1.6 Writing Quadratic Functions

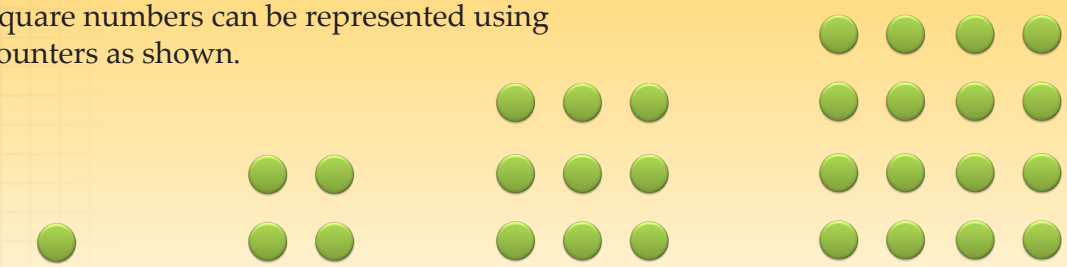
FOCUSING QUESTION What are the characteristics of a quadratic function?

LEARNING OUTCOMES

- I can determine patterns that identify a quadratic function from its related finite differences.
- I can determine the quadratic function from a table using finite differences, including any restrictions on the domain and range.
- I can use finite differences to determine a quadratic function that models a mathematical context.
- I can analyze patterns to connect the table to a function rule and communicate the quadratic pattern as a function rule.

ENGAGE

Square numbers can be represented using counters as shown.

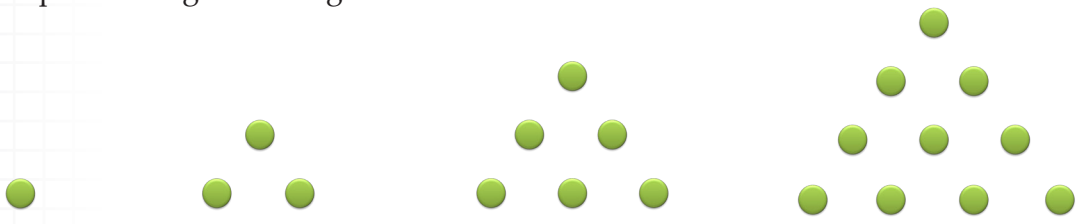


TERM 1: 1 TERM 2: 4 TERM 3: 9 TERM 4: 16

What patterns do you see in the geometric arrangements of square numbers?

EXPLORE

A **figurative number**, sometimes called a **figurate number**, is a number that can be represented by a regular geometric arrangement of dots or other objects. For example, **triangular numbers** can be represented using arrangements of dots that are shaped like regular triangles.



1 3 6 10

Use counters to build a sequence of the first six triangular numbers. Record the numbers in a table like the one shown.

TERM NUMBER	TRIANGULAR NUMBER
1	1
2	
3	
4	
5	
6	

1. As you build the sequence, what patterns do you see in each successive term?

2. Does the data set follow a linear or an exponential function? Explain your reasoning.

3. What patterns do you see in the finite differences or the successive ratios?

4. Calculate the second finite difference. What do you notice?

5. The quadratic parent function is $y = x^2$. Generate a sequence with y-values for $\{x \mid x = 1, 2, 3, 4, 5, 6\}$.

A set of numbers, such as x-values or y-values, can be represented with braces using set notation. The set of whole numbers less than 10 is represented as {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. If this set is a set of x-values, it can be written as $\{x \mid x = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ which is read "the set of all x such that x equals zero, one, two, …"

6. Calculate the second finite differences for the quadratic parent function. What do you notice?

	x	y
	1	1
$\Delta x = 2 - 1 = 1$	2	4
$\Delta x = 3 - 2 = 1$	3	9
$\Delta x = 4 - 3 = 1$	4	16
$\Delta x = 5 - 4 = 1$	5	25
$\Delta x = 6 - 5 = 1$	6	36

7. What type of function do you think represents the relationship between the triangular number and the term number, or its position in the sequence?

REFLECT

- **In a linear function, the first finite differences are constant. What is true about the finite differences for a quadratic function?**
- **A linear function contains a polynomial with degree one ($mx + b$) and a quadratic function contains a polynomial with degree two ($ax^2 + bx + c$). What relationship is there between the degree of the polynomial and the level of finite differences that are constant?**

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