

# Lesson 7: Graphs of Exponential Relations | Unit 4 – Exponential Relations

## (A) Lesson Context

BIG PICTURE of this UNIT:	<ul style="list-style-type: none"> <li>How can I analyze growth or decay patterns in data sets &amp; contextual problems?</li> <li>How can I algebraically &amp; graphically summarize growth or decay patterns?</li> <li>How can I compare &amp; contrast linear and exponential models for growth and decay problems.</li> </ul>		
CONTEXT of this LESSON:	<p>Where we've been</p> <p>In Lessons 5 &amp; 6, you looked at how exponential equations can be used to model real world scenarios</p>	<p>Where we are</p> <p>How do we interpret and analyze graphs of exponential equations that model growth &amp; decay patterns</p>	<p>Where we are heading</p> <p>How can I use graphs &amp; equations that will help me make predictions about scenarios which feature exponential growth &amp; decay?</p>

## (A) Lesson Objectives:

- Understand the basic appearance and features of the graph of a simple exponential relation
- Make predictions/extrapolations through graphic analysis
- Understand the basic connection between the parameters in an equation and its appearance in a graph

## (B) Graphs of Exponential Functions – REVIEW- The BASIC graph of $y = Ca^x + d$

- Use your TI-84 (or use DESMOS) to graph the equation  $y = 2^x$ . Then sketch the graph on the attached grid. Fill in the included data table as well.

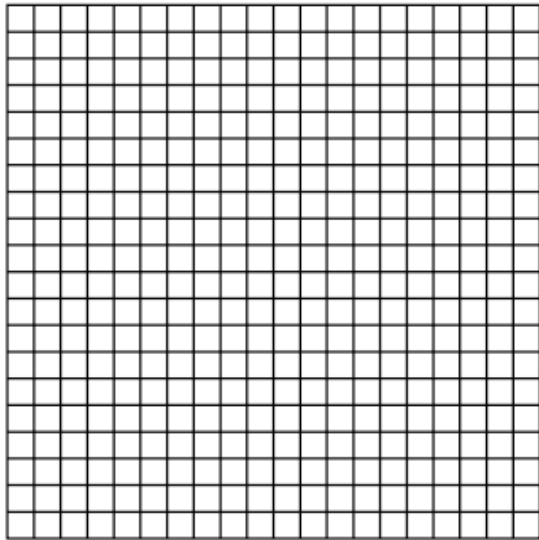
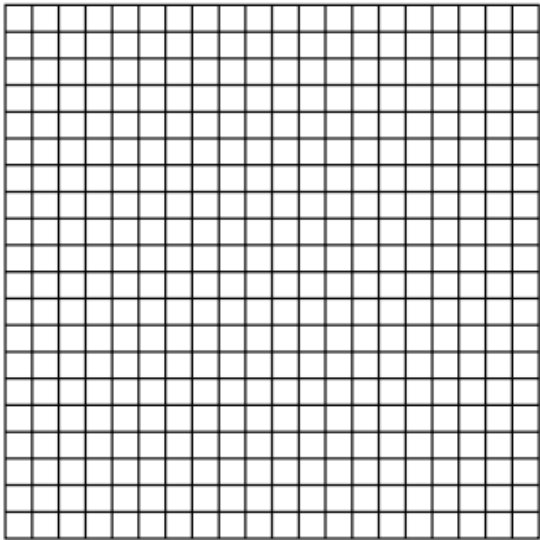
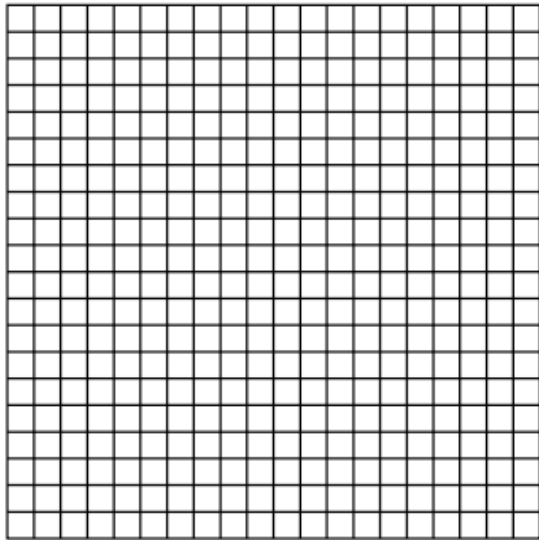
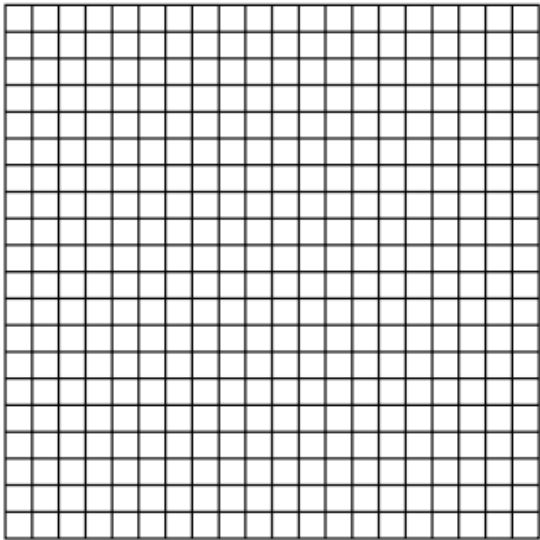
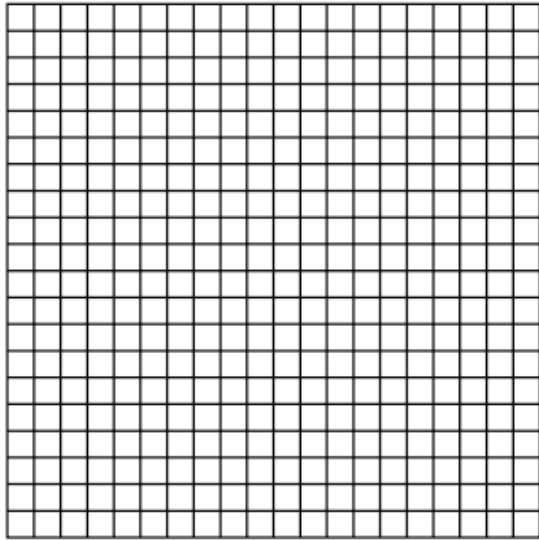
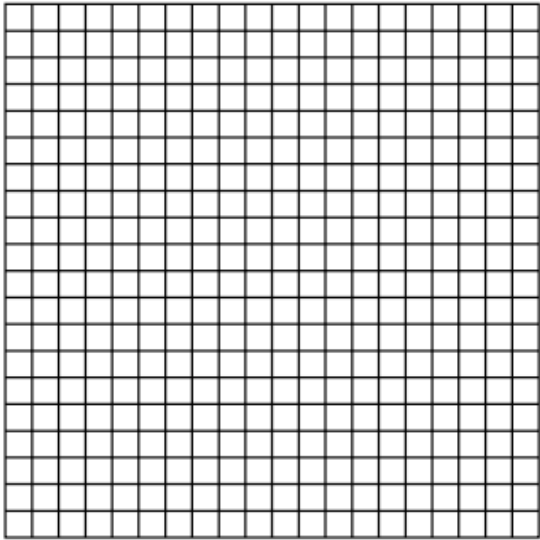
<p>GRAPH:</p>	<p>DATA TABLE:</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td>X</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td>Y</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <table border="1" style="width: 100%; text-align: center;"> <tr> <td>X</td> <td>0</td> <td>-1</td> <td>-2</td> <td>-3</td> <td>-4</td> </tr> <tr> <td>Y</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	X	0	1	2	3	4	Y						X	0	-1	-2	-3	-4	Y					
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Effect of Changing C → on graph:	on data table:																								
Effect of Changing d → on graph:	on data table:																								

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## (C) Graphs of Exponential Functions - CONSOLIDATION of Skills – Changing the values of C & d in $y = Ca^x + d$

WITHOUT using your TI-84, graph the equation  $y = 2^x$ . Then on the same graph, graph the following equations in order to compare the appearance of the graphs & compare the data points.

<p>Equation to graph: <math>y = -(2)^x + 3</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3								<p>Equation to graph: <math>y = (2)^{-x} - 2</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3							
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<p>Equation to graph: <math>y = 4(2)^x + 5</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3								<p>Equation to graph: <math>y = -1 + \frac{1}{3}(2)^x</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3							
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<p>Equation to graph: <math>y = -2(2)^x + 6</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3								<p>Equation to graph: <math>y = \frac{1}{2}(2)^{-x} - 4</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3							
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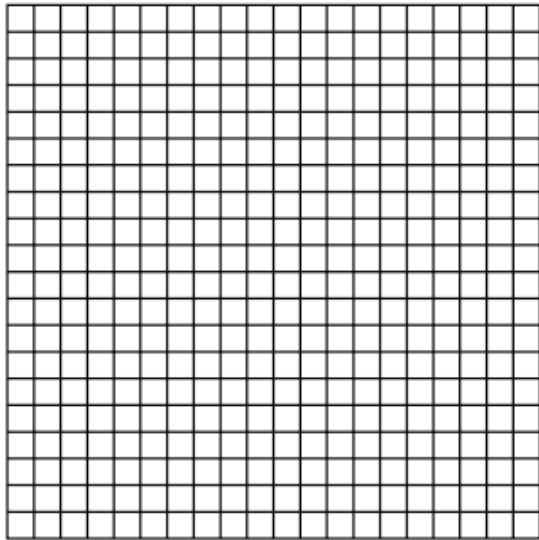
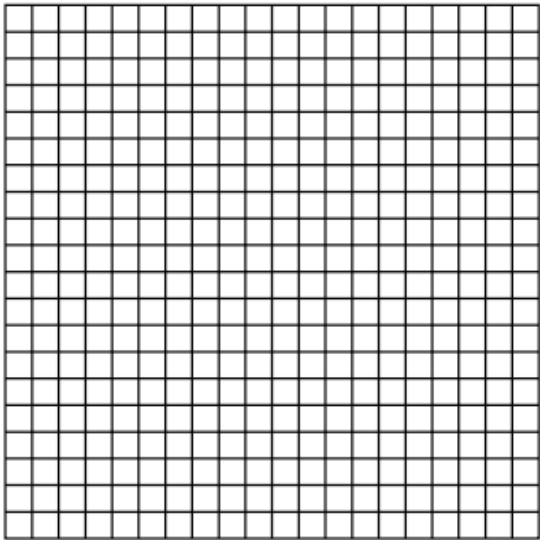
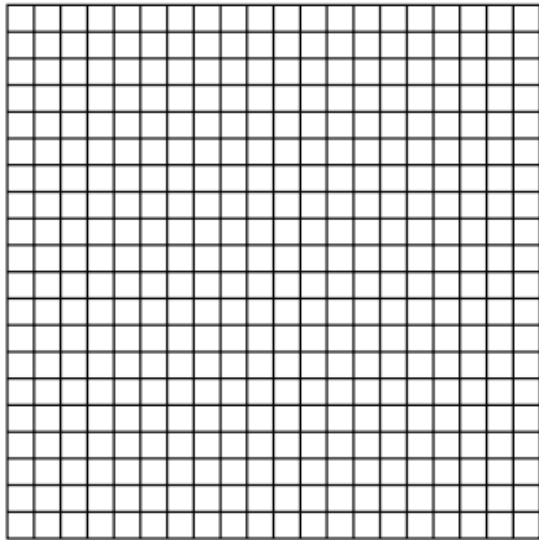
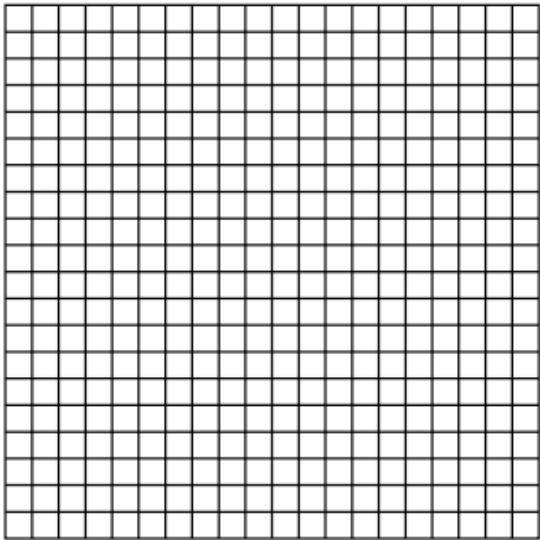
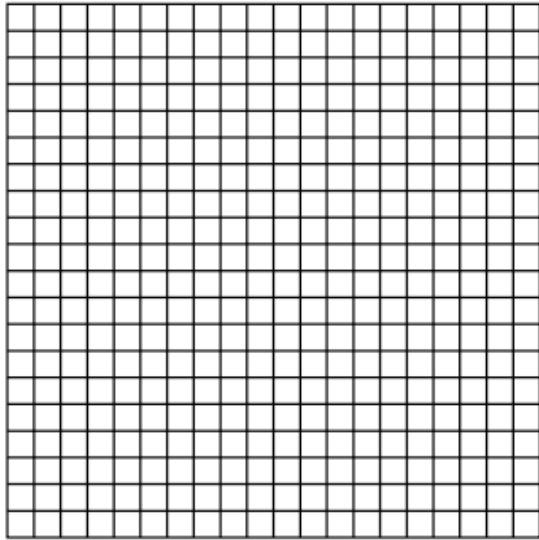
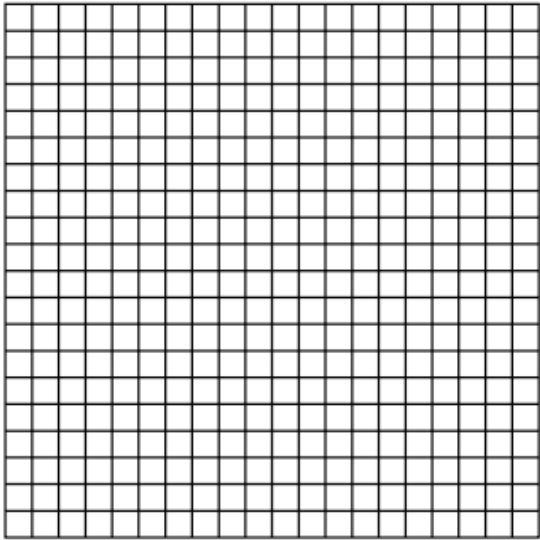


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## **(D) Graphs of Exponential Functions - CONSOLIDATION of Skills – Changing the values of C & d in $y = Ca^x + d$**

WITHOUT using your TI-84, graph the equation  $y = 2^x$ . Then on the same graph, graph the following equations in order to compare the appearance of the graphs & compare the data points.

<p>Equation to graph: <math>y = -\left(\frac{1}{2}\right)^x + 1</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3								<p>Equation to graph: <math>y = \left(\frac{1}{2}\right)^{-x} - 3</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3							
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<p>Equation to graph: <math>y = 8\left(\frac{1}{2}\right)^x - 4</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3								<p>Equation to graph: <math>y = -2 + \frac{1}{4}\left(\frac{1}{2}\right)^x</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3							
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<p>Equation to graph: <math>y = 5 - 3\left(\frac{1}{2}\right)^x</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3								<p>Equation to graph: <math>y = \frac{3}{2} + \frac{1}{2}\left(\frac{1}{2}\right)^{-x}</math></p> <p>Data table:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td> </tr> </table>	-3	-2	-1	0	1	2	3							
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**(E) Consolidation of Concepts**

Without a graphing calculator, use your understanding of the concepts that you learned in order to prepare a (i) data table and a (ii) graph of the following equations:

$Y = -2(2)^x + 8$	$Y = -8 + \frac{1}{4}(2)^{-x}$