Lesson 4: Graphing Exponentials in the Form $y = b^x$ – iPad Investigation

1. On your iPad, open Desmos.
2. Enter the equation: $y = b^x$ and turn on the slider for b. (Use the a^b button)
3. The default value for b is 1. You will notice a horizontal line with a y-intercept of 1. Explain why this makes sense by first filling in the blanks below:

$1^3 =$ 1 $\qquad 1^{-8} =$ 1 $\qquad 1^0 =$ 1 $\qquad 1^x =$ 1

1 times itself any number of times is 1

Part 1: Investigating $y = b^x$ when $b > 1$.

4. We are going to change the range of values that b can have. Click on the "-10" and change it to 1. Leave the "10" as it is. Finally, set the step to 0.1.
   Play around with the slider.
   Describe what happens to the curve as your b-value gets larger.

   Ask Mr. Gilbert for **your** equation. Write in your equation and complete the table below. You can determine the y-values by touching the curve, then sliding your finger back and forth along the curve. The first number listed is the x-value, the second is the y-value.

   Equation: $y = 4^x$

x-value	-2	-1	0	1	2	3
y-value	0.0625	0.25	1	4	16	64

Ratios of consecutive y-values					
	4	4	4	4	4

***To determine the ratios of consecutive y-values, divide the y-value on the right by the y-value on the left.**

5. What is your initial value? (the value of y when x = 0)?
   Explain why this makes sense in light of the exponent laws we learned earlier in the unit.

   1 → Anything to the exponent zero is 1

   $3^0 = 1 \quad 4^0 = 1 \quad 5^0 = 1 \quad 6^0 = 1$

6. Compare your equation to your "ratios of consecutive y-values". What do you notice?

   The ratios are the b-value (base)

7. Visit at least 3 other students in the class who have **different equations**.

a. Provide their equation and their initial value (the value of y when x = 0).

Equation	Initial Value
$y = 3^x$	1
$y = 5^x$	1
$y = 8^x$	1

What do you notice?

All 1!

Does this make sense? Why or why not?

Yep! $anything^0 = 1$

b. Look at their equations and ratios of consecutive y-values.

Equation	Ratios of Consecutive y-Values
$y = 3^x$	3
$y = 5^x$	5
$y = 8^x$	8

What do you notice?

Ratios same as base!

Does this make sense? Why or why not?

Yes! For first one ($y = 3^x$) we be tripling.....

Part 2: Investigating $y = b^x$ when $0 < b < 1$. (When b is between 0 and 1)

1. We are, again, going to change the range of values that b can have. Click on the "1" and change it to 0. Click on the "10" and change it to 1. Finally, set the step to 0.05.
   Play around with the slider.
   Describe how these curves are different from the curves from Part 1.

   These curves are decreasing.

   Describe what happens to the curve as your b-value moves between 0 and 1. Be sure to specify the direction your b-value is moving.

   As b gets smaller the curves decrease faster.

   $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ … $\frac{1}{10}$

   0.5 0.1

   smaller

   Ask Mr. Gilbert for **your** equation. Write in your equation and complete the table below.

   Equation: $y = 0.1^x$

x-value	-3	-2	-1	0	1	2
y-value	1000	100	10	1	0.1	0.01
Ratios of consecutive y-values	0.1	0.1	0.1	0.1	0.1	

***To determine the ratios of consecutive y-values, divide the y-value on the right by the y-value on the left.**

2. Visit at least 3 other students in the class who have **different equations**.
   a. Provide their equation and their initial value (the value of y when x = 0).

Equation	Initial Value
$y = 0.5^x$	1
$y = 0.8^x$	1
$y = 0.2^x$	1

Does this make sense? Explain.

Yep! $\text{anything}^0 = 1$

b. Look at their equations and ratios of consecutive y-values.

Equation	Ratios of Consecutive y-Values
$y = 0.5^x$	0.5
$y = 0.8^x$	0.8
$y = 0.2^x$	0.2

What do you notice?

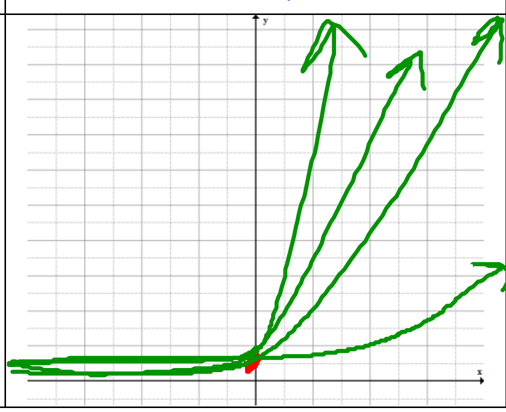
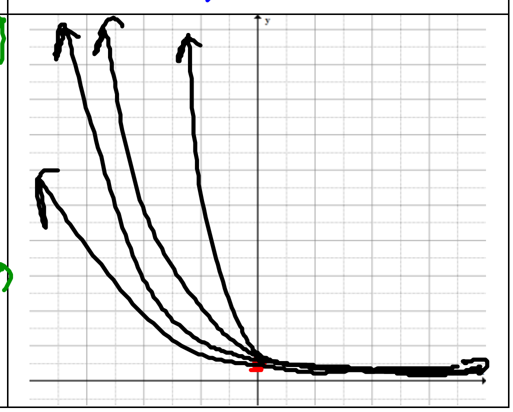
ratios are the base

Does this make sense? Why or why not?

Yes! for $y = 0.5^x$, we cut in half each time x goes up

Summary

Based on your observations in this investigation, complete the table below.

	$y = b^x$ when $b > 1$	$y = b^x$ when $0 < b < 1$ (0.1, 0.2, ... 0.9)
Initial Value	1	1
Behaviour from left to right	increases slow then fast	decreases fast then slow
Sketches		

Fill in the blanks:

For $y = 2^x$, when the value of x increases by 1, the value of y doubles.

For $y = 0.5^x$, when the value of x increases by 1, the value of y halves.