length and width of the pedestal in feet, and v represents the volume in cubic feet. Use the equation to answer Questions 4 and 5.

8. What are the domain and range of the function $s = \sqrt{\frac{1}{3}v}$?

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9. How would you describe a sensible domain and range for the situation?

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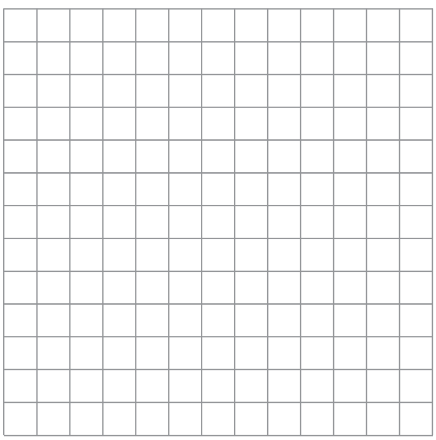
On a certain island, there were no rabbits until 1981, when they were introduced by tourists (three pet rabbits escaped and began the island's wild rabbit population). Naturalists watching the island's rabbit population in the years since have concluded that each year there are approximately 3 times as many rabbits as there were the previous year (this approximation takes into account both birth and death rates).

10. Use the naturalists' approximation to complete the table.

Year (Counted from Introduction of Rabbits)	Number of Rabbits on the Island
1	
2	
3	
4	
5	

11. Use the information in the table to make a scatter plot of the relation between time in years and number of rabbits on the island. Connect the points on the graph with a smooth curve.



12. Describe the shape of the graph.

13. Can you use the graph to predict the number of rabbits in the sixth year?

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14. Can you use the graph to predict the number of rabbits in the 20th year?

15. Is the relation between years and number of rabbits a function? If so, what kind? Explain.

16. The equation that models the naturalists' approximation is $y = 3^x$, where x represents the number of years and y represents the number of rabbits. Use the equation to answer Questions 13 and 14.

17. What are the domain and range of the function $y = 3^x$?

18. What would be a sensible domain and range for the situation involving numbers of rabbits? Explain.