Exponential Growth

What does that mean?
Parent Function of Exponential Growth

\[ f(x) = b^x \]

Always Increasing
Domain: All Reals
Range: \( y > 0 \)
Asymptote: x-axis
\[ f(x) = 3^x \]

<table>
<thead>
<tr>
<th></th>
<th>( f(-3) )</th>
<th>( f(-2) )</th>
<th>( f(0) )</th>
<th>( f(1) )</th>
<th>( f(2) )</th>
<th>( f(3/2) )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( 0.037 )</td>
<td>( 0.11 )</td>
<td>( 1 )</td>
<td>( 3 )</td>
<td>( 9 )</td>
<td>( 5.2 )</td>
</tr>
</tbody>
</table>

\( \sqrt[3]{3} = 1.27 \)
Exponential Function

\[ f(x) = ab^{x-h} + k \]
<table>
<thead>
<tr>
<th>Transformations of Exponential Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal Translation</strong></td>
</tr>
<tr>
<td>$(x-h)$: h units right</td>
</tr>
<tr>
<td>$(x+h)$: h units left</td>
</tr>
<tr>
<td><strong>Vertical Translation</strong></td>
</tr>
<tr>
<td>$k$: k units up</td>
</tr>
<tr>
<td>$-k$: k units down</td>
</tr>
<tr>
<td><strong>Orientation and Shape</strong></td>
</tr>
<tr>
<td>if $a &lt; 0$, the graph is reflected over the x-axis</td>
</tr>
<tr>
<td>$a$ also stretches or compresses the image vertically</td>
</tr>
</tbody>
</table>
Describe the transformation and Graph

\[ f(x) = 2^x + 1 \]

\[ f(0) = 2^0 + 1 = 2 \]
Describe the transformation and Graph

\[ y = 2^{x+3} - 5 \]

\[ y = 2^{0+3} - 5 \]

\[ 8 - 5 \]

\[ 3 \]
Describe the transformation and Graph

\[ y = -6^x - 3 \]
Exponential Decay

\[ f(x) = b^x \]

\[ 0 < b < 1 \]
$$f(x) = \left(\frac{1}{3}\right)^x$$

<table>
<thead>
<tr>
<th>x</th>
<th>f(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>27</td>
</tr>
<tr>
<td>-2</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>3/2</td>
<td>.192</td>
</tr>
<tr>
<td>2</td>
<td>.111</td>
</tr>
</tbody>
</table>

\[
\left(\frac{1}{3}\right)^{-3} = \frac{i^{-3}}{3^{-3}} = \frac{27}{1}
\]
Solving Exponential Equations

\[ 2^x = 8^3 \]

\[ 2^x = (2^3)^3 \]

\[ 2^x = 2^9 \]

\[ x = 9 \]
Solving Exponential Equations

\[
9^{2x-1} = 3^{6x}
\]

\[
\left(3^2\right)^{2x-1} = 3^{6x}
\]

\[
3^{4x-2} = 3^{6x}
\]

\[
4x-2 = 6x
\]

\[
-2 = 2x
\]

\[
x = -1
\]
Solving Exponential Equations

\[ 3^{x-4} = \frac{1}{9} \]

\[ 3^{x-4} = 3^{-2} \]

\[ x-4 = -2 \]

\[ x = 2 \]
Solving Exponential Equations

\[ 4^{x+3} = 2^{5x} \]
Solving Exponential Equations

\[ 5^{x-1} = 2^x \]