REACHING ALL LEARNERS

Extension

Have students use their tables from *Explore*. They use the figure number as the input number and the number of tiles in a figure as the output number. Students draw an Input/Output machine to represent their pattern.

Common Misconception

➤ Students do not recognize that the pattern in the table matches the pattern in the graph when the scale on the vertical axis is not 1 to 1.

How to Help: In the graph at the top of Student Book page 31, students may see that the vertical movement was $1\frac{1}{2}$ squares up, and forget to multiply by the scale: 1 square represents 2 units. Remind students to always consider the scale.

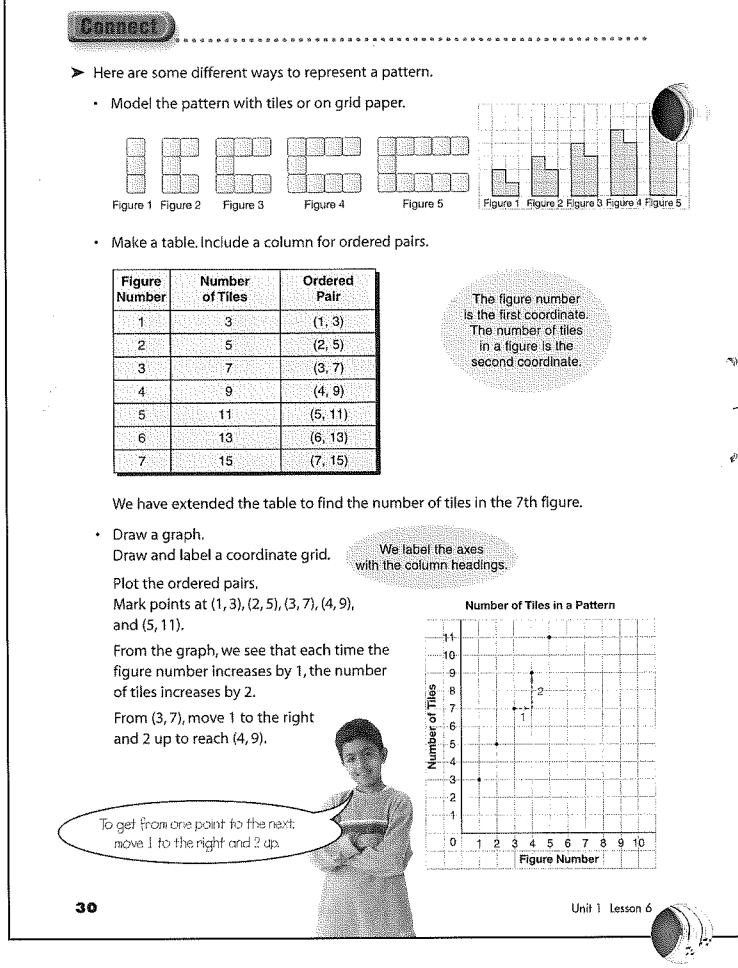
Sample Solutions

1. a)

Figure Number	Number of Squares
1	1
2	2
3	3
4	4

b)

Figure Number	Number of Counters
1	4
2	7
3	10
4	13



- How does the graph represent your pattern? *(In the table, the pattern in the figure numbers is: Start at 1. Add 1 each time. The pattern in the number of tiles is: Start at 4. Add 4 each time. This is shown on the graph. To get from one point to the next, I move 1 square right and 4 squares up.)*

AFTER Connect

Invite students to share their patterns and graphs. Compare the graphs created by different pairs of students. Ask:

- Is it possible to have the same graph for different patterns? *(Yes; the graph will look the same as long as the number of tiles in each figure is the same for each pattern. The way the tiles are arranged could be different.)*

Ask students to describe some different ways they could find out if any figure in their pattern has 100 tiles. Discuss all the different ways they suggest.

Present *Connect*. Ensure students understand that a graph is a way to represent the relationships in a visual pattern, a table of values, or an expression with a variable.

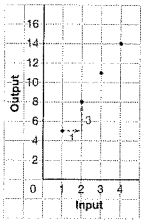
Emphasize the importance of identifying the relationship between the figure number and the number of tiles in a figure. This will allow students to make predictions without finding the values of the intermediate terms.

Practice

Have 1-cm grid paper (PM 23) available for questions 1, 2, 4, and 5. Have 2-column charts (PM 19) available for questions 1, 3, and 5.

➤ We can graph the relationship shown in an Input/Output table.

Input	Output
1	5
2	8
3	11
4	14

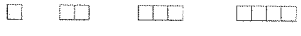


As the input increases by 1, the output increases by 3.

Practice

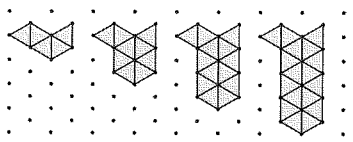
1. Record each pattern in a table. Then draw a graph to represent the pattern. Explain how the graph represents the pattern.

a)



b)

c)



2. Use grid paper. Graph each table. Describe the relationship shown on the graph.

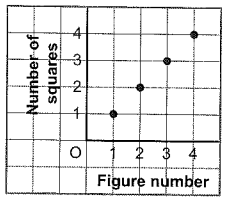
a)

Input	Output
1	3
2	6
3	9
4	12

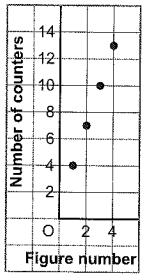
b)

Input	Output
1	5
2	6
3	7
4	8

a)



b)

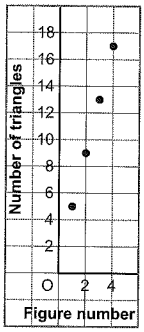


a) The pattern in the figure number is: Start at 1. Add 1 each time. The pattern in the number of squares is: Start at 1. Add 1 each time. On the graph, to get from one point to the next, move 1 to the right and 1 up.

b) The pattern in the figure number is: Start at 1. Add 1 each time. The pattern in the number of counters is: Start at 4. Add 3 each time. On the graph, to get from one point to the next, move 1 to the right and 3 up.

c)

Figure Number	Number of Triangles
1	5
2	9
3	13
4	17



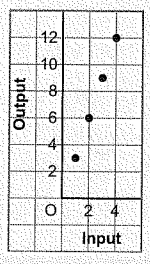
The pattern in the figure number is: Start at 1. Add 1 each time. The pattern in the number of triangles is: Start at 5. Add 4 each time. On the graph, to get from one point to the next, I move 1 to the right and 4 up.

Assessment Focus: Question 4

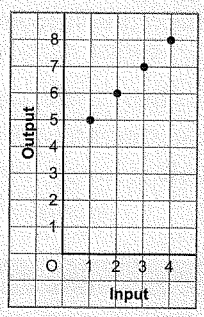
Students should use the numbers in the table as ordered pairs and plot them on a graph as separate points, with the horizontal axis of the graph showing the figure number and the vertical axis the number of shapes. They should use a variable to create an expression. Accept different strategies for finding subsequent values. Students who say they would extend the table to find the number of shapes needed for the 18th figure should be encouraged to explore more efficient strategies.

(Sample Solutions continued)

2. a)



b)



The graph in part a shows that as the input increases by 1, the output increases by 3. The graph in part b shows that as the input increases by 1, the output increases by 1.

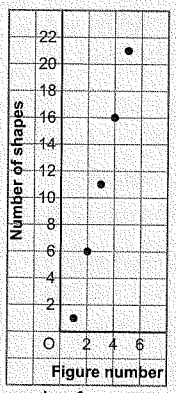
3. a)

Input	Output
2	3
4	7
6	11
8	15

b)

Input	Output
2	12
4	16
6	20
8	24

4. a)



b) As the figure number increases by 1, the number of shapes increases by 5.

c) Let *n* represent the number of shapes.

d) I extended the table down to Figure 8. I could use the same strategy to find the number of shapes in the 18th figure but it would take a long time. It would be more efficient to substitute $n = 18$ into the expression in part c:
$5 \times 18 - 4 = 86$
There are 86 shapes in the 18th figure.

5. a)

Figure Number	Number of Counters
1	4
2	6
3	8
4	10
5	12

b) The graph shows that each time the figure number increases by 1, the number of counters increases by 2.

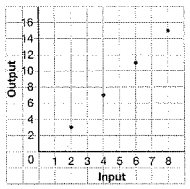
c) I used the pattern to extend the table to the 7th figure.

d) I wrote an expression to represent the relationship between the figure number and the number of counters: $2n + 2$, where n represents the figure number. Then, I substituted $n = 23$ into the expression: $2 \times 23 + 2 = 48$; there are 48 counters in the 23rd figure.

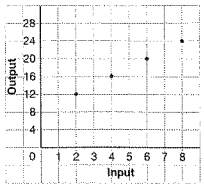
REFLECT: I can represent a pattern in a table, on a graph, with a visual model, with an expression, and in words. I prefer to represent a pattern with an expression. Once I have the expression, I can substitute into the expression to solve problems. It takes a lot more time to draw a graph, a table, or a visual model.

3. For each graph, make an Input/Output table.

a)



b)



2.3

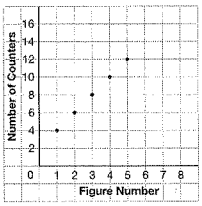
$5n - 4$

4. Use grid paper.
   a) Graph the data in the table.
   b) Describe the relationship shown on the graph.
   c) Write an expression to represent the pattern.
   d) Find the number of shapes in the 8th figure.
   What strategy did you use? 36
   Could you use the same strategy to find the number of shapes in the 18th figure? Explain.

Figure Number	Number of Shapes
1	1
2	6
3	11
4	16
5	21

5. Use grid paper.
   a) Make a table.
   Record the figure number and the number of counters in a figure.
   b) How does the graph represent the pattern?
   c) Find the number of counters in the 7th figure.
   Describe the strategy you used. 16
   d) How many counters are in the 23rd figure? 48
   Describe the strategy you used to find out.

Number of Counters in a Pattern



Reflect

Describe some of the different ways you can represent a pattern. Which way do you prefer? Why?

ASSESSMENT FOR LEARNING

What to Look For

Conceptual Understanding

✔ Students recognize that the same pattern can be represented in a variety of ways.

✔ Students can describe the strategies they use to find subsequent figures in a growing pattern.

Procedural Knowledge

✔ Students can create a table of values from a given pattern or graph.

✔ Students can describe the relationship shown on a graph.

✔ Students can draw a graph to represent a pattern.

What to Do If You Don't See It

Adjust Instruction

Review the connection between the figure numbers in a visual pattern and the input numbers in an Input/Output table. Have students copy the patterns in *Practice* question 1a and 1b and number each figure. Ensure they understand that the right-hand column of the table they create will represent the "total number of pieces" for each figure in the pattern. Emphasize that the same pattern can be shown in many ways.

Visual learners may benefit from modelling the pattern in the table of values in *Practice* question 4 with shapes and the pattern in the graph in *Practice* question 5 with counters.