

### 8.1: Graphing Exponential Growth and Decay

- I can identify whether an exponential function models growth or decay
- I can graph an exponential function

**Exponential Graphs:**  $y = ab^x$  where  $b > 0$  but  $b \neq 1$  (if  $b = 1$  there's no change)

$a =$  initial value or y-intercept

$b =$  growth factor  $b > 1$  or decay factor  $0 < b < 1$

Go to Numbers for making a Table: -2, -1, 0, 1, 2

**ASYMPTOTE:** A line a graph approaches but never actually touches

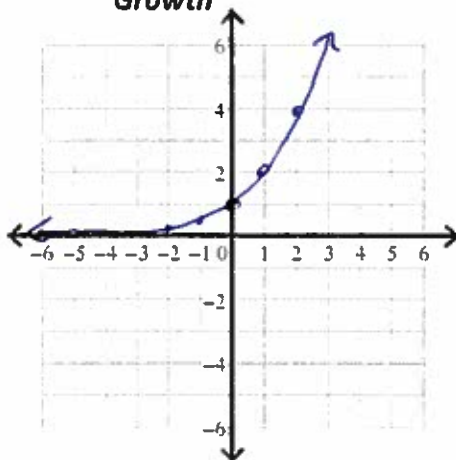
**STRICTLY INCREASING:** The amount the graph grows keeps increasing ↑1, ↑2, ↑4, ↑8

**STRICTLY DECREASING:** The amount the graph decays keeps decreasing ↓9, ↓3, ↓1, ↓1/3

Ex1:  $y = 2^x$

Growth

X	Y
-2	1/4
-1	1/2
0	1
1	2
2	4



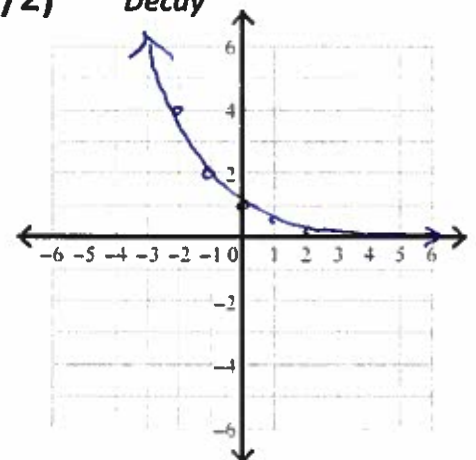
Domain:  $\mathbb{R}$  Y-Intercept:  $(0, 1)$

Range:  $y > 0$  Asymptote:  $y = 0$

Ex2:  $y = (1/2)^x$

Decay

X	Y
-2	4
-1	2
0	1
1	1/2
2	1/4



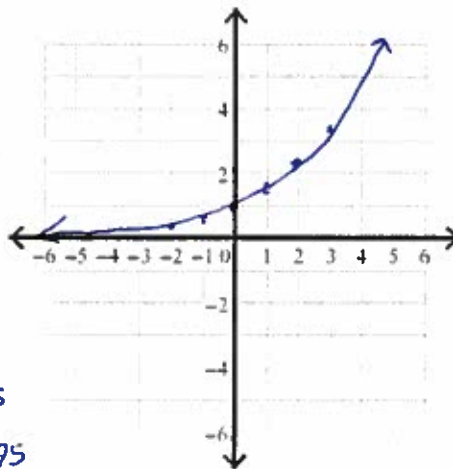
Domain:  $\mathbb{R}$  Y-Intercept:  $(0, 1)$

Range:  $y > 0$  Asymptote:  $y = 0$

**Quick Check:**

Ex3:  $y = (3/2)^x$

X	Y
-2	4/9 .44
-1	2/3 .67
0	1
1	3/2 1.5
2	9/4 2.25
3	27/8 3.375



Domain:  $\mathbb{R}$

Range:  $y > 0$

Y-Intercept:  $(0, 1)$

Asymptote:  $y = 0$

Exponential Graphs:  $y = ab^{x-h} + k$

1. Graph  $y = ab^x$  first.
2. Translate (shift) using  $h$  and  $k$

Ex4:  $y = -3(4)^{x-2} + 1$  *right 2 up 1*

X	Y
-2	$-3/16$
-1	$-3/4$
0	-3
1	-12
2	-48

Domain:  $\mathbb{R}$  Y-Intercept:  $(0, 13/16)$

Ex5:  $y = 2(1/3)^{x+1} - 4$  *left 1, down 4*

X	Y
-2	18
-1	6
0	2
1	$2/3$
2	$2/9$

Domain:  $\mathbb{R}$  Y-Intercept:  $(0, -3\frac{1}{3})$

Range:  $y < 1$  Asymptote:  $y = 1$

Range:  $y > -4$  Asymptote:  $y = -4$

**Quick Check:**

Ex6:  $y = 1/2(3)^{x-4} + 2$  *right 4 up 2*

X	Y
-2	$1/18$
-1	$1/6$
0	$1/2$
1	$3/2$ 15
2	$9/2$ 4.5

Domain:  $\mathbb{R}$

Range:  $y > 2$

Y-Intercept:  $(0, 2\frac{1}{162})$

Asymptote:  $y = 2$

$\frac{1}{2}(3)^{0-4} + 2 = \frac{1}{2}(\frac{1}{81}) + 2 = 2\frac{1}{162}$

**Do & Discuss:** How do  $a$ ,  $b$ ,  $h$ , and  $k$  affect the graph of an exponential?

- $a$  = reflection, initial  $y$ -intercept before shifts
- $b$  = growth if  $b > 1$ , decay if  $0 < b < 1$ . Also how fast the graph grows/decays
- $h$  = shifts left/right
- $k$  = shifts up/down, Range:  $y > k$  or  $y < k$ , Asymptote:  $y = k$

**Additional Resources:**

- Textbook Chapter 7.1 & 7.2
- <https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/graphs-of-basic-exponential-functions/v/graphing-exponential-functions>