Let's Explore Exponential Graphs

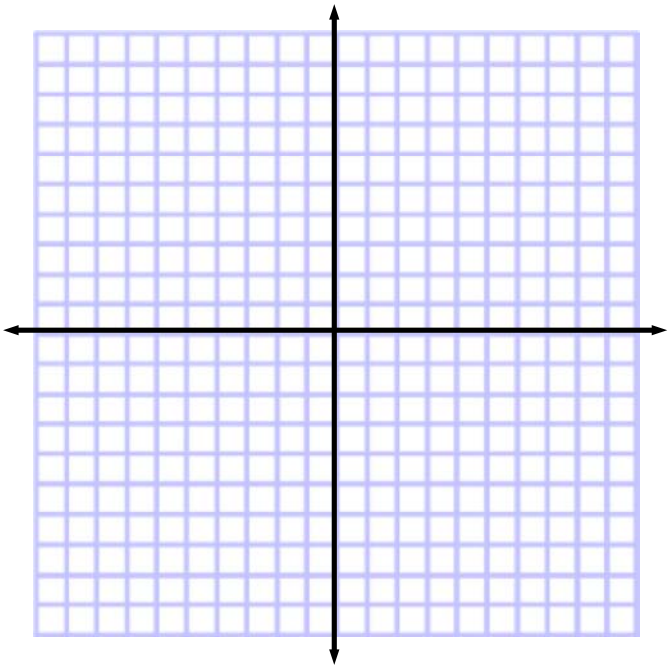
Exponential Function: a function that can be described by an equation

$y = b^x$, when $b > 1$ ~ growth

when $0 < b < 1$ ~ decay

Make a chart and graph

1. $f(x) = 2^x$



What is the domain :

What is the range:

Is this graph increasing or decreasing:

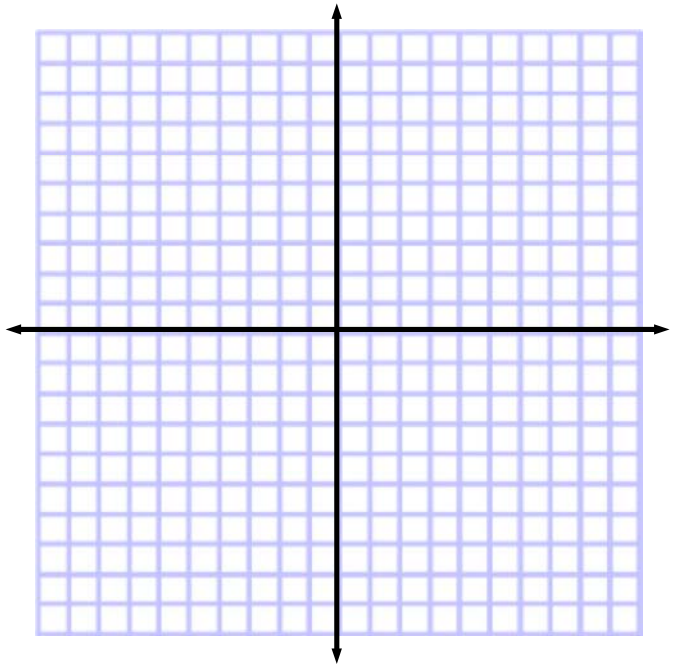
Where is the graph increasing/decreasing

What are the x-intercepts

What are the y-intercepts

What is the asymptote

2. $g(x) = \left(\frac{1}{2}\right)^x$



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What do we notice about basic exponential graphs?

Basic exponential graphs do **not** hit the **x-axis**, they get really close to it, but never touch it. Therefore, the x-axis is considered to be an **asymptote**.

Exponential graphs either **increase** or **decrease**

if "b" is greater than 1, (b>1) the graph increases ~ growth
if "b" is between 0 and 1, (0<b<1) the graph decreases ~ decay

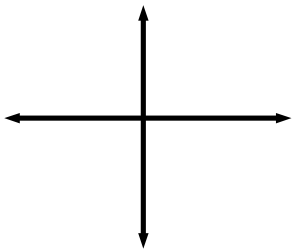
Basic exponential graphs **always** go through the point **(0,1)**

Calculator Exploration

On your calculator graph:

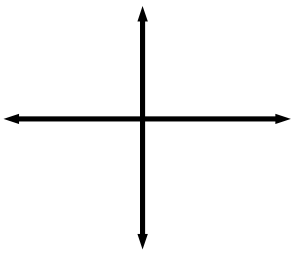
Draw a sketch and describe what is happening to the graph.

1. $y = 2^x$ (Parent Function)



2. $y = 2^x + 4$

3. $y = 2^x - 4$



Calculator Exploration

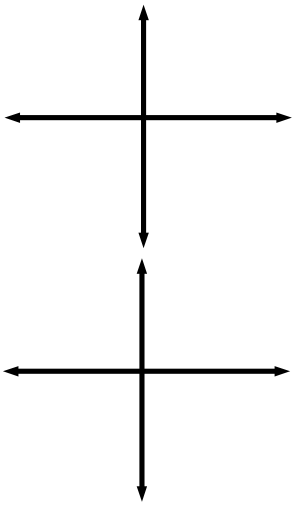
On your calculator graph:

1. $y = 2^x$ (parent function)

2. $y = 2^{x+4}$

3. $y = 2^{x-4}$

Draw a sketch and describe what is happening to the graph.



Calculator Exploration
when there is a # in front of "b"
$y = a\,b^x$

On your calculator graph:

Draw a sketch and describe what is happening to the graph.

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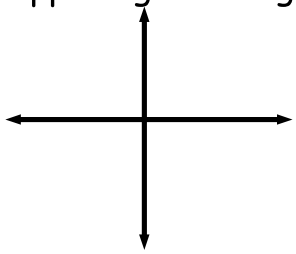
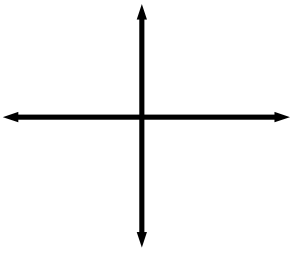
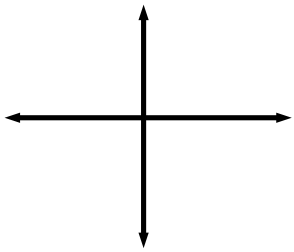


2. $y = -2^x$



3. $y = 3(2^x)$



4. $y = \frac{1}{3}(2^x)$

Remember:

if "a" is negative, the parent function will be reflected over the x axis

if "a" is greater than one, the graph will be stretched vertically (will appear more narrow)

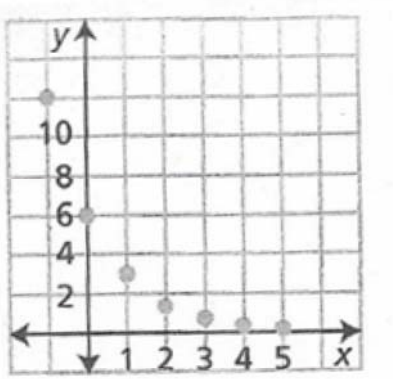
if "a" is between 0 and one (a decimal) , the graph will be stretched vertically (will appear more flat)

Exponential Function Rules
$f(x) = b^x$

Rule 1:		In words:
$y = b^x + k$	$g(x) = f(x) + k$	vertical shift UP
$y = b^x - k$	$g(x) = f(x) - k$	vertical shift DOWN
Rule 2:		
$y = b^{(x+k)}$	$g(x) = f(x + k)$	horizontal shift to the LEFT
$y = b^{(x-k)}$	$g(x) = f(x - k)$	horizontal shift to the RIGHT
Rule 3:		
$y = -b^x$	$g(x) = -f(x)$	reflection over the x-axis (flip)
Rule 4:		
$y = ab^x$	$g(x) = af(x)$	"a" will effect the y-intercept and effect how steep the curve is if a > 1, steep if a is between 0 and 1, flat

The data from the table are shown in the accompanying scatter plot.

x	y
	12
	6
1	3
2	1.5
3	.75
4	.375
5	



a) How are the x-values changing?

b) How are the y-values changing?

This is called a common ratio and is our "b" value.

Because the x-values increasing through addition and the y-values are changing by multiplication, this is NOT a linear function.

c) What is the initial value (y-intercept)?
[This is your "a" value]

d) Write the equation of this exponential function. $f(x) = ab^x$

Writing an exponential equation $Y = ab^x$ from a table

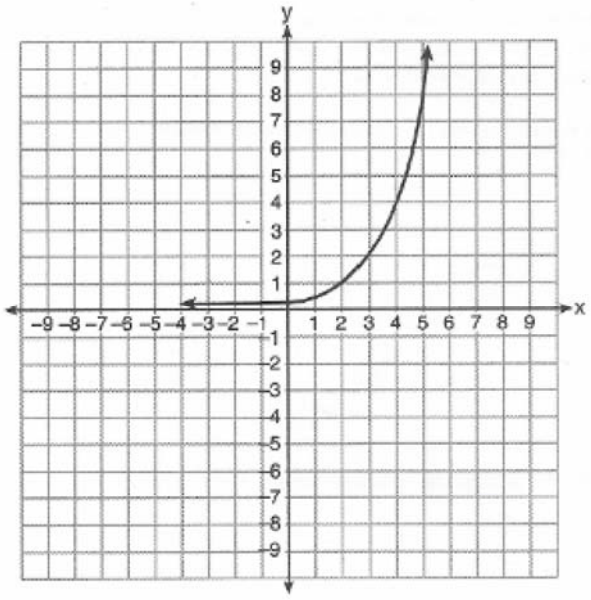
1. Find b (Common Ratio) by looking at the change in y values in the chart
2. Find a (initial value or y intercept) by going back on the table until x = 0
   OR substitute a value from the table into $y = ab^x$

Shelley's biology experiment began with 5 bacteria in an agar medium. The table below shows the bacterial growth over the next four days.

Day	1	2	3	4
# Bacterial cells	5	15	45	135

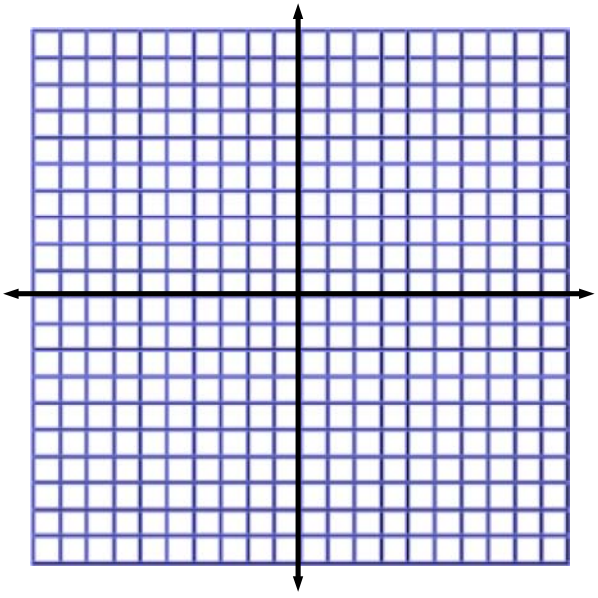
Write an explicit function that models the bacteria growth for Shelley's experiment. Define all variables of the model and any constraints on those variables.

Write an exponential equation for the graph shown below.



Explain how you determined the equation.

1. Graph $j(x) = 2^{x+5} - 4$



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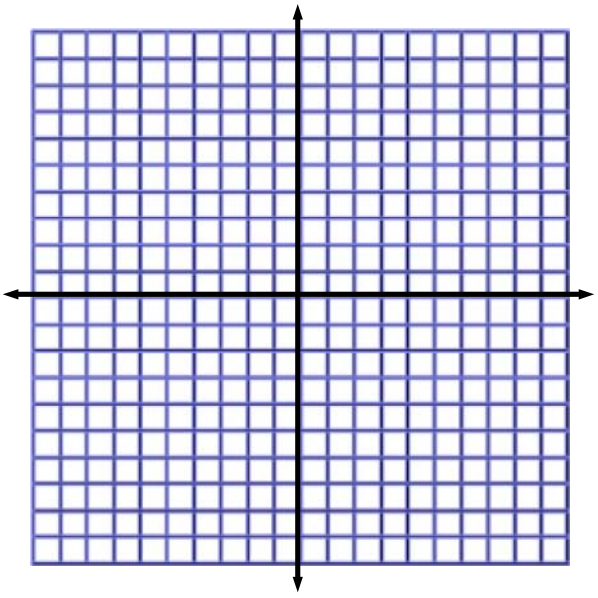
2. Graph $g(x) = -2^{x+3} - 4$



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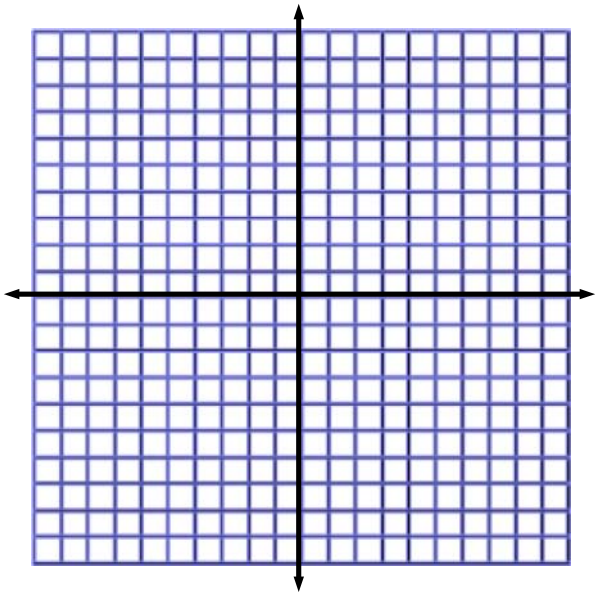
3. Graph $h(x) = f(x - 4)$; where $f(x) = 3^x$



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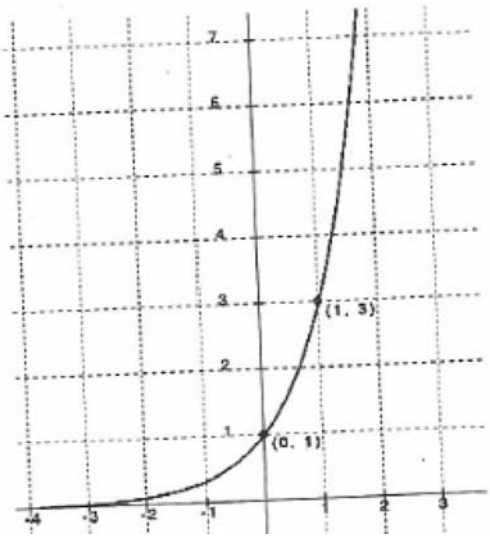
Write the equation for this exponential graph.