

## Problem-Based Task: To the Rescue!

### Coaching Sample Responses

- a. How should the table and window settings of your graphing calculator be set for this situation?

Think about the domain and range of the function and the type of numbers (e.g., integers, rational numbers) that should be displayed in the table. The results will need to be accurate in order to answer the rest of the coaching questions correctly.

Suggested window settings for the  $x$ -minimum,  $x$ -maximum,  $y$ -minimum, and  $y$ -maximum are 0, 10, 0, and 12, respectively.

Tables should start at the smallest domain value (1). The change/steps should be in increments that reflect the nature of the numbers in the domain; increments of 1 are suitable here.

- b. What does the domain  $[1, 6]$  indicate about the time needed for rescue attempts?

The domain is measured in hours, so the minimum amount of time needed for a rescue attempt is 1 hour. The maximum time for a rescue attempt *in this data set* is 6 hours. Future rescue attempts could redefine the domain if the rescue times are less than 1 hour or greater than 6 hours. There is also no restriction on what kind of number  $t$  is. It could be an integer, but it is more likely to be a decimal fraction or an improper fraction, such as 1 hour and 20 minutes.

- c. Why is 0 not included in the domain?

This would mean a time of 0 hours, which is not meaningful in a real-world situation. Technically, it is the time at which a rescue attempt started.

- d. What does the range  $[1, 12]$  mean?

The number of rescue attempts that can be performed in 1 to 6 hours is anywhere from 1 to 12.

- e. Why is the range limited to whole numbers?

The function is defined as the number of rescue attempts; only whole numbers make sense, as there cannot be “half” of a rescue.

- f. Why does the graphing calculator table show decimal numbers for the range?

The natural logarithm function for  $N(t)$  is an approximation of a function that is based on the actual data points of (12, 1), (8, 2), (4, 3), (2, 1), and (1, 1). The “best fit” function for this data is the function  $f(x) = 11.95 - 6.65 \cdot \ln x$ . The data shown in the graphing calculator table is based on using the whole-number domain [1, 6] with the function  $N(t) = 12 - 6 \cdot \ln x$ , which produces decimal numbers for  $N(t)$ .

- g. Determine the value of any intercept(s) of the graph.

Algebraically, the  $x$ -intercept occurs at the function value  $N(t) = 0$ , which gives the equation  $0 = 12 - 6 \cdot \ln t$  or  $\ln t = 2$ , or  $t \approx 7.4$  hours. Therefore, the intercept point is approximately (7.4, 0). Using the graphing calculator trace function indicates that the function value is 0 between the domain values of  $t \approx 7.34$  hours and  $t \approx 7.45$  hours.

- h. Use your graphing calculator’s table of values to determine the values of  $N(t)$  for  $t = 7$  and  $t = 8$ .

$$N(7) \approx 0.3 \text{ and } N(8) \approx -0.5$$

- i. How would you describe or interpret the value of  $N(t)$  at  $t = 7$  hours and  $t = 8$  hours?

The function values are not whole numbers, so they do not represent the data that matches the real-world conditions placed on the function values. The function and its values predict that no rescue attempts will take longer than 7 hours. However, new data could modify the function and its domain and function values.

### Recommended Closure Activity

Select one or more of the essential questions for a class discussion or as a journal entry prompt.