



Exponential Transformations

Student Activity



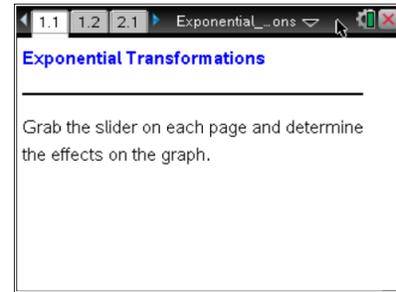
Name _____

Class _____

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

The graph of any function can be moved on the x - and y -axes by following a few rules. In this activity, you will discover these rules for exponential functions.

$$y = a \cdot \text{base}^{b(x-h)} + k$$



Move to page 1.2.

For this activity, the function used is $y = a \cdot 3^{b(x-h)} + k$. This activity's investigations also work for any base b such that $b > 0$ and $b \neq 1$.

1. a. What effect does dragging the k -value have on the parent function $y = 3^x$? What happens algebraically to the point $(0, 1)$ in terms of k as the graph is translated up or down?

b. Name the transformation, including its distance and direction, when the function $y = 3^x$ changes to $y = 3^x + 2$. How does the point $(0, 1)$ change?

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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. Christina says that the point $(0, 1)$ on the parent function translates to $(-2, 1)$ when she drags the h -value to -2 because the y -value is being multiplied by -2 . Is her explanation mathematically correct? Explain. Change the h -value and confirm your explanation by grabbing and dragging the slider.

c. Name the transformation, including its distance and direction, when the function $y = 3^x$ changes to $y = 3^{x-2}$.

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3. Change the a -value by clicking on the arrows.
 - a. When the a -value is 0.5, explain why the point $(1, 3)$ becomes the transformed point $(1, 1.5)$.

 - b. What happens to the point $(1, 3)$ when the function changes from $y = 3^x$ to $y = 2 \cdot 3^x$?
What transformation occurred?

Move to page 4.1.

4. Change the b -value by clicking on the arrows.
 - a. When $b < 0$, what happens to the point $(0, 1)$? If $b < 0$, what happens to the graph?

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

 - c. Suppose the function changes from $y = 3^x$ to $y = 3^{2x}$. Describe the transformation that occurs.

Move to page 5.1.

5. Apply what you have learned and change the values of h and k (by dragging their sliders) and of a and b (by clicking their arrows) so that in the displayed domain, the solid graph is transformed to the dashed graph. It will say *Correct!* when you have done it correctly.

Write the function you arrived at here. Describe your thought process of getting to the answer.



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6. David says that positive a -values greater than 1 cause the function to stretch vertically. Is he correct? Explain.
7. Leon says that changing $y = 3^x$ to $y = 3^{x+4}$ results in its graph having a horizontal translation of 4 units to the right. Is Leon correct? Why or why not?
8. a. Write the function that transforms $y = \sqrt{x}$ horizontally to the left 5 units and has a vertical dilation factor of 3.
- b. Write the function that transforms $y = |x|$ with a vertical translation up 3 units.