Welcome Back MYP Math 9!

	Assignment Effort Grade (Circle One)	Comments (What was interesting or challenging?)
Monday Date: 2/12 Topic: Nothing due... Index Laws Quiz was Friday!	0 1 2	
Tuesday Date: 2/12 Topic: Exponential Dot Pattern	0 1 2	
Wednesday Date: _____ Topic: _____	0 1 2	
Thursday Date: _____ Topic: _____	0 1 2	
Friday Date: _____ Topic: _____	0 1 2	

Class Plan

1) Explore growth
- Table, Graph
- Equation
- Make Predictions
- Defend realism

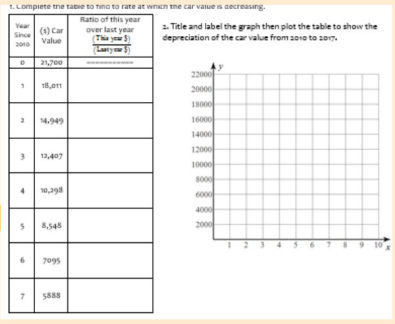
2) Exercises (Population of a city)

Explore exponential growth

1) Do: Ant population.

1) Complete table & graph

2) Examine patterns



1. Complete the table to find to rate at which the car value is decreasing.

Year Since 2010	(1) Car Value	Ratio of this year over last year $\frac{\text{(This year's)}}{\text{(Last year's)}}$
0	21,700	
1	18,011	
2	14,949	
3	12,407	
4	10,298	
5	8,548	
6	7095	
7	5888	

2. Title and label the graph then plot the table to show the depreciation of the car value from 2010 to 2017.

3) Make predictions
Number of ants after spring break?

4) Defend realism - or ***unrealism.***

Explore exponential growth

Ants have moved into the corner of our classroom! On Friday I noticed 16 ants. On Saturday Engineers found there were 24 ants. When I came to school Sunday to make copies I noticed there were 36 ants. Ms. Berg reported 54 ants in the corner on Monday!!!

The ant population is increasing! Find the pattern of increase and predict how many ants will be in our classroom when we return from parent teacher conferences **AND** from spring break.

Explore exponential growth

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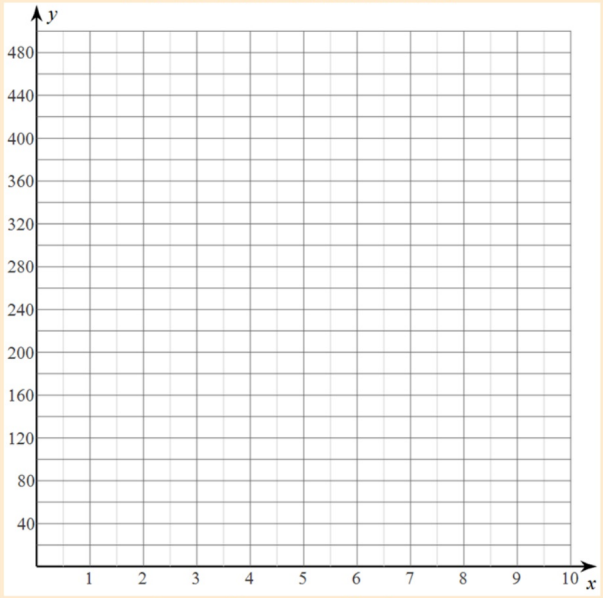
Day	Ants	Ratio of todays total to yesterday's total
0		~~~~~~~~~~~~~~~~~~~~ ~~~~~~~~~~~~~~~~~~~~
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Explore exponential growth

Ant Infestation!

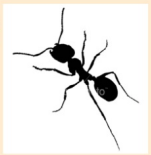
Day	Ants	Ratio of todays total to yesterday's total
0	16	~~~~~~~~~~~~~~~~~~~~
1	24	$\frac{24}{16} = \frac{3}{2}$
2	36	$\frac{36}{24} = \frac{3}{2}$
3	54	$\frac{54}{36} = \frac{6}{4} = \frac{3}{2}$
4	81	$\frac{3}{2}$
5	121.5	$\frac{3}{2}$
6	182.25	$\frac{3}{2}$
7	273.375	$\frac{3}{2}$
8	410.0625	$\frac{3}{2}$
9	615.09375	$\frac{3}{2}$
10	922.640625	$\frac{3}{2}$

Number of ants



Number of days

Modeling Investigation, Key



1) Create a table showing the number of ants for 0 – 10 days.

Day	Ants	Ratio of todays total to yesterday's total
0	16	~~~~~~~~~~
1	24	$\frac{24}{16} = \frac{3}{2}$
2	36	$\frac{36}{24} = \frac{3}{2}$
3	54	$\frac{54}{36} = \frac{6}{4} = \frac{3}{2}$
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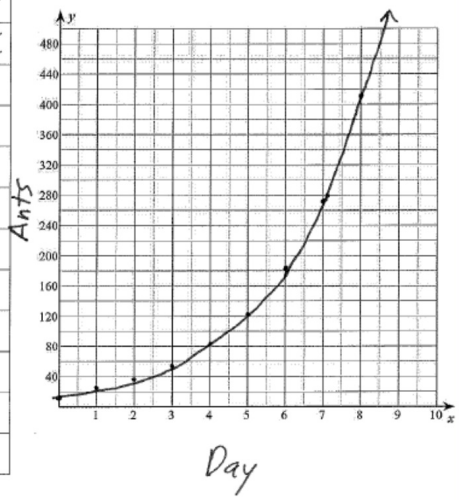
2. Label the graph and plot the table for 0 – 10 days.



Questions:

1) What do you notice about the graph? Describe the shape and any patterns you see.

It increases at a greater rate each day. The ratio between each day is $\frac{3}{2}$. (Exponential)

Explore exponential growth

$y = a \cdot b^x$ **a:** The starting, *initial* value.
b: The constant multiplier.

2) Writing a rule: Complete each sentence.

a) The starting population of the ants is _____

b) Each day the ant population is multiplying by a constant rate of _____

c) Write an equation modeling the ants' population growth. [$y = a \cdot b^x$]. _____

3) Use the pattern or equation to predict the population of ants after we return from parent teacher conferences. (Eek! ***11 days*** of population growth!!) Show your work.

Modeling Investigation, Key

$y = a \cdot b^x$ **a:** The starting, *initial* value. **b:** The constant multiplier.

2) Writing a rule: Complete each sentence.

a) The starting population of the ants is 16

b) Each day the ant population is multiplying by a constant rate of 1.5

c) Write an equation modeling the ants' population growth. [$y = a \cdot b^x$]. $y = 16(1.5)^x$

3) Use the pattern or equation to predict the population of ants after we return from parent teacher conferences. (Eek! ***11 days*** of population growth!!) Show your work.

$x = 11$ days $\quad y = 16(1.5)^{11}$

$y = 16(86.498)$

$y \approx 1384$ ants!

1.5^{11}
86.49755859
Ans*16
1383.960938

Explore exponential growth

4) Use the pattern or equation to predict the population of ants after we return from spring break. (Eek! ***58 days*** of population growth!!) Show your work.

Modeling Investigation, Key

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$Y = 16(1.5)^{58}$

$Y = 16(1.6 \times 10^{10})$

$Y \approx 2.6 \times 10^{11}$

```
1.5^58
  1.634154165E10
Ans*16
  2.614646664E11
```

$2.6 \times 10^{11} \approx 260{,}000{,}000{,}000$ ants!

Explore exponential growth

5) When would we have 100,000,000,000 ants??? How did you determine this many days?

Modeling Investigation, Key

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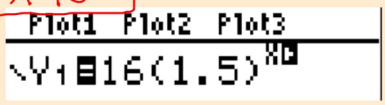
$100{,}000{,}000{,}000 = 1 \times 10^{11}$

① Enter equation in Calculator:



② 2nd Graph look at the table.

X	Y1
51	1.5E10
52	2.3E10
53	3.4E10
54	5.2E10
55	7.7E10
56	1.2E11
57	1.7E11

Between the 55th & 56th day!

Explore exponential growth

6) Defend whether your predictions are realistic, ***or not realistic.***

Modeling Investigation, Key

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This is not realistic.. The biggest ant colonies ever found have had ants in the hundreds of millions, and this prediction is <u>way</u> bigger than that. ~~The~~ Things like food and space will eventually limit the colony's growth.

Conclusion: 23D Growth

How did you know the data was *growing* based on the equation?

$$y = a(1+r)^x$$

a: starting value

r: rate of growth

Example: Ant Population

$$y = 16(1+.5)^x$$

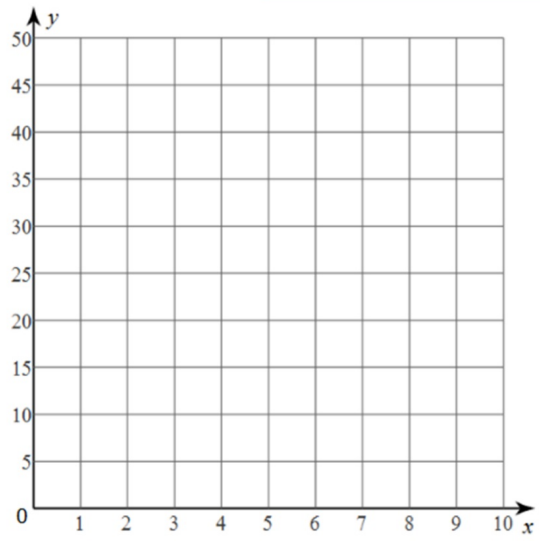
50% growth in population

Exercises:

MYP 9 – 23D Exponential Growth Exercises Name_____

The population of a city was determined by census at 10 year intervals:

Year (after 2000)	0	1	2	3	4	5
Population (thousands)	23.0	27.6	33.1	39.7	47.7	57.2
Ratio of ***current*** population to previous census population. (**current/previous**)						



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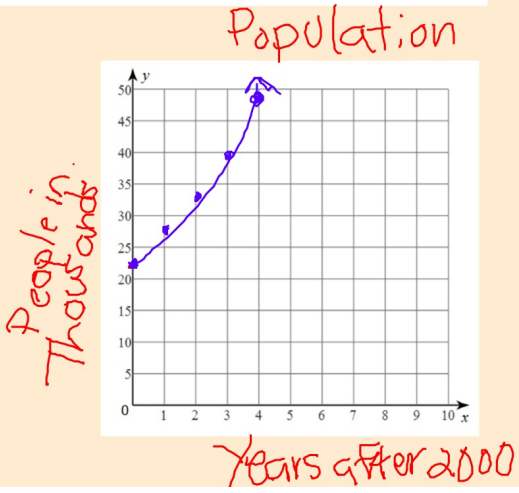
Ratio of ***current*** population to previous census population. (**current/previous**)	X	$\frac{27.6}{23}$ ≈ 1.2	$\frac{33.1}{27.6}$ ≈ 1.2	$\frac{39.7}{33.1}$ ≈ 1.2	$\frac{47.7}{39.7}$ ≈ 1.2	$\frac{57.2}{47.7}$ ≈ 1.2

Exercises:

Year (after 2000)	0	1	2	3	4	5
Population (thousands)	23.0	27.6	33.1	39.7	47.7	57.2
Ratio of **current** population to previous census population. (**current/previous**)	X	$\frac{27.6}{23} \approx 1.2$	$\frac{33.1}{27.6} \approx 1.2$	$\frac{39.7}{33.1} \approx 1.2$	$\frac{47.7}{39.7} \approx 1.2$	$\frac{57.2}{47.7} \approx 1.2$

2) Graph the data on the graph below. Remember to **label** your **axes** and give the graph a **title**!



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3) Writing a rule: Complete each sentence.

a) The starting population of the city is 23000

b) Each year the population is multiplying by a constant rate of 1.2

4) Write an equation modeling the city's population growth. [$y = a \cdot b^x$].

$y = 23{,}000(1.2)^x$

X: years after 2000

y: Population in thousands

Exercises:

Year (after 2000)	0	1	2	3	4	5
Population (thousands)	23.0	27.6	33.1	39.7	47.7	57.2
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5) Use your equation to **verify** that in 2002, the population is ***about*** 33,000.

$y = 23000(1.2)^x$

{2002, 2 years after 2000}

$y = 23{,}000(1.2)^2$

$y = 23{,}000(1.44)$

$y = 33{,}120$

Verified!

Exercises:

6) a) Use your equation to predict the population in the year 2010.

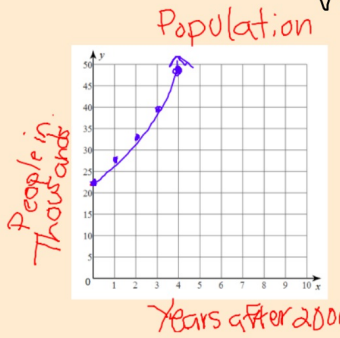
$X = 10$ years $\quad Y = 23{,}000(1.2)^{10}$

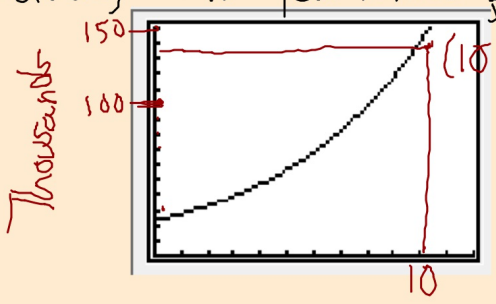
$Y = 23{,}000(6.19)$

$Y \approx 142{,}410$ people

b) Add this value to your graph at year 10. How closely does this point follow the curve of growth?

Very close, the 10th year follows the pattern.





Exercises:

7) After how many years will the population be over 200,000? Show work **or** explain how you arrived at your answer.

X	Y1
7	82.413
8	98.896
9	118.67
10	142.41
11	170.89
12	205.07
13	246.08

X=13

Between the 11th & 12th year of growth.

$y = 23{,}000(1.2)^{11.9}$

$y \approx 23{,}000(8.76) \approx 201{,}365$ People

Population