Name:_____ Date:_____ Period:_____

Exponential Transformation Discovery Task

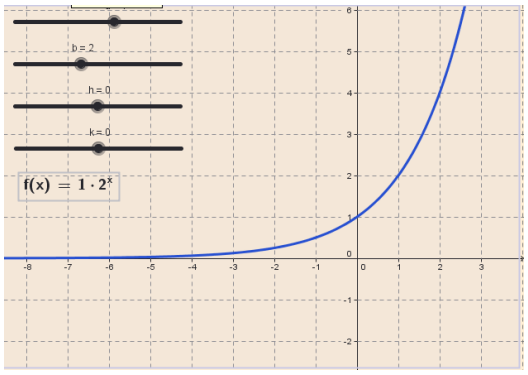
We have discussed the exponential function in class but we have not spent a lot of time with the connection between the function and its corresponding graph. Today you will use GeoGebra to discover how changing different parameters of the exponential function affect the graph.

The base exponential function is the following:

$$y = a(b)^{x-h} + k$$

Go to the blog and open up the GeoGebra worksheet Exponential Transformations

Right now the base function is set as f(x) = 1●2^x



So what is the current value of a? _____

What is the current value of b?_____

What is current value of h?_____

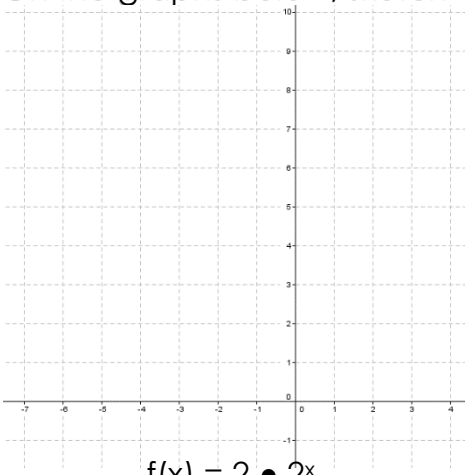
What is the current value of k?_____

The Parameter "a"

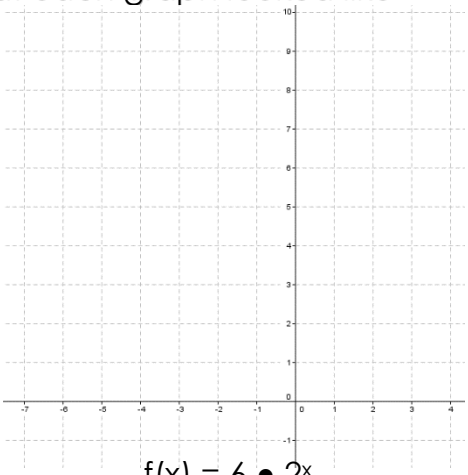
We will begin by investigating the parameter "a". Use the slider to make ***a*** be 2. What changes did you see in the graph?

Now change **a** to be 6. What changes do you notice in comparison to its original value of 1?

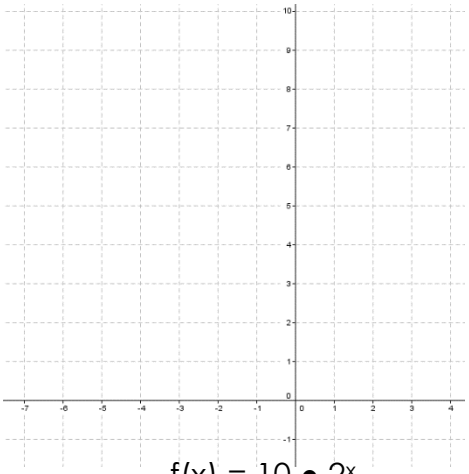
Predict what you think will happen when you change ***a*** to 10. Then move the slider to 10 and see if your prediction was correct.
On the graphs below, sketch what each graph looked like



f(x) = 2 ● 2^x



f(x) = 6 ● 2^x

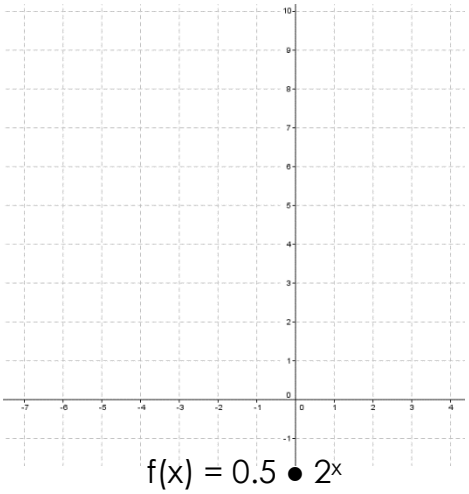


f(x) = 10 ● 2^x

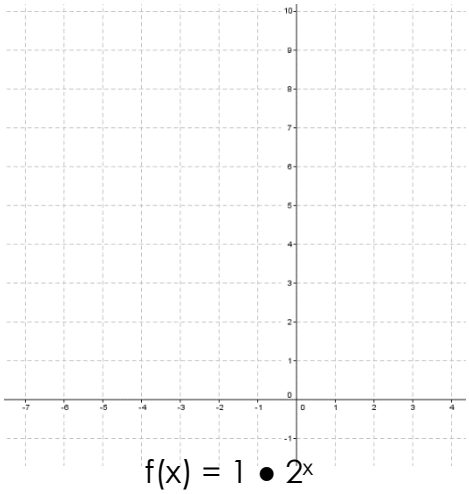
Now let's try when ***a*** is smaller than one. Begin by moving the slider back to the original position of 1. Now move the slider to a = 0.5. What changes did you see?

Now change ***a*** to be 0.1. What changes did you see to the original value of 1?

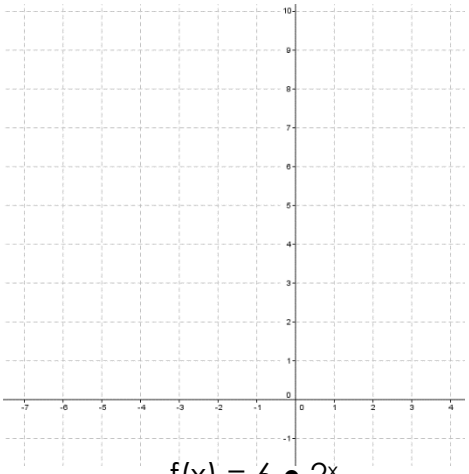
Sketch the following graphs.



$f(x) = 0.5 \bullet 2^x$



$f(x) = 1 \bullet 2^x$



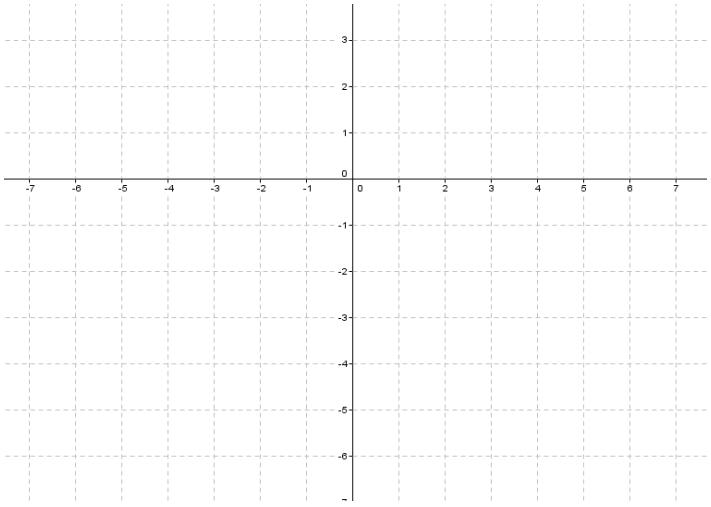
$f(x) = 6 \bullet 2^x$

Make a hypothesis about the value of ***a*** when $0 < a < 1$

Make a hypothesis about the value of ***a*** when $a > 1$

What about when a is negative? Move your slider so ***a*** is negative. Sketch your graph and write your function below.

$f(x) = \_\_\_\_ \bullet 2^x$

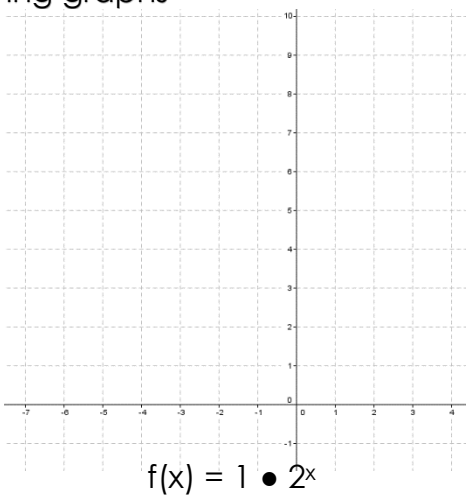


What happens when ***a*** is a negative number?

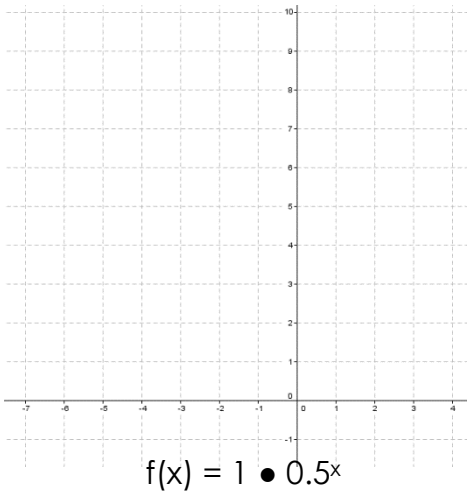
The Parameter "b"

Now we will investigate a new parameter. Move your slider back to the original function $f(x) = 1 \bullet 2^x$. Now move the ***b*** slider to 0.5. What change did you notice in the graph?

Sketch the following graphs



$f(x) = 1 \bullet 2^x$



$f(x) = 1 \bullet 0.5^x$

Make a hypothesis about the value of ***b*** when $b > 1$

Make a hypothesis about the value of ***b*** when $0 < b < 1$

The Parameter "h"

Now we will investigate a new parameter. Move your slider back to the original function $f(x) = 1 \bullet 2^x$. Now move the ***h*** slider to 2. What change did you notice in the graph?

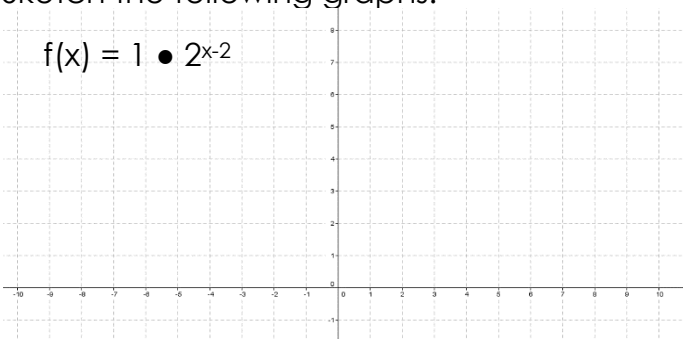
Now change **h** to be 6. What changes do you notice in comparison to its original value of 0?

Now change **h** to be -2. What changes do you notice in comparison to its original value of 0?

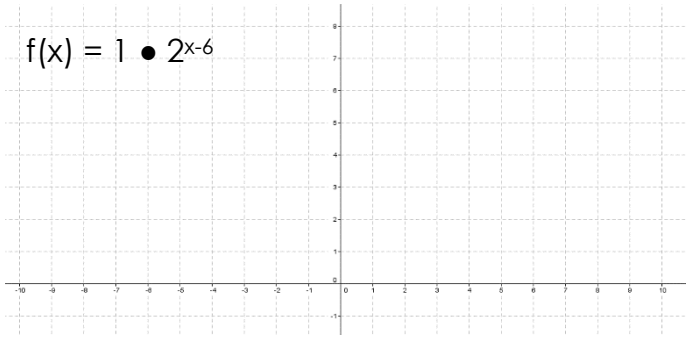
Now change **h** to be -6. What changes do you notice in comparison to its original value of 0?

Sketch the following graphs.

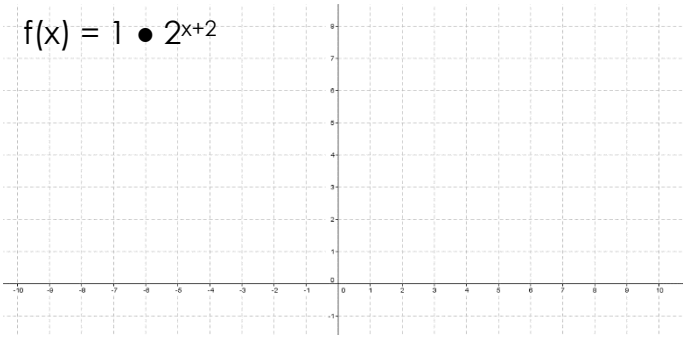
$f(x) = 1 \bullet 2^{x-2}$



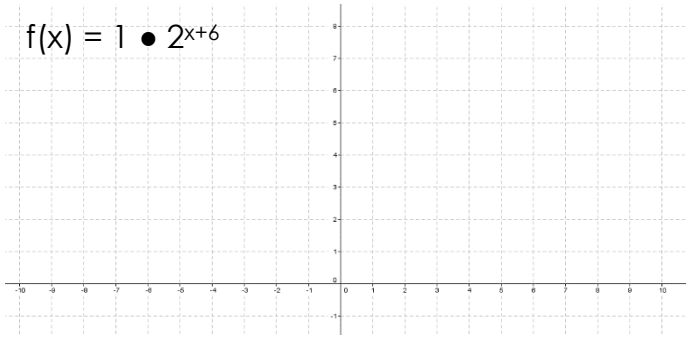
$f(x) = 1 \bullet 2^{x-6}$



$f(x) = 1 \bullet 2^{x+2}$



$f(x) = 1 \bullet 2^{x+6}$



Remember that the base exponential function has x MINUS h in the exponent. With that in mind answer the following.

I hypothesize that when the h is positive the exponential graph…

I hypothesize that when the h is negative the exponential graph…

The Parameter "k"

Now we will investigate a new parameter. Move your slider back to the original function $f(x) = 1 \bullet 2^x$. Now move the ***k*** slider to 2. What change did you notice in the graph?

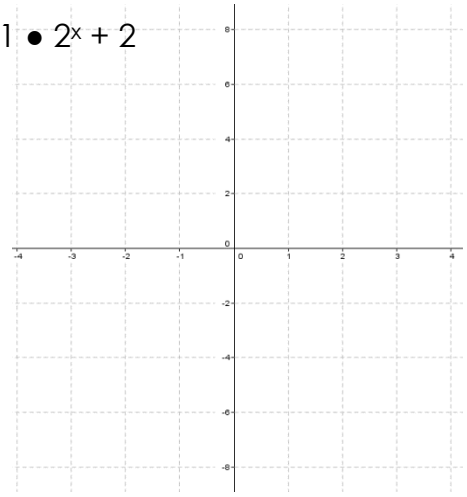
Now change **k** to be 6. What changes do you notice in comparison to its original value of 0?

Now change **k** to be -2. What changes do you notice in comparison to its original value of 0?

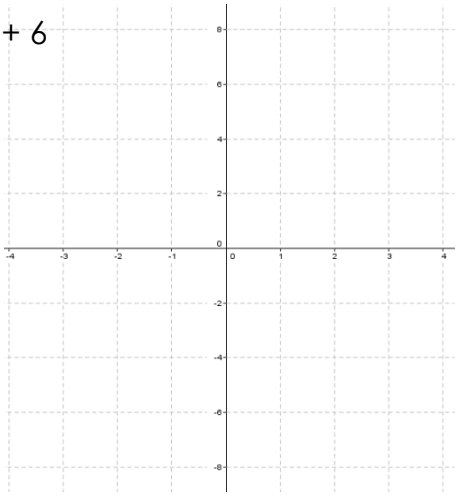
Now change **k** to be -6. What changes do you notice in comparison to its original value of 0?

Sketch the following graphs.

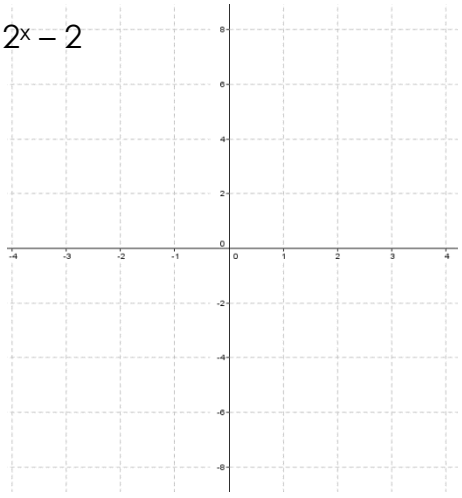
$f(x) = 1 \bullet 2^x + 2$



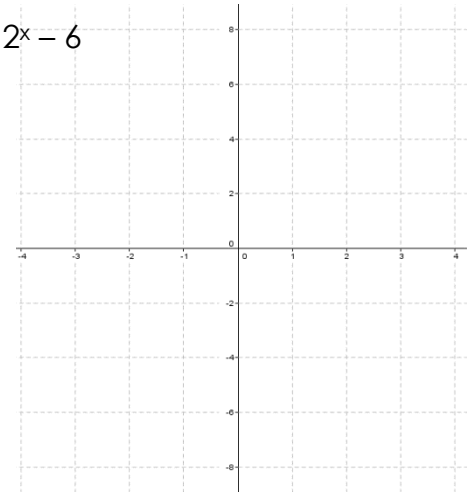
$f(x) = 1 \bullet 2^x + 6$



$f(x) = 1 \bullet 2^x - 2$



$f(x) = 1 \bullet 2^x - 6$



I hypothesize that when the k is positive the exponential graph…

I hypothesize that when the k is negative the exponential graph…

PUTTING THE PIECES TOGETHER

Now that you have discovered how different parameters affect the exponential graph and made hypothesis, let's use the 'math lingo' to correctly match the parameter to its effect. Copy the boxes from the bottom of this paper onto the correct parameter.

$$y = a(b)^{x-h} + k$$

Parameter	Effect
a	
b	
h	
k	

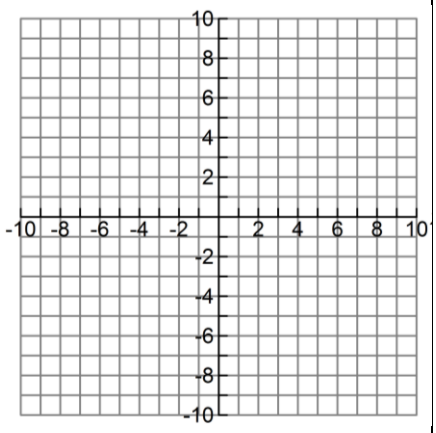
When it is between 0 and 1 the graph **shrinks** When it is greater than 1 the graph **stretches** When it is **negative** the graph **Reflects over the x-axis**	When it is between 0 and 1 the graph is a **decay** When it is greater than 1 the graph is a **growth**
A **positive** value moves the graph to the **right**	A **positive** value moves the graph **up** A **negative** value moves the graph **down**

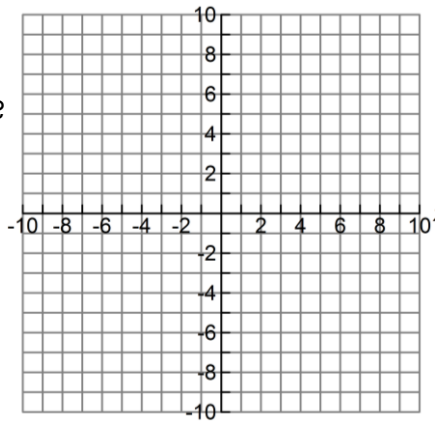
A **negative** value moves the graph to the **left**	

Practice and check!

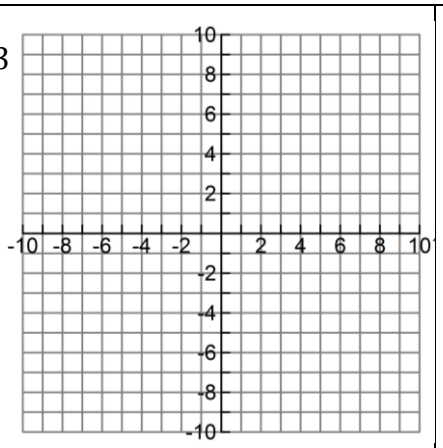
For each of the following ***describe*** how the exponential graph will move from the parent function f(x) = 1●2^x. Then sketch the graph. Check your solution by using the GeoGebra application.

$y = \frac{2}{3}(3)^{x-4} - 2$ Growth/Decay? Stretch/Shrink? Horizontal Shift? Vertical Shift? Reflection? **Asymptote:** **End Behavior:** **Range:** **Domain:** **Increase/ decrease?**	$y = 5\left(\frac{1}{2}\right)^x - 3$ Growth/Decay? Stretch/Shrink? Horizontal Shift? Vertical Shift? Reflection? **Asymptote:** **End Behavior:** **Range:** **Domain:** **Y-Intercept:** **Increase/ decrease?**





$y = -\frac{5}{2}\left(\frac{4}{7}\right)^{x+1} + 3$



Growth/Decay?

Stretch/Shrink?

Horizontal Shift?

Vertical Shift?

Reflection?

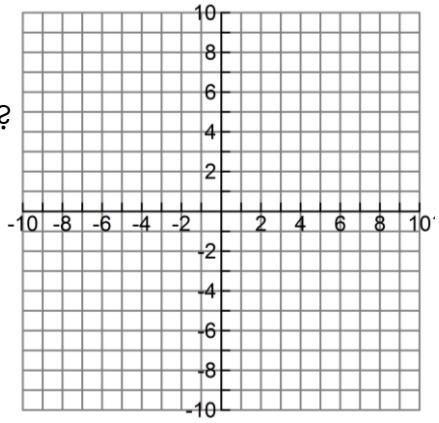
Asymptote: **End Behavior:**

Range:

Domain: **x- intercept:**

Increase/ decrease?

$y = \frac{7}{3}(6)^{x+2}$



Growth/Decay?

Stretch/Shrink?

Horizontal Shift?

Vertical Shift?

Reflection?

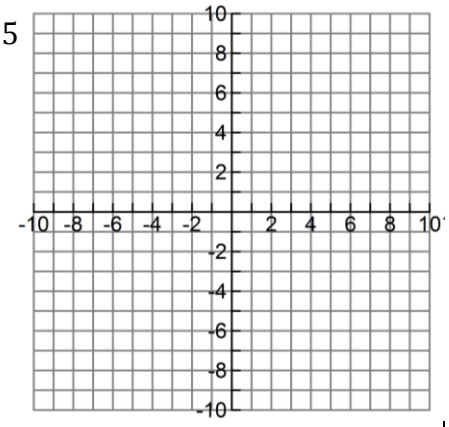
Asymptote: **End Behavior:**

Range:

Domain:

Increase/ decrease?

$y = -\frac{1}{2}\left(\frac{2}{3}\right)^{x-1} + 5$



Growth/Decay?

Stretch/Shrink?

Horizontal Shift?

Vertical Shift?

Reflection?

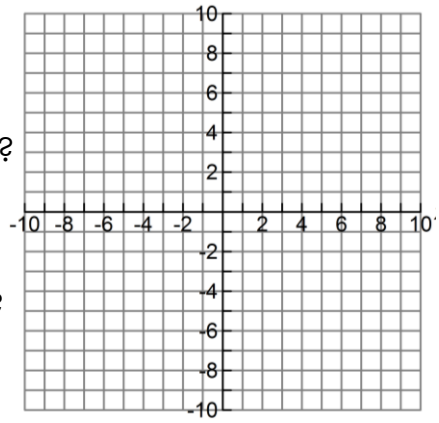
Asymptote: **End Behavior:**

Range:

Domain:

Increase/ decrease?

$y = \left(\frac{8}{3}\right)^{x-3} + 3$



Growth/Decay?

Stretch/Shrink?

Horizontal Shift?

Vertical Shift?

Reflection?

Asymptote: **End Behavior:**

Range:

Domain: **Zeros:**

Increase/ decrease?