EXAMPLE 2 Graph an exponential function

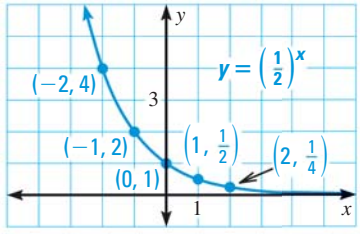
Graph the function $y = \left(\frac{1}{2}\right)^x$ and identify its domain and range.

Solution

READ A GRAPH
Notice that the graph has a y-intercept of 1 and that it gets closer to the positive x-axis as the x-values increase.

STEP 1 **Make** a table of values. The domain is all real numbers.

x	-2	-1	0	1	2
y	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$



STEP 2 **Plot** the points.

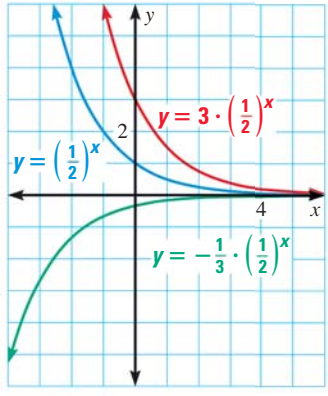
STEP 3 **Draw** a smooth curve through the points. From either the table or the graph, you can see the range is all positive real numbers.

EXAMPLE 3 Compare graphs of exponential functions

Graph the functions $y = 3 \cdot \left(\frac{1}{2}\right)^x$ and $y = -\frac{1}{3} \cdot \left(\frac{1}{2}\right)^x$. Compare each graph with the graph of $y = \left(\frac{1}{2}\right)^x$.

Solution

x	$y = \left(\frac{1}{2}\right)^x$	$y = 3 \cdot \left(\frac{1}{2}\right)^x$	$y = -\frac{1}{3} \cdot \left(\frac{1}{2}\right)^x$
-2	4	12	$-\frac{4}{3}$
-1	2	6	$-\frac{2}{3}$
0	1	3	$-\frac{1}{3}$
1	$\frac{1}{2}$	$\frac{3}{2}$	$-\frac{1}{6}$
2	$\frac{1}{4}$	$\frac{3}{4}$	$-\frac{1}{12}$



Because the y-values for $y = 3 \cdot \left(\frac{1}{2}\right)^x$ are 3 times the corresponding y-values for $y = \left(\frac{1}{2}\right)^x$, the graph of $y = 3 \cdot \left(\frac{1}{2}\right)^x$ is a vertical stretch of the graph of $y = \left(\frac{1}{2}\right)^x$.

Because the y-values for $y = -\frac{1}{3} \cdot \left(\frac{1}{2}\right)^x$ are $-\frac{1}{3}$ times the corresponding y-values for $y = \left(\frac{1}{2}\right)^x$, the graph of $y = -\frac{1}{3} \cdot \left(\frac{1}{2}\right)^x$ is a vertical shrink with reflection in the x-axis of the graph of $y = \left(\frac{1}{2}\right)^x$.

GUIDED PRACTICE for Examples 2 and 3

2. Graph $y = (0.4)^x$ and identify its domain and range.

3. Graph $y = 5 \cdot (0.4)^x$. Compare the graph with the graph of $y = (0.4)^x$.