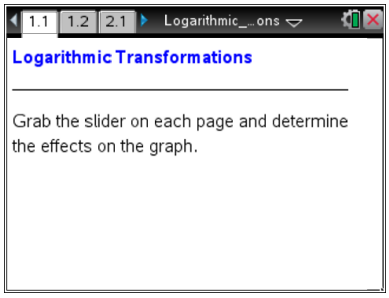
Logarithmic Transformations

Student Activity

Name _____

Class _____

Open the TI-Nspire document *Logarithmic_Transformations.tns*.



The graph of any function can be moved on the *x*-axis or *y*-axis following a few rules. In this activity, you will discover these rules for logarithmic functions.

$y = a \cdot \log\left(b\left(x - h\right)\right) + k$

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1. For this activity, the function used is $y = a \cdot \log\left(b\left(x - h\right)\right) + k$. This activity's investigations also work for any $b > 0$ and $b \neq 1$.
   a. What effect does dragging the *k*-value have on the parent function $y = \log_3 x$?

      Change the *k*-value by grabbing and dragging the slider. What happens algebraically to the point (1, 0) in terms of *k* as the graph gets translated up or down?

   b. Name the transformation (including its distance and direction) when the function $y = \log_3 x$ changes to $y = \log_3\left(x\right) + 4$.

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2. Change the *h*-value by grabbing and dragging the slider.
   a. What happens to the equation and graph when $h < 0$?

   b. Name the transformation (including its distance and direction) when the function $y = \log_3 x$ changes to $y = \log_3\left(x - 3\right)$.

   c. Chris says that the point (1, 0) on the parent function translates to (–3, 0) when she drags the *h*-value to –4 because the log of 1, base 3 is zero. Is her explanation mathematically correct? Explain. Change the *h*-value and confirm your explanation by grabbing and dragging the slider.

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3. Change the *a*-value by clicking the arrows.
   a. As the *a*-value changes the graph, explain why the point (1, 0) remains on the transformed graph.

   b. When the graph $y = \log_3(x)$ is changed to $y = (-1/2) \cdot \log_3(x)$, what transformation has occurred? Describe the transformation in terms of what is happening with the points.

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4. Change the *b*-value by clicking the arrows.
   a. When $b < 0$, what happens to the graph?

   b. What other effects does the *b*-value have on the graph?

   c. Suppose the function changes from $y = \log_3(x)$ to $y = \log_3(3x)$. Describe the transformation that occurs.

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5. Apply what you have learned and change the values of variables *h*, *k*, *a*, and *b* by clicking their arrows so that the dashed graph is transformed to the solid graph in the displayed domain. It will say *correct* when you have done it correctly. Write the correct function here.

6. Nate says that transforming $y = \log_3(x)$ to $y = \log_3(x+2)$ is a horizontal translation of 2 to the right. Is Nate correct? Why or why not?

7. What is the equation of the parent function $y = \log(x)$ translated 5 to the left and 2 up?

8. a. Write the function that transforms $y = x^2$ with a horizontal translation to the right of 5 and a vertical dilation by a factor of 7.

   b. Write the function that transforms $y = x$ with a vertical translation down 3 units.