Think about it:

What happens to $2^x$ as $x$ goes to $\infty$?

really big

What happens to $2^x$ as $x$ goes to $-\infty$?

Small
Exponential Functions: Variable is in the exponent.

Graph: $y = a^x$

$\begin{array}{c|c}
 x & y \\
 \infty & 0 \\
 -4 & 0.0625 \\
 -2 & 0.25 \\
 0 & 1 \\
 2 & 4 \\
 4 & 16 \\
 \infty & \infty \\
\end{array}$

Increasing/Growth:

Decreasing/Decay:

End Behavior:

Domain: $(-\infty, \infty)$

Range: $y > 0$

End Behavior:

Domain: $(-\infty, 0)$

Range: $y > 0$

End Behavior:
Transformations of exponential functions

\[ y = a \cdot b^{x-h} + k \]

Asymptote: \( y = k \)

\( y \)-intercept: \( f(0) = \text{plug in 0 for x} \)

Translations: vertical shift \( h \) up \( k \) down, horizontal shift \( -h \) right \(-h \) left

Transformations: Stretch \( a \neq 1 \), reflection \( a < 0 \)

Example 1:
Graph the exponential function by hand. Identify the following features of the graph:

\[ f(x) = 3^{x-2} \]

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>(-\frac{2}{3})</td>
</tr>
<tr>
<td>-2</td>
<td>(-\frac{1}{3})</td>
</tr>
<tr>
<td>-1</td>
<td>(-\frac{1}{9})</td>
</tr>
<tr>
<td>0</td>
<td>(-\frac{1}{27})</td>
</tr>
<tr>
<td>1</td>
<td>(-\frac{1}{81})</td>
</tr>
<tr>
<td>2</td>
<td>(\frac{1}{3})</td>
</tr>
</tbody>
</table>

Asymptote: \( y = 0 \)
Increasing/Decreasing

Example 4:
Graph the exponential function by hand. Identify the following features of the graph:

\[ f(x) = 5^{-x} + 3 \]

Asymptote: \( y = 3 \)

Increasing/Decreasing

Example 5: Natural base Exponential
Graph the exponential function by hand. Identify the following features of the graph:

\[ b(x) = e^{\frac{1}{x}} + 2 \]

Asymptote: \( y = 2 \)

Increasing/Decreasing
3.1 assignment

Worksheet, Exponential Functions