

common core

Performance Coach



Sample Lesson

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Standards

5.OA.2

5.OA.1

5.OA.3

5.NBT.1

5.NBT.2

5.NBT.3.a

5.NBT.3.b

5.NBT.4

5.NBT.5

5.NBT.6

5.NBT.7

5.NBT.7

5.NBT.7

5.NF.1

5.NF.2

5.NF.3

5.NF.4.a

5.NF.4.b

5.NF.5.a, 5.NF.5.b

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Standards

5.NF.6
5.NF.7.a, 5.NF.7.b
5.NF.7.c
5.MD.1
5.MD.2
5.MD.3.a, 5.MD.3.b, 5.MD.4
5.MD.5.a, 5.MD.5.b
5.MD.5.c
5.G.1
5.G.2
5.G.3, 5.G.4

Relating Numerical Expressions

Student Edition pages 21–29

LESSON OVERVIEW

Objectives

Students will:

- Generate numerical patterns given a rule and identify relationships between patterns
- Represent the relationship between two patterns using ordered pairs and graph them on a coordinate plane
- Make connections between different representations of patterns

Discussion Questions

- MP1** Explain the relationship between a list of ordered pairs and a graph created by the ordered pairs.
- MP7** How do you know when a sequence of numbers does not have a pattern or rule?
- MP8** Explain one method you use to determine if a sequence is a pattern.

Differentiation

Lesson Support With each problem, provide a visual of the pattern. Have students use a four-quadrant graphic organizer to view the different representations of the patterns. Quad 1—the pattern; Quad 2—rule; Quad 3—ordered pairs; Quad 4—the graph.

Lesson Extension Have students find the 10th and 20th terms of a pattern and explain how they found the terms. *Ask: How did the rule help you in finding the 10th and 20th terms?*

Standard

5.OA.3

Key Terms

coordinate plane rule
 corresponding sequence
 terms term
 ordered pair

Materials

- Math Tool: Grids, p. C3
Student Edition p. 299
- Math Tool: Coordinate Grids, p. C19
Student Edition p. 331

1 GETTING THE IDEA

Lesson Opener

On the board provide three representations of two related simple patterns—the patterns, the **ordered pairs**, and a graph. *Ask: How are the three representations related?*

The three representations will provide visuals of the new vocabulary. Use this as an opportunity to discuss the vocabulary presented in this lesson. Student

answers will give you an opportunity to assess their understanding and identify any misconceptions.

▲ **ELL Support** The word *order* is a homonym. Different meanings for *order* include:

A set of instructions:

Your orders are to clean your room.

An arrangement:

The numbers were put in order from least to greatest.

The cognates for order in Spanish are ordenar (verb) and el orden (noun).

► Example 1

This example requires students to relate the **corresponding terms** of two patterns. Assist students in identifying the relationship. Ask: *What can you do to 4 to get 12?* Explore all options—multiply by 3 or add 8. Ask: *Do either of those options apply to the next pair of corresponding terms?* Have students try out both options. Have them test their rule on the other pairs.

▲ **Journal Prompt** **MP3** **MP4** *A rule is a statement that tells you what is and is not allowed. In this lesson you are finding rules between patterns. Where else do you encounter rules?*

► Example 2

This example is similar to Example 1, except that students must first generate the patterns. This example includes patterns with the same numbers. Have students create a table to distinguish between the two.

► Example 3

This example shows how corresponding terms in two related patterns can be plotted on a **coordinate plane**. If necessary, review how to plot the ordered pairs on a grid. Ask: *What point is a good starting place when graphing ordered pairs? Why?*

Ask: *When graphing, which direction should you move first—left to right, or bottom to top? Does it matter?*

▲ **Common Errors** *Errors occur when students switch the order of corresponding terms in creating and plotting ordered pairs. Emphasize the importance of organizing the information presented in tables. Explore this error by having students compare points such as (3, 15) and (15, 3).*

2 COACHED EXAMPLE

Have students use a four quadrant graphic organizer to display the different requirements of the problem. Quad 1—the given table; Quad 2—the rule; Quad 3—ordered pairs; Quad 4—the graph. When finished, discuss the connection among the four representations of the problem.

▲ **Journal Prompt** *How much tomato sauce would you need if you had 32 basil leaves? Explain how you found your answer.*

For answers, see page A3.

3 LESSON PRACTICE

As students are working, pay special attention to problem 7, which requires students to form ordered pairs and graph them on the coordinate plane. Ask students to explain how they know they are correct.

For answers, see page A4.

Relating Numerical Expressions

1 GETTING THE IDEA

A pattern is a **sequence** of numbers in an ordered list. Each number in the pattern is called a **term**. The first 5 terms of a pattern are shown below.

8, 16, 24, 32, 40, ...

You can generate numerical patterns using given rules, identify relationships of the **corresponding terms** between two patterns, and graph the patterns on a **coordinate plane**.

Example 1

Write a rule for each pattern. Then identify the relationship between the two patterns.

4, 8, 12, 16, 20, ...

12, 24, 36, 48, 60, ...

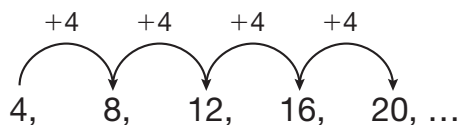
Strategy Compare terms to identify rules and relationships in the patterns.

Step 1

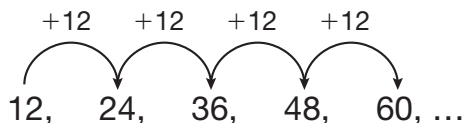
Identify a rule in each pattern.

Determine what you can do to the first term to get the second term.

Check that the rule applies to every term in the pattern.



You can add 4 to a term to get the next term. The rule is add 4.



You can add 12 to a term to get the next term. The rule is add 12.

Step 2

Identify corresponding terms in each pattern.

You can list the sets of corresponding terms.

$$\begin{array}{ccccc} 4 & 8 & 12 & 16 & 20 \\ 12 & 24 & 36 & 48 & 60 \end{array} \left. \vphantom{\begin{array}{ccccc} 4 & 8 & 12 & 16 & 20 \\ 12 & 24 & 36 & 48 & 60 \end{array}} \right\} 4, 12 \quad 8, 24 \quad 12, 36 \quad 16, 48 \quad 20, 60$$

Step 3

Compare corresponding terms.

Compare the terms in the second pattern to the corresponding terms in the first pattern.

12 and 4: 12 is 3 times 4 or 8 more than 4.

24 and 8: 24 is 3 times 8, but not 8 more than 8.

Step 4

Check the remaining terms and identify a relationship.

Terms in the second pattern are 3 times the corresponding terms in the first pattern.

Solution

The rule is add 4 for the first pattern and add 12 for the second pattern. The terms in the second pattern are 3 times the corresponding terms in the first pattern.

Example 2

Use the given rules and the starting numbers to generate the first 5 terms in two different numerical patterns. Then identify the relationship between corresponding terms in the patterns.

First pattern: Add 2, starting with 2.

Second pattern: Add 8, starting with 8.

Strategy

Use counting by multiples to generate the patterns. Then compare the corresponding terms.

Step 1

Generate the numerical patterns.

Count by multiples of 2 for the first pattern: 2, 4, 6, 8, 10

Count by multiples of 8 for the second pattern: 8, 16, 24, 32, 40

Step 2

List the corresponding terms in the two patterns.

2, 8 4, 16 6, 24 8, 32 10, 40

Step 3

Identify the relationship between corresponding terms.

In the first two corresponding terms, 8 is 4×2 and 16 is 4×4 .

Check each of the corresponding terms to make sure the relationship applies to all of the terms.

The terms in the second pattern are 4 times the corresponding terms in the first pattern.

Solution

The two numerical patterns are 2, 4, 6, 8, 10 and 8, 16, 24, 32, 40. The terms in the second pattern are 4 times the corresponding terms in the first pattern.

An **ordered pair** is used to locate a point on the coordinate plane. The ordered pair (2, 5) is located 2 units to the right of the origin and 5 units up. You can make ordered pairs from corresponding terms of two patterns to graph the patterns.

Example 3

The table shows the cost of buying screen-print T-shirts in packs of three.

Number of T-shirts	3	6	9	12	15
Cost (\$)	15	30	45	60	75

Identify the relationship between the cost of the T-shirts and the number of T-shirts. Form ordered pairs for the relationship and then graph the relationship on a coordinate plane.

Strategy

Use the numbers in the table to identify the relationship, write ordered pairs, and graph the ordered pairs.

Step 1

Identify the relationship between the cost of T-shirts and the number of T-shirts.

Identify a relationship between the corresponding terms for the first two terms in the pattern.

15 is 5 times 3 T-shirts. }
 30 is 5 times 6 T-shirts. } The cost of T-shirts in dollars is
 5 times the number of T-shirts.

Check that the remaining terms have the same relationship.

Step 2

Form ordered pairs.

Write ordered pairs for the corresponding terms in the table:
(number of T-shirts, cost).

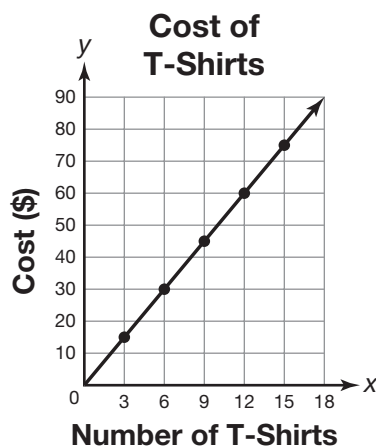
The ordered pairs are (3, 15), (6, 30), (9, 45), (12, 60), (15, 75).

Step 3

Graph the ordered pairs on the coordinate plane.

Plot a point for each of the ordered pairs.

Draw a line through the points.

**Solution**

The relationship between the corresponding terms in the patterns is that the cost in dollars is 5 times the number of T-shirts. The ordered pairs are (3, 15), (6, 30), (9, 45), (12, 60), (15, 75). The graph is shown in Step 3.

2 COACHED EXAMPLE

The table shows the number of basil leaves and amount of tomato sauce used in a pasta recipe.

Number of Basil Leaves	4	8	12	16	20
Tomato Sauce (in fl oz)	8	16	24	32	40

Identify the relationship between the amount of tomato sauce and the number of basil leaves in the recipe. Form ordered pairs for the relationship, and graph the ordered pairs on the coordinate plane.

Identify a relationship between the corresponding terms for the first two terms in the pattern.

8 fl oz of tomato sauce is ____ times 4 basil leaves.

16 fl oz of tomato sauce is ____ times 8 basil leaves.

The terms in the pattern for tomato sauce are ____ times the corresponding terms in the pattern for basil leaves.

The amount of tomato sauce in fluid ounces is ____ times the number of basil leaves.

Form ordered pairs. (basil leaves, tomato sauce)

The ordered pairs are (____, ____), (____, ____), (____, ____), (____, ____), (____, ____).

Graph the ordered pairs on a coordinate plane.



3 LESSON PRACTICE

- 1 Use each rule and starting number to generate two numerical patterns.

Pattern A: Add 3, starting with 0. _____, _____, _____, _____, _____

Pattern B: Add 18, starting with 0. _____, _____, _____, _____, _____

Identify the relationship between the two patterns.

- 2 Rami generated two numerical patterns.

5, 10, 15, 20, 25, ...

10, 20, 30, 40, 50, ...

The rule for the first pattern is _____.

The rule for the second pattern is _____.

Identify the relationship between the two patterns.

- 3 Mandy made turquoise paint by mixing drops of green tint and blue tint in jars of white paint. The table shows how many drops Mandy used.

Drops of Green Tint	2	4	6	8	10
Drops of Blue Tint	4	8	12	16	20

Circle the rule for each statement.

The rule for green tint is add 1 . The rule for blue tint is add 2 .
add 2 . add 4 .
add 4 . add 8 .

Identify the relationship between the two colors of tint.

- 4 Omar generated two numerical patterns.

10, 20, 30, 40, 50, ...

50, 100, 150, 200, 250, ...

Which describes the patterns? Circle all that apply.

- A. The terms in the second pattern are 5 times the corresponding terms in the first pattern.
- B. The terms in the first pattern are one-half the corresponding terms in the second pattern.
- C. The rule for the first numerical pattern is add 40.
- D. The rule for the first numerical pattern is add 10.
- E. The rule for the second numerical pattern is add 50.
- F. The rule for the second numerical pattern is add 100.

- 5 Identify the relationship between the two numerical patterns.

3, 6, 9, 12, 15, ...

12, 24, 36, 48, 60, ...

- 6 Select True or False for each statement about the two numerical patterns.

20, 40, 60, 80, 100, ...

5, 10, 15, 20, 25, ...

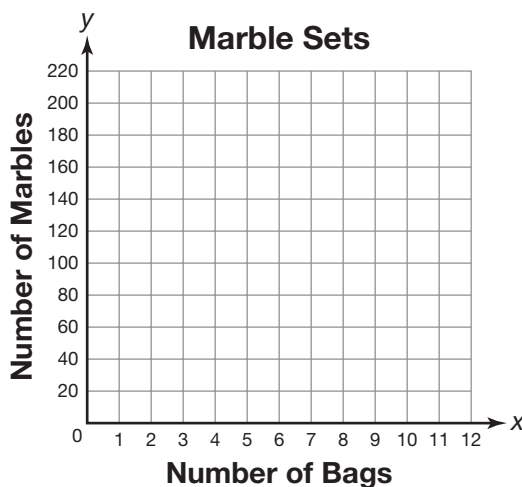
- A. Add 15 is the rule for the first pattern. True False
- B. Add 20 is the rule for the first pattern. True False
- C. Add 5 is the rule for the second pattern. True False
- D. The terms in the first pattern are 4 times the corresponding terms in the second pattern. True False

- 7 A company sells bags of marbles in sets. Each set contains 2 bags and 40 marbles. Generate two numerical patterns using the rules for the number of bags and the number of marbles in a set. The starting number for each is given.

Number of bags: 2, _____, _____, _____, _____

Number of marbles: 40 _____, _____, _____, _____

Write ordered pairs for the two numerical patterns. Graph the ordered pairs on a coordinate plane.



- 8 Use the numbers in the box to complete the statements about the two number patterns. Numbers may be used once, more than once, or not at all.

25, 50, 75, 100, 150, ...

50, 100, 150, 200, 250, ...

Which describes the patterns? Circle all that apply.

The rule for the first pattern is add _____.

The rule for the second pattern is add _____.

The terms in the second pattern are _____ times the corresponding terms in the first pattern.

2
5
25
50

- 9 Ed generated two numerical patterns. The rules are add 4, starting with 0 for the first pattern, and add 8, starting with 0 for the second pattern.

0, 4, 8, 12, 16, ...

0, 8, 12, 20, 28, ...

Did Ed generate correct patterns? Use words or numbers to justify your answer.

- 10 Look at the two numerical patterns. Select Yes or No for each statement.

15, 30, 45, 60, 75, ...

60, 120, 180, 240, 300, ...

- A.** The terms in the second pattern are 2 times the corresponding terms in the first pattern. Yes No
- B.** The terms in the second pattern are 4 times the corresponding terms in the first pattern. Yes No
- C.** The rule for the first pattern is add 15. Yes No
- D.** The rule for the second pattern is add 30. Yes No