

1 | Is There a Pattern Here?

2 | The Password Is...
Operations!

3 | Did You Mean: *Recursion*?

4 | Pegs, N Discs

LESSON 1

Is There a Pattern Here?

Recognizing Patterns and Sequences

Learning Goals

- Recognize and describe patterns.
- Represent patterns as sequences.
- Predict the next term in a sequence.
- Represent a sequence as a table of values.

REVIEW (1–2 minutes)

- Each set shows the distance in miles a car traveled at the end of each hour for 4 hours. Determine whether each set shows a constant rate of change. If the rate is constant, write the rate.

1 {55, 110, 165, 220}

2 {11, 22, 33, 44}

3 {30, 35, 45, 60}

4 {0, 0, 0, 0}



KEY TERMS

sequence

term of a
sequence

infinite sequence

finite sequence

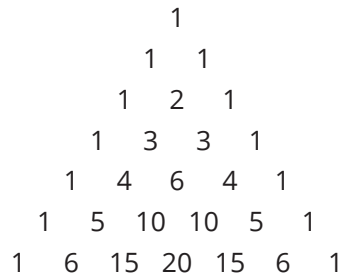
Since early elementary school, you have been recognizing and writing patterns involving shapes, colors, letters, and numbers.

How do patterns relate to sequences and how can you represent them in tables?



A Pyramid of Patterns

Pascal's Triangle is a famous pattern named after the French mathematician and philosopher Blaise Pascal. A portion of the pattern is shown.



- 1 List at least 3 patterns that you notice.
- 2 Describe the pattern for the number of terms in each row.
- 3 Describe the pattern within each row.
- 4 Describe the pattern that results from determining the sum of each row.
- 5 Determine the next two rows in Pascal's Triangle. **Explain your reasoning.**

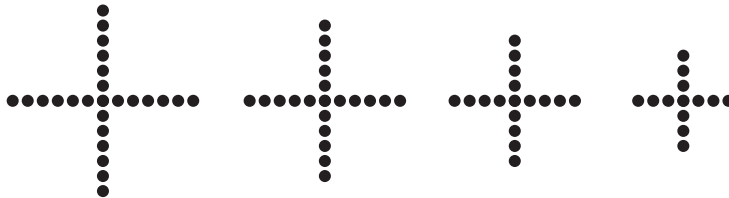


Patterns to Sequences to Tables

A **sequence** is a pattern involving an ordered arrangement of numbers, geometric figures, letters, or other objects. A **term of a sequence** is an individual number, figure, or letter in the sequence.

➤ Seven examples of sequences are given in this activity. For each sequence, describe the pattern, draw or describe the next terms, and represent each sequence numerically.

1 Positive Thinking



(a) Analyze the number of dots. **Describe the pattern.**

(b) Draw the next three figures of the pattern.

(c) Represent the number of dots in each of the seven figures as a numeric sequence.

(d) Represent the number of dots in each of the first seven figures as a function using a table of values.

Term Number	Term Value
1	
2	
3	
4	
5	
6	
7	

HABITS OF MIND

- Model with mathematics.
- Use appropriate tools strategically.

THINK ABOUT...

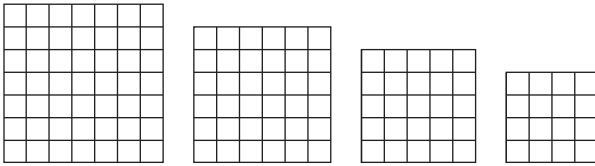
You can represent all numeric sequences as functions. The independent variable is the term number beginning with 1, and the dependent variable is the term of the sequence.

**2 Family Tree**

Jessica is investigating her family tree by researching each generation, or set, of parents. She learns all she can about the first four generations, which include her two parents, her grandparents, her great-grandparents, and her great-great-grandparents.

- a Think about the number of parents. **Describe the pattern.**
- b Determine the number of parents in the fifth and sixth generations.
- c Represent the number of parents in each of the 6 generations as a numeric sequence. Then represent the sequence using a table of values.

Term Number	Term Value

**3 A Collection of Squares**

a Analyze the number of small squares in each figure. **Describe the pattern.**

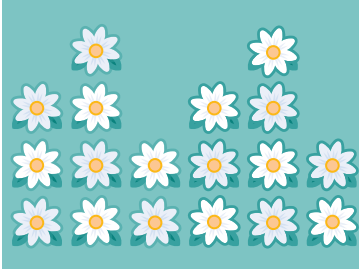
b Draw the next three figures of the pattern.

c Represent the number of small squares in each of the first seven figures as a numeric sequence. Then represent the sequence using a table of values.

Term Number	Term Value

**4 Donna's Daisies**

Donna is decorating the top border of her bedroom walls with a daisy pattern. She is applying decals, with each column having a specific number of daisies.



- a** Think about the number of daisies in each column. **Describe the pattern.**
- b** Draw the number of daisies in each of the next three columns.
- c** Represent the number of daisies in each of the first 8 columns as a numeric sequence. Then represent the sequence using a table of values.

Term Number	Term Value

**5 Gamer Guru**

Mica unlocks some special mini-games where he earns points for each one he completes. After completing 1 mini-game, he has 550 points. After completing 2 mini-games, he has 600 points, and after completing 3 mini-games, he has 650 points.

- a** Think about the total number of points Mica gains from mini-games.
Describe the pattern.

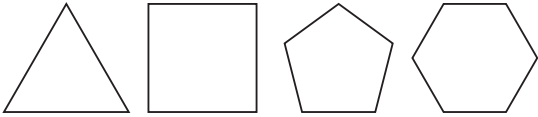
- b** Determine Mica's total points after he plays the next two mini-games.

- c** Represent Mica's total points after completing each of the first 5 mini-games as a numeric sequence. Be sure to include the number of points he started with. Then represent the sequence using a table of values.

Term Number	Term Value



6 Polygon Party



a Analyze the number of sides in each polygon. **Describe the pattern.**

b Draw the next two figures of the pattern.

c Represent the number of sides of each of the first 6 polygons as a numeric sequence. Then represent the sequence using a table of values.

Term Number	Term Value

**7 Pizza Contest**

After a pizza-making contest, Jacob plans to cut his whole pizza so that he can pass the slices out to share. After that, he cuts each of those slices in half. Then he cuts each of those slices in half, and so on.

a Think about the size of each slice in relation to the whole pizza. **Describe the pattern.**

b Determine the size of each slice compared to the whole pizza after the next two cuts.

c Represent the size of each slice compared to the whole pizza after each of the first 5 cuts as a numeric sequence. Include the whole pizza before any cuts. Then represent the sequence using a table of values.

Term Number	Term Value



ACTIVITY 2

MATHia CONNECTION

- Describing Patterns in Sequences

Sequences

TOPIC 2

LESSON 1

Getting
StartedActivity
1 2Talk
the Talk

Looking at Sequences More Closely

Many different patterns can generate a sequence of numbers. For example, you may have noticed that you could generate some of the sequences in the previous activity by performing the same operation using a constant number. In other sequences, you may have noticed a different pattern.

You calculate the next term in a sequence by determining the sequence's pattern and then using that pattern on the last known term of the sequence.

HABITS OF MIND

- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

- Complete the table to describe each sequence from the previous activity.

Problem	Sequence	Increases (I) or Decreases (D)	Description
Positive Thinking	25, 21, 17, 13, 9, 5, 1	D	Begin at 25. Subtract 4 from each term.
Family Tree			
A Collection of Squares			
Donna's Daisies			
Gamer Guru			
Polygon Party			
Pizza Contest			

- Which sequences are similar? **Explain your reasoning.**

- What do all sequences have in common?



4 What is the domain of a sequence? What is the range?

5 Consider a sequence in which the first term is 64, and you calculate each term after that by dividing the previous term by 4. Margaret says that this sequence ends at 1. Jasmine disagrees and says that the sequence continues forever. Who is correct? If Margaret is correct, explain why. If Jasmine is correct, predict the next two terms of the sequence.



6 Which sequences in the table end? Which continue forever? **Explain your reasoning.**

When a sequence continues forever, it is an **infinite sequence**.
When a sequence terminates, it is a **finite sequence**.

TAKE NOTE...

An ellipsis is three periods, which means “and so on.” You can represent an infinite sequence using an ellipsis. For example, 2, 4, 6, ...



Searching for a Sequence

In this lesson, you have seen that many different patterns can generate a sequence of numbers.

- 1 Explain why all sequences represent functions.
- 2 Create a sequence to fit the given criteria. Describe your sequence using figures, words, or numbers. Provide the first four terms of the sequence. **Explain how you know that it is a sequence.**
 - a Create a sequence that begins with a positive integer, is decreasing by multiplication, and is finite.
 - b Create a sequence that begins with a negative rational number, is increasing by addition, and is infinite.



LESSON 1 ASSIGNMENT

➤ Use a separate piece of paper for your Journal entry.

JOURNAL

Explain why all sequences represent functions.

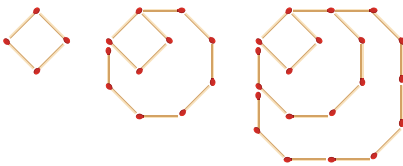
REMEMBER

A sequence is a pattern involving an ordered arrangement of numbers, geometric figures, letters, or other objects. It is a function whose domain is the set of natural numbers.

PRACTICE

➤ Consider the three sequences given. For each sequence, describe the pattern. Then, represent the sequence as a numeric sequence and as a table of values.

1 Matchstick Mayhem



Term Number	1	2	3	4	5	6
Term Value						

2 Hancox Homes

Hancox Homes is a popular construction company that builds affordable housing. When the company first started, they sold 1 home the first month, 3 homes the second month, 9 homes the third month, and 27 homes the fourth month.

Term Number	1	2	3	4	5	6
Term Value						



**3** Violet's Videos

Violet is a yoga instructor who regularly posts new exercise videos on a website for her clients. One week after launching the website, she had posted a total of 6 videos. At the end of week 2, she had a total of 10 videos. At the end of week 3, she had a total of 14 videos. At the end of week 4, she had a total of 18 videos.

Term Number	1	2	3	4	5	6
Term Value						

STRETCH Optional

Robin is opening a restaurant and tells her staff they must go above and beyond to please their customers, especially on opening day. She reasons that when one customer is pleased with the restaurant, that person is likely to tell 4 people about it. Then each of those people is likely to tell 4 people about it, and so on.

- 1 Describe the pattern for the number of customers Robin's Restaurant will reach with each telling.
- 2 Determine how many customers Robin reaches after the 5th, 6th, and 7th tellings.
- 3 Represent the number of customers reached with each telling as a numeric sequence. Then represent the sequence using a table of values.
- 4 Identify the appropriate function family for the function. Then describe whether the function is continuous or discrete.