



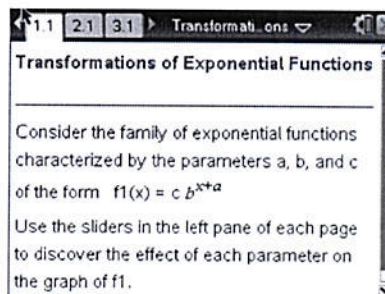
Transformation of Exponential Functions

Student Activity

DATE _____

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

The purpose of this activity is to examine the family of exponential functions of the form $f(x) = c b^{x+a}$ where a , b , and c are parameters. At the end of this activity, you will use your results to match each function with its corresponding graph.



Note: The parameter b is the base of the exponential function and $b > 0, b \neq 1$.

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Press **ctrl** **▶** and **ctrl** **◀** to navigate through the lesson.

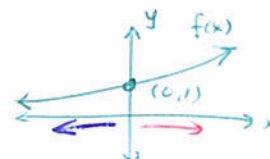
- The graph of $y = f1(x) = b^x$ is shown in the right panel. Click the arrows in the left panel to change the value of b , and observe the changes in the graph of $f1$.
 - Explain why for every value of b , the graph of $f1$ passes through the point $(0,1)$.

$$b^0 = 1$$

- For $b > 1$, using limit notation, describe the graph of $y = f1(x) = b^x$.

$$\lim_{x \rightarrow -\infty} f(x) = 0$$

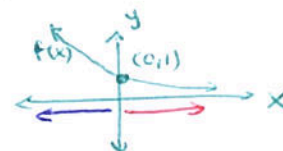
$$\lim_{x \rightarrow \infty} f(x) = \infty$$



- For $0 < b < 1$, using limit notation, describe the graph of $y = f1(x) = b^x$.

$$\lim_{x \rightarrow \infty} f(x) = 0$$

$$\lim_{x \rightarrow -\infty} f(x) = \infty$$



- Find the domain and range of function $f1(x) = b^x$.

$$D \in (-\infty, \infty) = \mathbb{R}$$

$$R \in (0, \infty)$$

- Does the graph of $y = b^x$ intersect the x -axis? Explain why or why not.

No, because an exponential function has H.A. @ $y = 0$.



Student Activity

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2. The graph of $y = f(x) = b^{x+a}$ is shown in the right panel. For a specific value of b , click the arrows to change the value of a and observe the changes in the graph of f . Repeat this process for other values of b .

- a. Describe the effect of the parameter a on the graph of $y = b^{x+a}$. Discuss the effects of both positive and negative values of a .

- When $a > 0$ (positive), the graph shifts to left a units
- When $a < 0$ (negative), the graph translates (shifts) to right a units

Think opposite

Move to page 4.1.

3. The graph of $y = f(x) = c \cdot b^{x+a}$ is shown in the right panel. For specific values of a and b , click the arrows to change the value of c , and observe the changes in the graph of f . Repeat this process for other values of a and b .

- a. Describe the effect of the parameter c on the graph of $y = c \cdot b^{x+a}$. Discuss the effects of both positive and negative values of c .

- When $c > 1$ or $c < -1$ ($|c| > 1$), we have a vertical stretch by a factor of c
- When c is negative, $c < 0$, graph reflects over x -axis
- When $-1 < c < 1$, $c \neq 0$, the graph contracts vertically or shrinks vertically.

CONCLUSION:

Describe the transformation of the graph with parameters a, b, c , and d : $y = c \cdot b^{x+a} + d$.

$a \rightarrow$ horizontal shift; $a > 0$ shift left and $a < 0$ shift right

$b \rightarrow b > 1$ $\lim_{x \rightarrow \infty} f(x) = \infty$ and $0 < b < 1$ $\lim_{x \rightarrow \infty} f(x) = 0$ reflects graph over y -axis

$c \rightarrow$ See #3a

$d \rightarrow$ vertical shift; $d < 0$ shift down, $d > 0$ shift up

Describe the transformation of the graph: $y = 3 \cdot 2^{x+1} - 5$

- Vertical stretch by a factor of 3
- $\lim_{x \rightarrow \infty} f(x) = \infty$, $\lim_{x \rightarrow -\infty} f(x) = -5$
- Vertical shift down 5 units
- Horizontal shift left 1 unit

