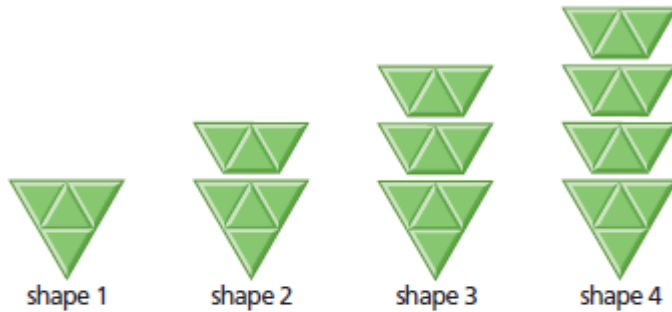# Chapter 1: Patterns in Mathematics

Lesson 1 – Identifying Number Patterns
Learning Goals: Describe a number pattern within each column of a table of values.

Question:

Wei made this pattern with triangle pattern blocks.

shape 1   shape 2   shape 3   shape 4

a) Make a table of values to show the number of blocks for each shape in Wei's pattern.
b) Write a pattern rule for each column in the table.
c) How many blocks would Wei need to make shape 6?
d) Use a model or diagram to check your answer for part c).

At-Home Help

A **table of values** is a way to present numbers in columns and rows so you can see patterns. A table of values can be vertical or horizontal.

A **pattern rule** is a description of how a pattern starts and how it continues. For example, for the pattern 1, 3, 5, ..., a pattern rule is "Start at 1 and add 2 each time."

Answer:

a)

Wei's Pattern:

Shape number	1	2	3	4
Number of blocks	4	7	10	13

b) For example, the rule for the shape numbers is start at 1 and add 1 each time. The rule for the number of blocks is start at 4 and add 3 each time.

c) 19 blocks; for example, I continued the table by adding 1s to the Shape number row and adding 3s to the Number of blocks row until I got to shape 6.

Wei's Pattern:

Shape number	1	2	3	4	5	6
Number of blocks	4	7	10	13	16	19

d) I used pattern blocks to keep Wei's pattern going. Shape 6 has 19 blocks, so my answer for part c) was correct.

shape 5 (16 blocks)   shape 6 (19 blocks)

Lesson 2 - Describing Relationships in Tables

Question:

The table below shows how much guitar lessons cost if you also pay at the start to rent a guitar.

Cost of Guitar Lessons and Rental

Number of lessons	Total cost ($)
1	80
2	110
3	140
4	170

a) Write a rule that shows how the number of lessons can be used to figure out the total cost. Explain your thinking.

b) Use your rule to figure out the cost of eight lessons. Show your work.

c) Show how you can check your answer for part b).

d) Why do eight lessons not cost twice as much as four lessons?

Answer:

a) Multiply the number of hours by $30 and then add $50. For example, the cost increases by $30 each time, so you can compare the total cost with multiplying the hours by 30.

Number of lessons	× $30	Total cost ($)
1	30	80
2	60	110
3	90	140
4	120	170

Each amount in the total cost column is $50 more than the × $30 column. This difference of $50 is probably the cost of the rental.
The total cost is $30 for each lesson plus $50.

b) $290; for example, $8 \times \$30 = \$240$; $\$240 + \$50 = \$290$.

c) For example, I can check by extending my table from 4 lessons to 8 lessons by adding $30 to each previous cost:

Number of lessons	Total cost ($)
1	80
2	110
3	140
4	170
5	200
6	230
7	260
8	290

d) For example, 8 lessons would cost twice as much as 4 lessons if there were no charge for the guitar rental. But a rental charge of $50 is included in each cost and you would not be paying that twice.

At-Home Help

You can write a pattern rule that relates the numbers in one column of a table of values to the numbers in the other column. For example,

Li spent $2 on a lunch discount card. With her card, each lunch costs $3.

Number of lunches	Cost ($)
0	2
1	5
2	8
3	11

Li's rule is "Multiply the number of lunches by 3 and add 2."
So, if Li has 10 lunches, the cost will be 10 × 3 plus 2, or $32.

Lesson 3 – Using Expressions to Create Tables

Learning Goals: Create and use a mathematical expression to make a table of values.

Question:

Cost of Bowling	
Number of games	Total cost ($)
1	10
2	22
3	
4	
5	

Asha and her friends are going bowling. The cost of each game is $12 for the group. They have a coupon for $2 off the cost of the first game.

a) Why do the numbers 10 and 22 make sense in the second column of the table at the left?

b) Use words to write a rule that you can use to calculate the total cost for any number of games.

c) Write an expression that has the same meaning as your rule in part b). Remember to include a variable in your expression.

d) Copy the table. Use your expression to figure out the missing numbers.

e) How many games can Asha and her friends play for $82? Show your work.

Answer:

a) For example, the number 10 makes sense because the first game will cost $12 − $2 and that's $10. The number 22 makes sense because it will cost $10 for the first game and $12 for the second game and $10 + 12 = 22$.

b) For example, the rule for figuring out the cost in dollars is multiply the number of games by 12 and subtract 2.

c) For example, $12g − 2$, where g is the number of games

d) Cost of Bowling

Number of games	Total cost ($)
1	10
2	22
3	34
4	46
5	58

e) 7 games; for example, my table shows that the cost goes up $12 for each game they play. It costs $58 for 5 games, so it would cost $70 for 6 games and $82 for 7 games. I checked with my expression and it was right. $7 \times 12 = 84$ and $84 − 2 = 82$.

Lesson 4 - Comparing Expressions
Learning Goals: Create related number patterns, and compare the expressions that describe them.

Question:

Jason created a pattern with linking cubes. He made a table to describe his pattern. What cube patterns and expressions can you make by changing Jason's starting number or the amount he added each time?

My Cube Pattern

Row (r)	Number of cubes $(3r + 2)$
1	5
2	8
3	11
4	14

Answer: - *Possible Solution*

Cube Pattern 1

Pattern: Start with 5, and add 2 for each row.

Expression: To get the number of cubes, use $2r + 3$, where r represents the row number.

Row number	Number of cubes
1	5
2	7
3	9
4	11

Cube Pattern 2

Pattern: Start with 6, and add 3 for each row.

Expression: To get the number of cubes, use $3r + 3$, where r represents the row number.

Row number	Number of cubes
1	6
2	9
3	12
4	15

Lesson 5 - Equivalent Equations
Learning Goals: Model and create equivalent equations.

Question:

$4n = 8$
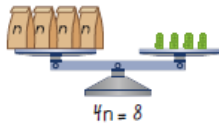
a) Which equations are equivalent to $4n = 8$? Explain how you know.

$4n + 2 = 10$	$16n = 32$
$2n = 4$	$8n = 10$

b) Write one more equation that is equivalent to $4n = 8$. Explain how you know that your equation is equivalent to $4n = 8$.

Answer:

a) $4n + 2 = 10$, $2n = 4$, $16n = 32$

For example, if you add 2 to both sides of $4n = 8$, you get $4n + 2 = 10$.

If you divide both sides of $4n = 8$ by 2, you get $2n = 4$.

If you multiply both sides of $4n = 8$ by 4, you get $16n = 32$.

$8n = 10$ is not equivalent because you would have to multiply $4n$ by 2 to get $8n$ on the left side and then add 2 to 8 to get 10 on the right side. You would have to change each side in a different way. You can also tell because all the other equations are true when $n = 2$. But $8 \times 2 = 16$, not 10.

b) For example, $4n - 7 = 1$. I subtracted 7 from both sides of $4n = 8$ to get $4n - 7 = 1$.

I did the same operation on both sides of the equation, so the equations are equivalent.

The solution to $4n = 8$ is $n = 2$, and the same solution works for $4n - 7 = 1$.

Lesson 6 - Solving Problems Using Patterns
Learning Goals: Identify and use patterns to solve problems.

Question:

Tiles are being used to make this design. How many tiles might be in step 10? Show your work.

step 1   step 2   step 3
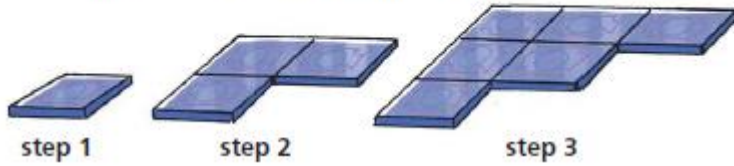
Answer:

55 tiles; for example, I can make a table. The pattern for the bottom row is start at 1 and add 2, then add 3, then add 4, and so on.

Step number	1	2	3	4	5	6	7	8	9	10
Number of tiles	1	3	6	10	15	21	28	36	45	55

+2 +3 +4 +5 +6 +7 +8 +9 +10