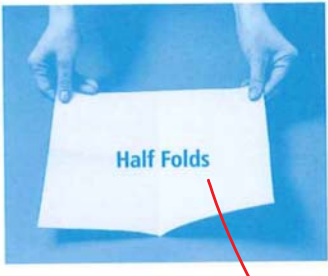


EXPLORE & REASON

Use two pieces of $8\frac{1}{2}$ by 11 paper. Fold one of the pieces of paper accordion-style for five folds. Fold the other in half for five folds. After each fold, unfold each piece of paper and count the total number of rectangular sections.

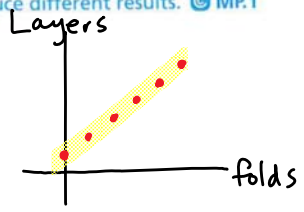


A. Find the pattern relating the number of folds to the number of sections for each folding style. What do you notice?

Linear Pattern
 1, 2, 3, 4, 5, 6, ...
 ↑ ↑
 Folds 0 1 ...

Exponential Pattern
 1, 2, 4, 8, 16, 32, ...
 ↑ ↑
 Folds 0 1 ...

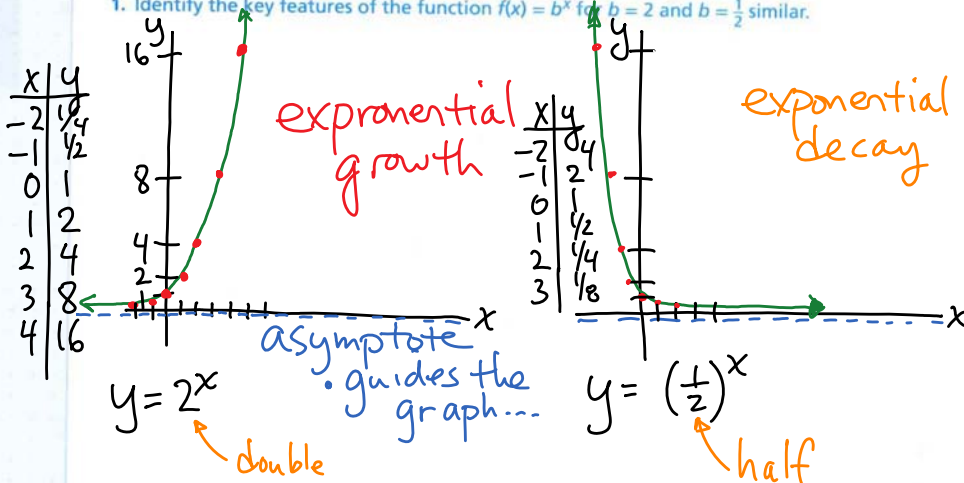
B. **Make Sense and Persevere** Explain why the two different folded pieces of paper produce different results. © MP.1



HABITS OF MIND

Model With Mathematics Describe another situation that you could represent using an exponential function. © MP.4

Doubling \$\$\$ | Flu outbreak

EXAMPLE 1 Try It! Key Features of Exponential Functions1. Identify the key features of the function $f(x) = b^x$ for $b = 2$ and $b = \frac{1}{2}$ similar.**EXAMPLE 2** Try It! Graph Exponential Functions

2. How long will it take for the virus to spread to 50,000 computers?

1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768, 65536, ...

2^{16}

HABITS OF MIND

Use Appropriate Tools Suppose the spread of another virus is modeled by the function $g(x) = 5^x$. If it takes the virus five and a half hours to spread, what tools could you use to investigate the function $g(x) = 5^x$? © MP.5

$$g(x) = 5^x$$

base

Exponential Function

$$f(x) = a \cdot b^x$$

a → initial amount
 b → base (constant ratio)

EXAMPLE 3 Try It! Write Exponential Functions

3. Write an exponential function for each set of points.

a. (0, 3), (1, 12), (2, 48), (3, 192), and (4, 768)

x	y
0	3
1	12
2	48
3	192
4	768

initial amount: a
 base: $\cdot 4$ (between consecutive y-values)
 $f(x) = 3 \cdot 4^x$

b. (0, 2,187), (1, 729), (2, 243), (3, 81), and (4, 27)

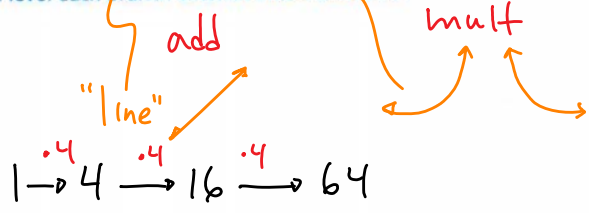
x	y
0	2187
1	729
2	243
3	81
4	27

a
 $\div 3$ (between consecutive y-values)
 $f(x) = 2187 \left(\frac{1}{3}\right)^x$

EXAMPLE 4 Try It! Compare Linear and Exponential Functions

4. Identify each function as linear or exponential. Explain.

a. $f(x)$ equals the number of branches at level x in a tree diagram, where at each level each branch extends into 4 branches.



b. $f(x)$ equals the number of boxes in row x of a stack in which each row increases by 2 boxes.

$+2$ → linear

HABITS OF MIND

Use Structure In an exponential function, why is a a nonzero constant and $b \neq 1$? © MP.7

$$f(x) = a \cdot b^x$$

$b \neq 1$
 $b \neq 0$

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** What are the characteristics of exponential functions?

2. **Look for Relationships** How can you tell whether the graph of a function of form $f(x) = ab^x$ will increase or decrease from left to right? **MP.7**

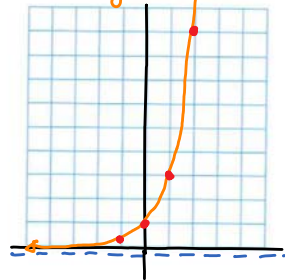
3. **Make Sense and Persevere** Why is $b \neq 1$ a condition for $f(x) = ab^x$? **MP.1**

4. **Error Analysis** Martin says that $f(x) = 2(4)^x$ starts at 4 and has constant ratio of 2. What error did Martin make? Explain. **MP.3**

Do You KNOW HOW?

Graph each function.

5. $f(x) = 3^x$ *growth*

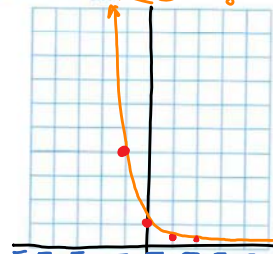


$$y = a \cdot b^x$$

base $b > 1$: growth
 $0 < b < 1$: decay

x	y
-1	$3^{-1} = \frac{1}{3}$
0	$3^0 = 1$
1	$3^1 = 3$
2	$3^2 = 9$

6. $f(x) = \left(\frac{1}{4}\right)^x$ *decay*



x	y
-1	$\left(\frac{1}{4}\right)^{-1} = 4$
0	$\left(\frac{1}{4}\right)^0 = 1$
1	$\left(\frac{1}{4}\right)^1 = \frac{1}{4}$
2	$\left(\frac{1}{4}\right)^2 = \frac{1}{16}$

Write each exponential function.

7.

x	f(x)
0	4
1	2
2	1
3	$\frac{1}{2}$
4	$\frac{1}{4}$

$a = 4$
 $\div 2$
 $\div 2$
 $\div 2$
 $\div 2$

initial value ($x=0$)

$$y = a \cdot b^x$$

$$y = 4 \cdot \left(\frac{1}{2}\right)^x$$

8.

x	f(x)
0	3
1	6
2	12
3	24
4	48

$$y = 3 \cdot 2^x$$