

CHAPTER

2

Number Patterns

Vocabulary:

pattern
ordered
term
element
pattern rule
sequence
factor
multiple
prime number
composite
number

Chapter Outcomes:

- Recognize and explore number patterns up to 1 000.
- Develop an understanding of different types of numbers by exploring their patterns.
- Develop an understanding that pattern recognition can aid in problem solving.



Construction workers have to know the size of the space they have to work with and the size of the pieces they have to place in that space. They can use number patterns to make sure they use just the right amount of pieces, which requires adding and subtracting lengths of material. The laying of the glass tiles on the face of the National Academy of the Performing Arts building required such mathematical skills.

Getting Ready for Chapter 2

Find the missing number.

1. $8 + \square = 15$

2. $\square - 9 = 5$

Write the missing number in each pattern.

3. 3, 6, 9, 12, $\square$

4. 5, 10, 15, $\square$, 25

5. 85, $\square$, 65, 55, 45

Find each product.

6. $4 \times 9 = \square$

7. $8 \times 7 = \square$

Find each quotient.

8. $63 \div 7 = \square$

9. $24 \div 8 = \square$

Describe Number Patterns

Teaching Point 1:

How can you identify patterns?

A number pattern is an **ordered** set of numbers. Each number in the pattern is called a **term** or **element**.

A **sequence** is a list of numbers that follow a specific pattern.

The numbers below form a pattern. The first term in the pattern is 3.



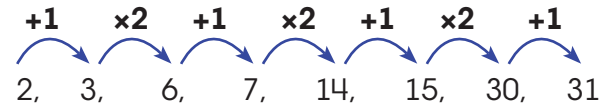
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First term

A pattern **rule** is used to describe patterns. In this pattern the **rule** is **add 4**.

Other patterns can be found in the numbers.

e.g. The **terms** in the pattern are all odd numbers.

You can say this pattern is made from doing **two operations**.



The pattern **rule** is **add 1, multiply by 2**.

Activity 1:

Write the pattern rule for each pattern.
Describe other patterns in the numbers.

- 16, 20, 24, 28, 32
- 75, 70, 65, 60, 55
- 4, 8, 16, 32, 64, 128
- 104, 94, 84, 74, 64
- 16, 24, 32, 40, 48
- 28, 24, 28, 24, 28, 24
- 14, 14, 12, 12, 10, 10, 8, 8
- 7, 8, 6, 7, 5, 6, 4

9. 63, 62, 31, 30, 15, 14, 7

10. 3, 3, 6, 9, 15, 24

11. 12, 7, 14, 9, 16, 11

Activity 2:

Use the rule to write the numbers in the pattern. Describe another pattern in the numbers.

1. Rule: Add 4.

15, __, __, __, __, __, ...

2. Rule: Multiply by 3.

2, __, __, __, __, __, ...

3. Rule: Subtract 5.

50, __, __, __, __, __, ...

4. Rule: Divide by 2.

128, __, __, __, __, __, ...

5. Rule: Subtract 1. Multiply by 2.

55, __, __, __, __, __, ...

6. Rule: Subtract 5. Add 6.

19, __, __, __, __, __, ...

7. Rule: Multiply by 10.

1, __, __, __, __, __, ...

8. Rule: Add 7.

12, __, __, __, __, __, ...

9. Rule: Divide by 3. Add 6.

9, __, __, __, __, __, ...

10. Rule: Subtract 3. Multiply by 2.

10, __, __, __, __, __, ...

11. Why is it important to look at more than the first two numbers of a pattern to decide the rule for the pattern?

12. Why do the terms in the number pattern 11, 16, 21, 26, 31, 36, alternate between odd and even numbers?

13. The first term in a pattern is an odd number. The rule is to multiply by 2. Explain why the rest of the terms in the pattern will be even numbers?

Complete Number Patterns

Teaching Point 1:

Write the missing elements in the number pattern.

+4 -2 +4 -2 +4
3, 7, 5, 9, , 11, 9, 13

The rule is **add 4, subtract 2**.

Therefore, the missing number is **7**.

Activity 1:

Write the missing numbers in the pattern.

1. 15, 19, 23, , 31, 35

2. 64, 32, , 8, 4, 2

3. 1, 3, , 27, 81, 243

4. 19, 16, 18, 15, 17, ,

5. 36, 18, 20, , 12, 6

6. 16, 32, 8, 16, 4,

7. 3, 6, 9, 12, 15, ,
8. , 86, 82, 84, 80, 82, 78
9. 2, 2, 4, 6, 10, , 26,
10. 5, 5, 10, 15, , 40, 65,

Solve the problems below.

11. Kejan lives in the tenth house on Dean Street. The first house on Dean Street is numbered 3. The second house is 6. The third is 9. If the pattern continues what is Kejan's house number likely to be?
12. Balata trees bear fruit every four years. Marianna who is now 18 years old saw her first balata when she was five years old. Write a number pattern which shows her ages when the balata trees bore fruit.
13. Akal saved \$75 dollars during the vacation. He plans to spend \$5 each week when school begins. Write a pattern to show how much money Akal will have after 6 weeks.
14. Jamal earns \$20 each week from washing his father's car. Each week he spends \$10 from his earnings and saves the rest. Write a pattern to show how much money Jamal would have in his savings after 6 weeks.
15. Matthew is reading a book from the school library. He reads 15 pages the first day. Then each day he reads 6 more pages than the day before. How many pages did he read on the eighth day?
16. Marcus and Mikey are saving money to buy a football. Marcus adds \$5

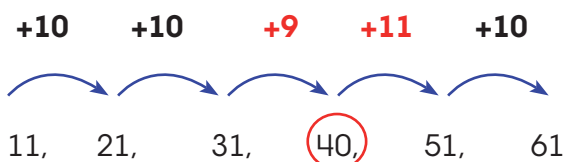
dollars to their piggy bank every week. Mikey adds \$10 every other week. How much money would they have at the end of the 10th week?

17. Jervon's father pays him \$20 to wash his car on Sundays. During the week Jervon spends \$10 from the money he earned and saves the rest. If Jervon has \$60 at the beginning of the 6th week, how much money did he have at the beginning of the 4th week?

Identify Errors in Number Patterns

Teaching Point 1:

Find the error in the pattern below.



The **rule** is **add 10**.

Therefore, the **error** in the number pattern is **40**.

The pattern should be:

11, 21, 31, 41, 51, 61

Activity 1:

Identify and correct the error in each number pattern.

1. 10, 20, 30, 30, 50
2. 9, 12, 15, 16, 21
3. 275, 250, 225, 200, 185

4. 72, 68, 60, 54, 48
5. 13, 26, 13, 26, 13, 13
6. 640, 120, 80, 20, 5
7. 2, 4, 7, 11, 17, 22, 29
8. 1, 1, 2, 3, 7, 8, 13, 21
9. 7, 70, 700, 7 000, 77 000, 700 000
10. 1, 4, 9, 16, 25, 37

Relationships in Patterns

Teaching Point 1:

The table below shows the ages of two children. **How old will Alina be when Alex is 25?**

Alex's Age (yrs)	15	16	17	18	19
Alina's Age (yrs)	10	11	12	13	14

Find the relationship between the two sets of numbers.

The **rule** is subtract 5.

Therefore, $25 - 5 = 20$. Alina will be 20 years old.

Activity 1:

Identify the relationship in the numbers and solve the problems.

1. The table shows the ages of two children. How old will Alex be when Alina is 34?

Alex's Age (yrs)	15	16	17	18	19
Alina's Age (yrs)	10	11	12	13	14

2. Myron jogs each day. What is the rule for the pattern shown in his jogging record?

Day	1	2	3	4	5
Time in minutes	30	45	60	75	90

3. The table below shows the number of cricket bats sold at a sports store. Based on the pattern shown, how many bats were sold on the Day 6?

Day	1	2	3	4	5	6	7
Bats Sold	8	6	11	9	14		17

4. The table below shows heights of two plants over 5 weeks.

Week	Tomato Height (cm)	Ochro Height (cm)
1	1	3
2	3	5
3	6	8
4	9	11
5	15	

- a) Complete the table.
- b) If the plants continue growing this way, what will be the height of the tomato plant if the ochro is 20 cm?

5. Emily and Nneka saves money each month. Based on the pattern shown, how much money will Emily have in savings if Nneka has \$100?

Emily's Savings	\$50	\$75	\$100		\$150
Nneka's Savings	\$20	\$45	\$70	\$100	\$120

Patterns with One and Zero

Teaching Point 1:

Add zero.

$$12 + 0 = 12$$

$$0 + 12 = 12$$

When you **add** to **zero** or **add zero** to a number the **sum** is the same as the number.

When you **subtract zero** the same number is left.

Subtract zero.

$$12 - 0 = 12$$

Multiplying by one and zero.

x	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

When you multiply a number and **1**, the **product** is the same number.

When you multiply a number and **0**, the **product** is **0**.

Multiply with 10	$4 \times 10 = 40$	Add one zero to the product.
Multiply with 100	$4 \times 100 = 400$	Add two zeros to the product.
Multiply with 1 000	$4 \times 1\,000 = 4\,000$	Add three zeros to the product.

Activity 1:

Complete each number sentence.

1. $345 + \square = 345$

2. $690 - \square = 690$

3. $\square + 0 = 477$

4. $\square - 0 = 631$

5. $45 \times \square = 45$

6. $\square \times 12 = 0$

7. $287 \times \square = 287$

8. $\square \times 89 = 89$

9. $134 \times \square = 0$

10. $58 \times 1 = \square$

Activity 2:

Find each product.

- | | |
|--------------------|--------------------|
| 1. $8 \times 5 =$ | 2. $11 \times 2 =$ |
| $8 \times 50 =$ | $11 \times 20 =$ |
| $8 \times 500 =$ | $11 \times 200 =$ |
| $8 \times 5000 =$ | $11 \times 2000 =$ |
| 3. $6 \times 7 =$ | 4. $4 \times 9 =$ |
| $6 \times 70 =$ | $4 \times 90 =$ |
| $6 \times 700 =$ | $4 \times 900 =$ |
| $6 \times 7000 =$ | $4 \times 9000 =$ |
| 5. $12 \times 3 =$ | 6. $10 \times 5 =$ |
| $12 \times 30 =$ | $10 \times 50 =$ |
| $12 \times 300 =$ | $10 \times 500 =$ |
| $12 \times 3000 =$ | $10 \times 5000 =$ |

$5 \times 9 = 45$ The tens digit in a product will be 1 less than the factor being multiplied by 9.

Activity 1:

Use patterns in factors and multiples to solve the problems.

- Which of the numbers are multiples of 2?
32, 78, 90, 15, 126, 1541
- Which of the numbers below are multiples of 5?
36, 40, 165, 95, 300
- Which of the numbers below are multiples of 3?
27, 91, 126, 56, 108, 711
- Which of the numbers below are NOT multiples of 9?
27, 81, 90, 56, 108, 37
- Which of the numbers below have multiples of 30, 40, 50 and 60?
2, 3, 5, 6, 10
- Write the multiple of 2 that comes after each multiple below.
a) 134 b) 260 c) 88
- Write the multiple of 5 that comes after each multiple below.
a) 365 b) 490 c) 675
- Write the double facts for the multiplication facts below.
a) $12 \times 2 = 24$ b) $19 \times 2 = 38$
c) $16 \times 2 = 32$ d) $23 \times 2 = 46$

Factors and Multiples Patterns

Teaching Point 1:

You can use patterns to find factors and multiples.

What patterns can you find in multiples of 2 and 9?

0, 2, 4, 6, 8, 10, 12, 14, ... Multiples of 2 end with 0, 2, 4, 6 or 8.

3, 6, 9, 12, 15, 18, ... The sum of the digits of multiples of 3 will be a multiple of 3.

0, 9, 18, 27, 36, 45, ... The sum of the digits of the multiples will be 9 or a multiple of 9, unless the multiple is 0.

What patterns can you find in factors?

$7 \times 2 = 14$ is the same as $7 + 7 = 14$.
Multiplying by 2 is the same as using a double fact.

e) $13 \times 2 = 26$ f) $17 \times 2 = 34$

9. Write the missing digit in each multiplication fact.

a) $8 \times 9 = \square 2$ b) $3 \times 9 = \square 7$

c) $7 \times 9 = \square 3$ d) $10 \times 9 = \square 0$

e) $6 \times 9 = \square 4$ f) $5 \times 9 = \square 5$

10. Write the missing digit in each multiplication fact.

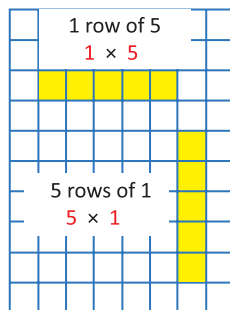
a) $8 \times 10 = 8 \square$ b) $\square \times 10 = 50$

c) $1 \square \times 10 = 170$

Prime and Composite Numbers

Teaching Point 1:

The grid shows all the arrays possible for 5.

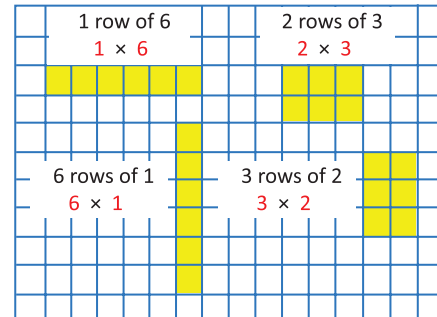


The **factors** of 5 are 1 and 5.

Prime numbers have **two** factors, 1 and itself. 5 is a prime number.

Other multiples of 5 are not prime numbers.

The grid shows all the arrays possible for 6.

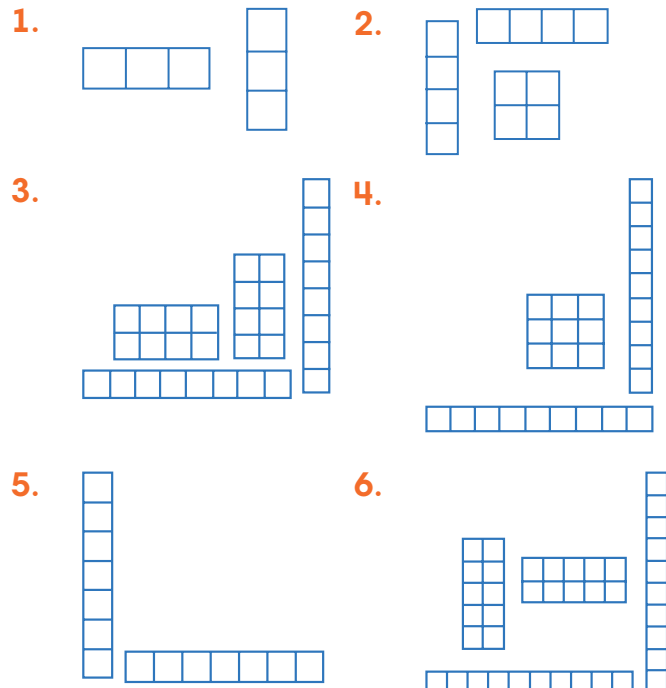


The **factors** of 6 are 1, 2, 3 and 6.

Composite numbers have **more than two** factors. 6 is a composite number.

Activity 1:

Write the number represented by the arrays and state whether it is prime or composite.



7. Follow the guidelines to create a list of prime numbers from 1 to 100.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

- Write all the numbers from 1 to 100.
- Draw a square around 1. It is not a prime or a composite number.
- Shade the prime number 2. Cross out all other multiples of 2.
- Shade the prime number 3. Cross out all other multiples of 3.
- Shade the prime number 7. Cross out all other multiples of 7.
- Continue in the same way until you have done all the numbers up to 100.

Solve the problems below.

- How many different arrays can you make to show the number 11?
- Daddy is laying 36 tiles. Draw all the arrays possible to show how he can lay the tiles with the same number of tiles in each row. Is 36 prime or composite?

- Alex has 7 trophies for sprinting that he wants to display in an array. How many different arrays are possible?
- There are 12 desks in a room. How many different ways can the desks be arranged if they are in even rows?
- Are all odd numbers prime numbers? Explain.
- Why is 1 neither a prime number nor a composite number?

Chapter Review

Complete the number sequences.

- 14, 22, 30, ____
- 233, 223, 213, ____
- 1, 3, 6, ____, 15
- 1, 1, 2, 1, 1, 2, ____, 1
- 3, 6, ____, 24, 48, 96
- 3, 3, 6, 9, ____, 24
- 216, 72, 144, ____, 96

Solve the problems below.

- What rule describes the pattern below?
12, 14, 11, 13, 10, 12
- The house numbers on one side of George Street are even. From the corner, the first four house numbers are 1042, 1052, 1062 and 1072. What will the number of the 10th house likely to be?
- Extend the pattern below by five terms.
Rule: subtract 6
76, ____, ____, ____, ____, ____

11. A school bus runs 6 times a day, 5 days a week. The bus can carry 25 passengers. Find the greatest number of children who can ride the school bus each week.
12. Using the pattern rule from the table below, what will be the cost of 15 school shirts?

Price	Number of School Shirts
\$200	8
\$225	9
\$250	10

13. Miss Betty has 72 roses to decorate Easter bonnets for sale. If she puts an even number of roses on each bonnet, what are some ways she could decorate the bonnets using all 72 roses?

No. of Roses	2	3	4	6	8
No. of Bonnets	36	24			

- a) Complete the table.
- b) Why can't Miss Betty decorate bonnets with 5 or 7 roses?
- c) What is one more way to decorate the bonnets?
14. Which of the numbers below are divisible by both 3 and 8?
168 132 192 320 24 468
15. What is the sum of the prime numbers that are less than 10?
16. The sets of dots below form a pattern.
- (a) Continue the drawings to show the fifth and sixth set of dots.



- (b) How many dots will be in the 10th set?
17. During the vacation, Anika read 24 pages each day. Her brother Aaron read 8 pages each day. Complete a table to show how many pages each of them read after 5 days.
18. Javan saves money from his allowance every month. Over the first four months his savings was \$50, \$52, \$55 and \$59. If the pattern continues what will be his savings for the 10th month?
19. The numbers 13, 17, 19 and 29 are prime numbers. If you reverse the order of the digits in each number, which of them also result in prime numbers?
20. A jogger jogs the following distances over 5 weeks as shown in the table below.
- | week 1 | week 2 | week 3 | week 4 | week 5 |
|--------|--------|--------|--------|--------|
| 2 km | 4 km | 7 km | 11 km | 16 km |
- If he continues to jog with the same pattern, how far will he jog during the 8th week?
21. Harry is saving money to buy a game. In the first week, he saved \$4. In the second week, he saved \$8 and in the third week he saved \$16.
- (a) If Harry continues to save in this manner, how much will he save in the sixth week?
- (b) How much money will Harry have at the end of the sixth week?