

Name:

IN THIS LESSON, YOU WILL:

- Recognize that exponential patterns grow by a constant growth factor
- Distinguish between exponential and linear functions
- Recognize that investments grow exponentially



INTRO

COMPARE: Which One Doesn't Belong?

Study the tables below to identify patterns, similarities, and differences. Then, answer the question.

Table 1		Table 2		Table 3		Table 4	
x	y	x	y	x	y	x	y
1	8	0	1	0	0	0	32
3	16	1	4	1	16	1	40
5	24	2	16	2	32	2	48
7	32	3	64	3	48	3	56
15	64	4	256	4	64	4	64

1. What do you notice about the tables? Identify 3 similarities or differences between them.

2. Which table doesn't belong? Explain your reasoning.



EXPLORE IT

MOVE: Exponential Growth

Follow your teacher's instructions to complete this activity. Then, answer the questions.

1. In Round 1, how many people stood up with each tap?
 2. In Round 2, how many people stood up with each tap?
 3. Which round did you complete the fastest? Explain why you think that was the case.
 4. Do you think the results would have been different if you did this with a stadium full of people? Why or why not?
-

ACTIVITY: Exponential Growth in Circles

You've seen how exponential growth can happen quickly. Next, you'll explore an exponential function in more detail, with both a visual pattern and numbers, to learn how to measure its growth. Follow your teacher's instructions to complete this Desmos activity.

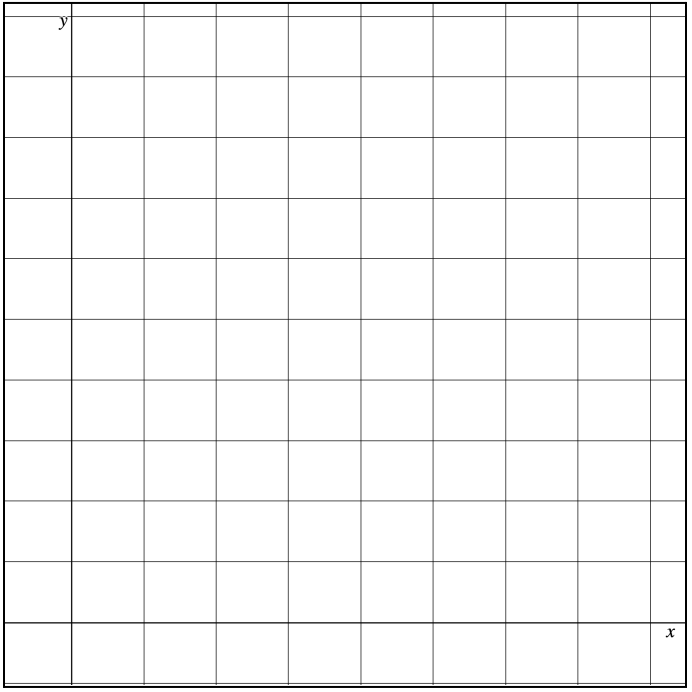


PRACTICE IT

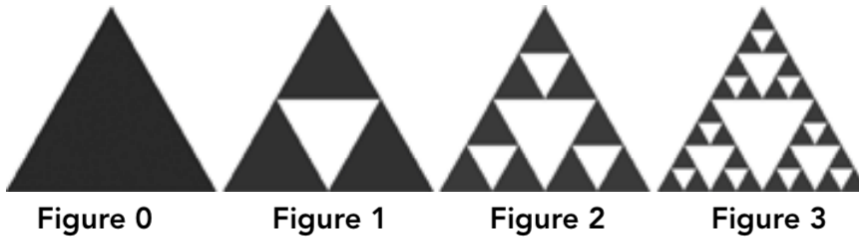
Reasoning with Exponential Patterns

Now that you're familiar with exponential patterns, you'll explore their different representations with your group. It's okay if some parts seem new or confusing; it might take some work to figure out.

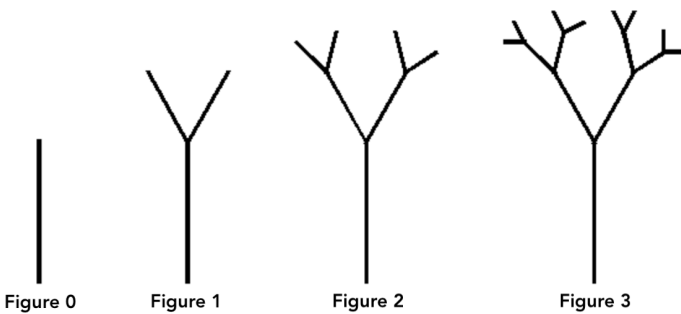
1. Work with your group to complete the table below based on your assigned pattern.

Draw a representation of the next step in the pattern. If the next step has too many pieces, you can draw a partial representation and explain what the complete step would look like.	Describe the way you see the pattern increasing or decreasing. Be sure to identify the <u>growth factor</u> and explain what that means in your pattern. Note: for Pattern D, it will be called the <u>decay factor</u>.
Create a table representing the pattern with numbers.	Plot the points from the table on the graph to illustrate the pattern. 

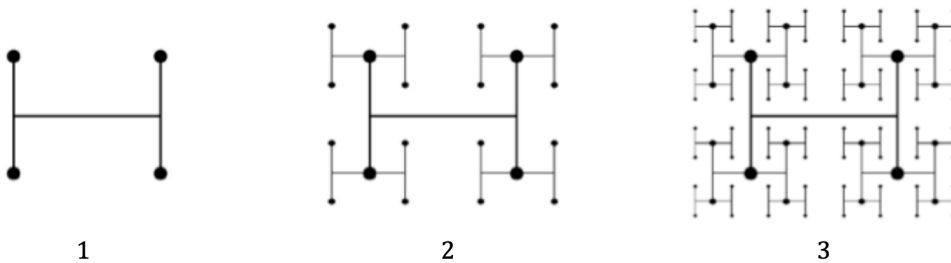
Pattern A: Count the number of shaded triangles in each figure.¹



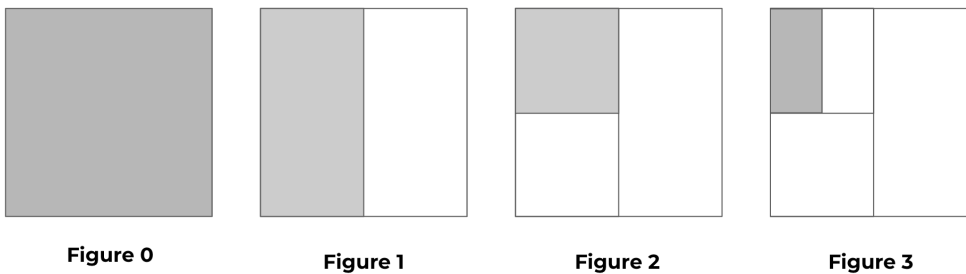
Pattern B: Count the number of endpoints (branches at the top) in each figure.²



Pattern C: Count the number of endpoints in each figure.³



Pattern D: Find the area of the shaded region. Assume Figure 0 has an area of 1.



¹ Source: "Exponents". Fractal Foundation. <https://fractalfoundation.org/resources/fractivities/fractals-and-exponents/>

² Source: "Fractal Trees". <https://davis.wpi.edu/~matt/courses/fractals/trees.html>

³ Source: "Exponents". Fractal Foundation. <https://fractalfoundation.org/resources/fractivities/fractals-and-exponents/>

Reflection Questions

After completing the activity, answer the reflection questions below.

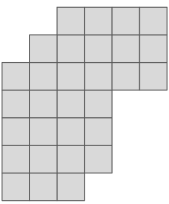
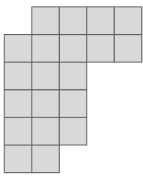
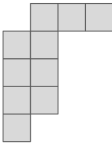
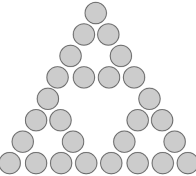
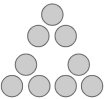
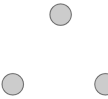
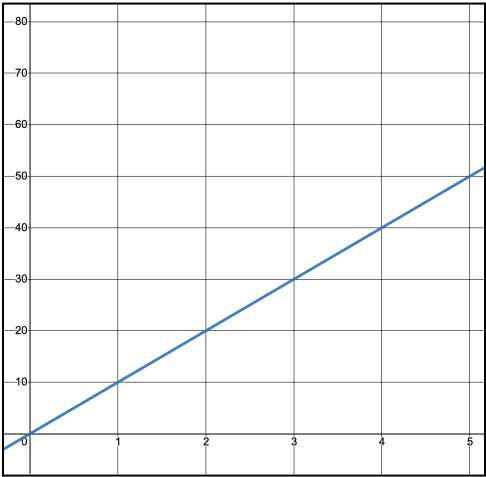
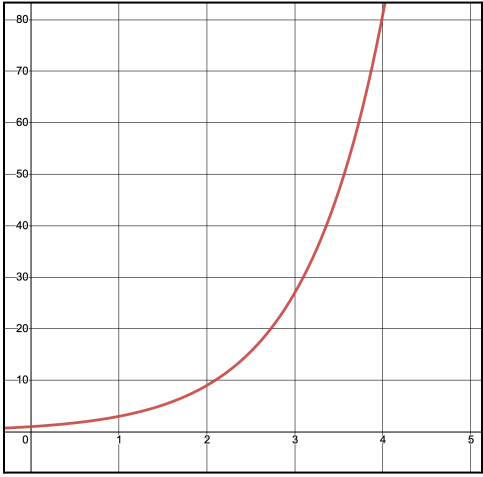
2. Consider the tables your classmates presented for each of the patterns they worked on. Which pattern do you think would have the largest y value when $x = 20$? Explain your reasoning.

 **LEARN IT**

COMPARE: Exponential vs Linear Patterns

Now that you’ve explored exponential growth, consider how it compares to linear growth.

1. Complete the table with a description of how each function is changing in the pattern and in the graph.

	$y = 10x$ Linear	$y = 3^x$ Exponential
Visual Pattern	 Figure 1 Figure 2 Figure 3	 Figure 1 Figure 2 Figure 3
How are the shapes changing in each step?		
Graph		

How do you see the pattern reflected in the graph?		
--	--	--

- Which function has a constant rate of change?
- Which function changes by a constant growth factor?
- Which function grows more between $x = 1$ and $x = 2$? Show your work or explain your reasoning.
- Which function do you think will grow more between $x = 5$ and $x = 6$? Explain your reasoning.



PRACTICE IT

CARD SORT: Linear and Exponential Functions

- Categorize each of the scenarios, patterns, or functions into the table below by identifying whether it represents linear or exponential change.

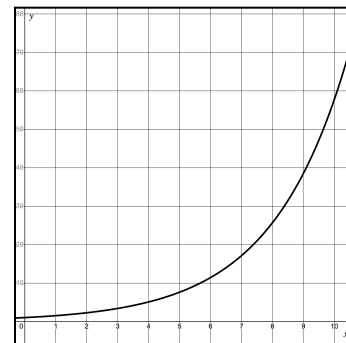
Linear	Exponential

A. $y = 2^x$	B. $7 \times 7 \times 7 \times 7 \times 7$	C. $y = 9^x$	D. $y = 2x$												
E. $5 + 5 + 5 + 5$	F. $y = (1.05)^x$	G. You add \$50 to your account every month	H. The value of an investment doubles every decade												
I. <table><tr><td>x</td><td>y</td></tr><tr><td>0</td><td>1</td></tr></table>	x	y	0	1	J. <table><tr><td>x</td><td>y</td></tr><tr><td>0</td><td>50</td></tr></table>	x	y	0	50	K. <table><tr><td>x</td><td>y</td></tr><tr><td>0</td><td>5</td></tr></table>	x	y	0	5	L.
x	y														
0	1														
x	y														
0	50														
x	y														
0	5														

1	5
2	25
3	125

1	75
2	100
3	125

1	50
2	500
3	5000



APPLY IT

Follow your teacher's directions to complete the Application Problems.

Teachers, you can find the Application problems linked in the Lesson Guide.