ALGEBRA

YEAR 5-6 ODD YEARS

Teacher Booklet

Task 1

Parvati is making mala for a Diwali decoration. She is threading the flowers in a pattern: red, green, yellow, orange, blue, purple.

What will be the colour of the 76th flower that she threads?

Find two different ways of solving the task and representations to prove your solutions.

Teacher Notes

During the launch, ask students to share where they see patterns in their lives. Reinforce discussion that patterns have sequential elements.

Have multilink cubes available for the students to model the pattern.

Facilitate the students to model the pattern in a way that highlights the structure of the pattern:
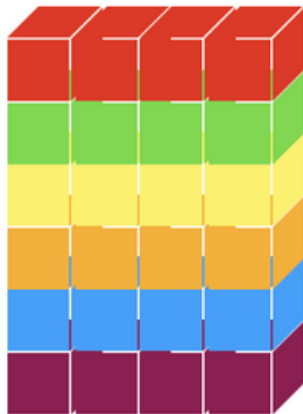
Use the model to support students to notice that certain elements align with specific numbers or multiples.

Use the term unit of repeat for the core of the pattern.

Notice students who use grouping or identify multiples to solve the task.

Expect students to represent using blocks and numbers and to identify the number patterns associated with the specific colours (similar to choral counting).

Teacher Notes

For the connect, students might notice that the purple flower is a multiple of 6 so the rule for the purple flower would be multiply by 6. Ask the students for the rule in words and then model explicitly writing the steps to find the colour before modelling as a rule with variables. Ask the students to explicitly create a set of steps to find a specific coloured flower and then write the rule.

Shareback

Select students to share who use a grouping strategy to solve the task. For example, students might notice that a purple flower is always a multiple of 6 and use this to get close to 76 by stating that 60 would be purple and then 72 would also be purple and then using the pattern structure.

Connect

What do you notice about all of the purple flowers in relation to their pattern position?
What rule could you use to find the location of every purple flower?
What rule could you use to find the location of every blue flower?
What rule could you use to find the location of every green flower?

Suggested Learning Outcomes

Reproduce a pattern using objects, drawings, or symbols.

Continue a sequential pattern.

Explain and justify the pattern in relation to ordinal aspects of number.

Identify the element for a sequential pattern for far terms.

Explain that a pattern has consistency.

Develop generalisations expressed in words and symbols related to a sequential pattern.

Develop a series of steps for an algorithm to find a specific part of a pattern

Independent Tasks

At Te Oro the Siva Samoa group is learning a maulu'ulu. As part of the dance, they used these movements:

arm, arm, arm, arm, clap, tap, tap, tap

They repeat these moves lots of times throughout the dance.
If they repeat the moves two times, how many taps would there be?
How many arms would there be? How many claps would there be?

Complete the table below:

Number of movement sequence	Tap	Arm	Clap
1			
			2
3			
	12		
		20	
6			
7			
			8

How many of each movement would there be if there were 50 movement sequences?
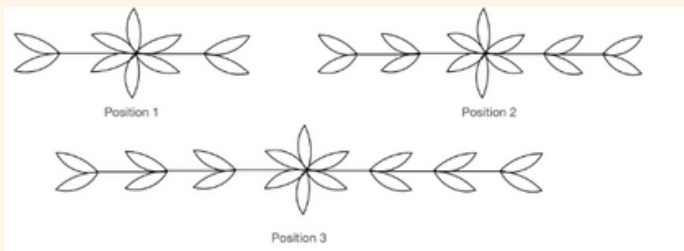How many of each movement would there be if there were 101 movement sequences?
What rules could you use to find the number of specific movements for any number of movement sequences?

Anticipations

Solutions, Misconceptions

Task 2

Position 1   Position 2

Position 3

This is the first three positions of a pattern on ngatu.

Viliami want to use the same pattern for a large ngatu and keep the pattern the same.

How do you see the pattern growing? Represent the pattern using numbers.

How many leaves would the next position have?
How many leaves would the 6th position have?
How many leaves would the 11th position have?
Represent this using a diagram and numbers.

Teacher Notes

During the launch, ask students to share different types of patterns that they know from their culture or every-day life.

Facilitate the students to notice the constant of six leaves in the middle and that the leaves around the edge change as the pattern grows.

Notice students who use recursive generalisation (add four each time) in relation to how the pattern grows and support them to move towards an explicit generalisation (what is the same as adding four multiple times?). For the connect, the following generalisations relate to each way of seeing the patterns. A) & B) 2(6 x 2) + 6 or 2(n × 2) + 6; C) & D) 4b + 6. Introduce letters as variables which can represent any number.

Expect students to represent using numbers and representations. Students could also be introduced to a table of data to show a structured way to see the relationship between the position and the total number of leaves.

For the independent task, have materials available if needed.

Shareback

Select students to share who have represented the pattern using colours or number and generalised this growing in different ways.
The images below represent the ways that Position 6 may be represented.
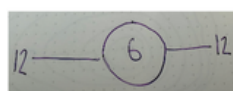
Connect

Describe how you would find the leaves for the 53rd position.

What is a rule that you could use to find the number of leaves no matter the position for each of the ways that the pattern is represented?

Suggested Learning Outcomes

Reproduce a pattern using objects, drawings, or symbols.

Continue a growing pattern.

Identify the growing element and constant in a linear growing pattern.

Represent the growing element and the constant using numbers and symbols.

Represent a growing pattern in a table of data.

Develop generalisations expressed in words and symbols related to a growing pattern.
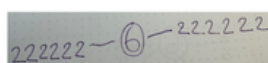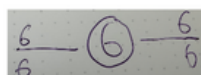
During Year 5
Use tables to recognise the relationship between the ordinal position and its corresponding element in a growing pattern, develop a rule for the pattern in words, and make conjectures about further elements or terms in the pattern.

Create and use an algorithm for generating a pattern, procedure, or pathway.

During Year 6
Use tables, XY graphs, and diagrams to recognise relationships in a linear pattern, develop a rule for the pattern in words (i.e., that there is a constant amount of change between consecutive elements or terms), and make conjectures about further elements in the pattern.

Mathematical Language

Position, element, rule, table of data.

Independent Tasks

Parvati is making mala for a Diwali decoration. She is threading the flowers in a pattern: orange, green, red, blue, yellow.

What will be the colour of the 43rd flower that she threads?

Find two different ways of solving the task and representations to prove your solutions.

What do you notice about all of the yellow flowers in relation to their pattern position?
What rule could you use to find the location of every yellow flower?
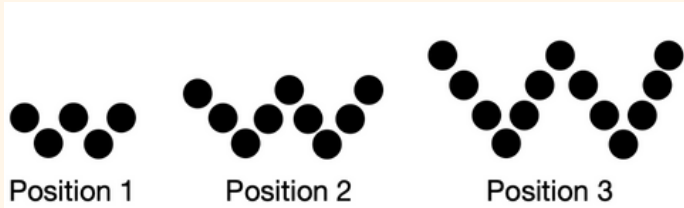What rule could you use to find the location of every red flower?

Anticipations

Solutions, Misconceptions

Task 3

Tatiana is making a pattern with counters:

Position 1   Position 2   Position 3

Use the counters to make the pattern for pattern 4.

How many counters would be used for pattern 8?
How many counters would be used for pattern 12?

What do you notice?

Represent using counters the parts of the pattern that are staying the same and the part of the pattern that changes as it grows using different colours.

How many counters would be used for pattern 34?

What rule could be used to find the number of counters for any pattern number?

Teacher Notes

Before you launch the task, do a pattern quick image warm-up. Show the students the pattern for three seconds and ask them to describe it.
Show the pattern again for three seconds and ask them to draw it. Display the pattern and ask them to draw the next term.

Have counters available for students to construct the pattern.
Facilitate the students to notice that the pattern has a constant (the part that stays the same) and a part that grows. Support them to use counters of one colour for the part that stays the same and counters of another colour for the part that grows and link their number sentences to this.

Notice students who use a table of data or a structured way of tracking the number of counters as the pattern grows. Model how to use a table of data if needed.

Expect students to move from recursive generalisation (it increases by + 4 after the first pattern) to an explicit generalisation.
For the independent task, have ice-block sticks available.

Big Ideas

Patterns are sequences (repeating or growing) made of numeric or spatial elements governed by a rule.

Patterns exist both in the world and in mathematics. The same pattern structure can be found in many different forms (e.g., numbers, shapes, colours, and rhythm).

A pattern can be described using a rule or you can create a pattern from a rule. To find the rule for a pattern, you need to identify the unit of the pattern (what is repeated or what grows).

In a pattern, the relationship between the ordinal position (e.g., first, second, and third) and the corresponding element is more useful for finding the pattern's rule than the relationship between successive elements. Identifying the rule of a pattern brings predictability and allows generalisations to be developed.

Generalisations can be expressed with both words and symbols.

Variables are symbols that take the place of numbers, or ranges of numbers. They have different meanings depending on whether they are being used as representations of quantities that vary or change, representations of specific unknown variables, or placeholders in a generalised expression or formula.

Shareback

Select students to share who have developed a generalisation including both recursive and explicit generalisations. If no students have developed an explicit generalisation, then model how to turn the recursive generalisation into a rule.

Connect

Tatiana thinks that she has found a rule to work out the total number of counters no matter the pattern number. Does her rule work?

$4(n + 1) - 3$

What other rules can you find that work?

Suggested Learning Outcomes

Reproduce a pattern using objects, drawings, or symbols.

Continue a growing pattern.

Identify the growing element and constant in a linear growing pattern.

Represent the growing element and the constant using numbers and symbols.

Represent a growing pattern in a table of data.

Develop generalisations expressed in words and symbols related to a growing pattern.

Test whether a generalisation works for a growing pattern.

Mathematical Language

Position, element, rule, table of data.

Independent Tasks

Mele is helping her Mum build a fence around their house.

This is the third section of the fence.

Build and then draw what the first, second, and fourth section would look like.

Complete the table:

Fence section	Number of posts
1	
2	
3	
4	
5	
8	
10	
13	
21	
25	

What patterns do you notice?
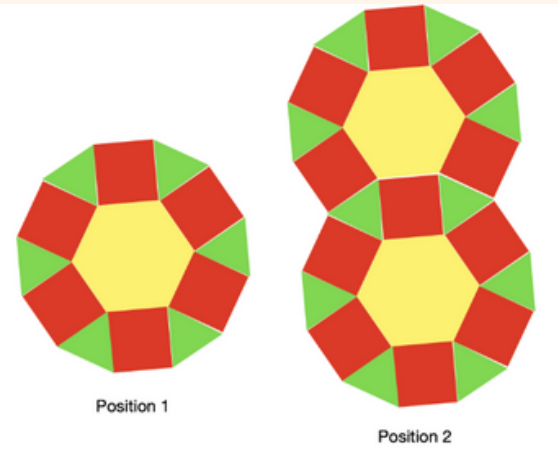
Can you develop a rule for the number of posts for the fence section of any size?

Anticipations

Solutions, Misconceptions

Task 4

Position 1

Position 2

Use the shape cards to build Position 4 and 5.

Complete the table:

Position Number	Hexagons	Squares	Triangle	Total pieces
1				
2				
3				
4				
5				
6				
7				
8				

Identify three patterns across the table and three patterns down the table.

How many hexagons would there be for the 10th sequence?
How many squares would there be for the 10th sequence?
How many triangles would there be for the 10th sequence?
How many shapes in total would there be for the 10th sequence?

Big Ideas

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Teacher Notes

Have shape blocks and counters available.

If students have difficulty making the pattern, support them to notice by putting their pattern next to a picture of the correct pattern and ask them to identify what is the same and what is different.

Facilitate the students to notice patterns in the table vertically may include sequential or single variational thinking (e.g., the hexagons increase by one, the squares increase by 5 each time) or horizontally co-variational or relational thinking (e.g., the total number of shapes is the squares plus the hexagon plus the triangles or the number of squares is the number of hexagons × 5 + 1).

If students use recursive patterns (+ 5 for the squares) facilitate them to connect this to multiplication. Facilitate the students to notice that the square at the beginning is the constant and stays the same as the pattern grows. This can be linked to the + 1 in the rule for the total number of squares.
Have counters available for the independent activity.

Shareback

Select students to share who develop explicit generalisations using multiplication and relationships to work out the different number of shapes who identify co-variational patterns in the table.

Connect

What rules can you use to find the different types of shapes?
Hexagons:
Squares:
Triangles:
Total number of shapes:

Suggested Learning Outcomes

Reproduce a pattern using objects, drawings, or symbols.

Continue a repeating pattern.

Explain and justify the pattern in relation to ordinal aspects of counting.

Communicate, explain, and justify their pattern.

Predict a point in a sequential pattern.

Explain that a pattern has consistency.

Independent Tasks

Tatiana is making a pattern with counters:

Position 1   Position 2   Position 3
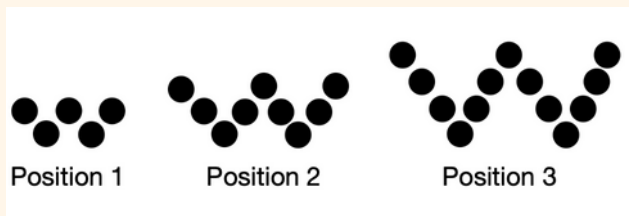
Complete the table:

Pattern number	Number of counters
1	
2	
3	
4	
5	
8	
10	
11	
16	
21	

A pattern has 73 counters in it, what pattern number has Tatiana made?

Anticipations

Solutions, Misconceptions

Task 5

A community centre is replacing the flooring in the corridor as the tiles are worn out. They are using a pattern of grey and white tiles as below:

How many grey tiles would be needed for a corridor with 10 white tiles?

How many grey tiles would be needed for a corridor with 14 white tiles?

How many grey tiles would be needed for a corridor with 50 white tiles?

How many grey tiles would be needed for a corridor with 100 white tiles?

Describe the relationship between the white tiles and the grey tiles.

Teacher Notes

Before you launch the task, do a pattern quick image warm-up. Show the students the pattern for three seconds and ask them to describe it. Show the pattern again for three seconds and ask them to draw it. Display the pattern and ask them to draw the next term.

Have grey and white square tiles available to construct the pattern and grid paper to draw the graphs for the connect.

Expect students to represent using diagrams, a table of data, numbers, and equations. If necessary for the connect, model how to create a line graph to represent how the pattern grows.

For the independent activity, have black and white square tiles and graph (squared) paper available.

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Generalisations can be expressed with both words and symbols.

Variables are symbols that take the place of numbers, or ranges of numbers. They have different meanings depending on whether they are being used as representations of quantities that vary or change, representations of specific unknown variables, or placeholders in a generalised expression or formula.

Shareback

Select students to share who have developed different ways of showing how the pattern increases and have used multiple representations (e.g., diagrams, tables of data, numbers) to show their reasoning.

Connect

Represent how the pattern grows using a line graph on the graph (squared) paper.

What a rule you could use to find the number of grey tiles for any number of white tiles?

Suggested Learning Outcomes

Reproduce a pattern using objects, drawings, or symbols.

Continue a growing pattern.

Represent a growing pattern in a table of data.

Represent a growing pattern on a graph.

Identify patterns in a table of data that draw on single variational thinking or co-variational thinking.

Develop generalisations expressed in words and symbols related to a growing pattern.

Independent Tasks
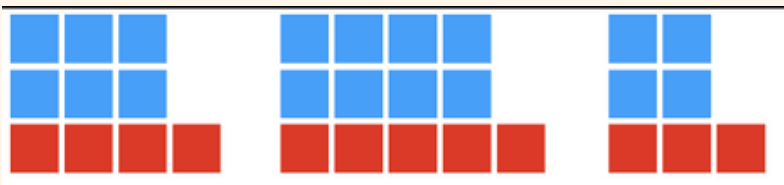
Sima is playing with tiles. He builds the patterns above.

Use the tiles to build other patterns that would belong in the sequence.

What would be the first pattern in the sequence?

What is the relationship between the red tiles and the blue tiles in the pattern?

Use a table of data and a graph to show how the number of blue tiles relates to the number of red tiles.

Anticipations

Solutions, Misconceptions

Task 6

NZ Bargain phone plans is currently offering two deals for mobile data.

Plan A costs $20 monthly membership plus $8 per 1 gb.
Plan B costs $45 monthly membership plus $4 per 1 gb

Use a number sentence to represent the two deals.

Show the results for Plan A and Plan B in a table.

Amount of GB	Plan A	Plan B
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Which deal is better?
What advice would you give to someone considering both the plans?

Teacher Notes

Before you launch the task, do a pattern quick image warm-up. Show the students the pattern for three seconds and ask them to describe it. Show the pattern again for three seconds and ask them to draw it. Display the pattern and ask them to draw the next term.

Facilitate the students to notice that the different deals with vary depending on the constant (monthly price) and the cost of each GB.

Expect students to represent using number sentences and a variable and a table of data.

For the independent task, have shapes, ice-block sticks and grid paper for the students to work with.

Shareback

Select students to share who can represent the unknown using a letter or informal variable (shape) and use the table of data to compare the results.

Connect

Ask students to show the results for both deals on a line graph using two different colours.
Ask them to discuss how the graph could help them make predictions.

Suggested Learning Outcomes

Represent a situation with unknowns using a number sentence.

Solve number sentences with different quantities.

Represent a function in a table of data.

Compare functional situations for different quantities.

Independent Tasks

Develop a growing pattern to match these rules:

Squares = $(4 \times n) + 3$

Ice-block sticks = $(8 \times h) + 4$

Tiles = $(5 \times g) - 1$

Develop your own growing patterns and write a rule to match them.

Anticipations

Solutions, Misconceptions

Task 7

Payton builds a pattern with the blocks:

Position 1   Position 2   Position 3

Use the square shapes to create Position 4, Position 5, and Position 6 and draw these.

How many squares would they each use?

How many squares would be used for position 10?

How many squares would be used for position 20?

How could you find out how many squares would needed for any position number?

Teacher Notes

Have square shapes or blocks.

If students have difficulty creating or continuing the pattern ask them to re-create the earlier positions and compare them to see what is the same and different.

Notice students who use a table of data or a structured way of tracking the number of squares and total number of shapes as the pattern grows.

For the independent task, provide students with graph (squared) paper.

Shareback

Select students to share who develop generalisations (recursive or explicit) that identify how parts of the pattern grows (e.g., square numbers in the middle; pattern number multiplied by 4 each time for the outer squares).

Big Ideas

Patterns are sequences (repeating or growing) made of numeric or spatial elements governed by a rule.

Patterns exist both in the world and in mathematics. The same pattern structure can be found in many different forms (e.g., numbers, shapes, colours, and rhythm).

A pattern can be described using a rule or you can create a pattern from a rule. To find the rule for a pattern, you need to identify the unit of the pattern (what is repeated or what grows).

In a pattern, the relationship between the ordinal position (e.g., first, second, and third) and the corresponding element is more useful for finding the pattern's rule than the relationship between successive elements. Identifying the rule of a pattern brings predictability and allows generalisations to be developed.

Generalisations can be expressed with both words and symbols.

Variables are symbols that take the place of numbers, or ranges of numbers.

They have different meanings depending on whether they are being used as representations of quantities that vary or change, representations of specific unknown variables, or placeholders in a generalised expression or formula.

Connect

Provide students with blocks or squares of two different colours and ask them to build the pattern showing the structure of the pattern with the middle clearly shown. For example;
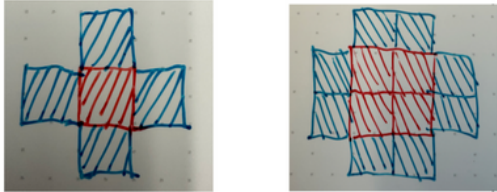
Ask the students to use this to develop a rule

Suggested Learning Outcomes

Represent a pattern using objects, drawings or a diagram.

Identify patterns related to growing patterns.

Use recursive methods to predict the next member of a sequence in a linear pattern.

Develop generalisations expressed in words and symbols related to a linear pattern.

Independent Tasks

Ta'ase and Lina are selling different types of chocolate bars to fundraise for camp.

Ta'ase gets $4 for each chocolate bar.

Lina has saved $25. Additionally, for each chocolate bar she sells, she gets $2.

Write a number sentence to represent each situation.

Use a table of data and graph to show when Ta'ase and Lina will have the same amount of money and how many chocolate bars Ta'ase will need to sell to have more money.

Anticipations

Solutions, Misconceptions

Task 8

The Fibonacci Sequence reflects growth that we can see in nature.

Each term is calculated by adding the previous two terms together.

1, 1, 2, 3, 5, 8, 13, 21

Continue the Fibonacci sequence and find the following terms.

The Fibonacci sequence also has other patterns in it.

Adding any three consecutive Fibonacci numbers together.
Record the results in a table.
What do you notice?
Can you explain it?

Adding any four consecutive Fibonacci numbers together.
Record the results in a table.
What do you notice?
Can you explain it?

Teacher Notes

During the launch, ask students to share different types of patterns that they know from their culture or every-day life. You might want to show the students a video to introduce Fibonacci and the golden ratio.

Support the students to continue the Fibonacci sequence and display this on the board so that the students can use it for the second part of the task.

Position the students to use different representations and diagrams including numbers and a table of data. A table of data with two columns may be introduced or modelled to support the students.

1, 1, 2	4
1, 2, 3	6
2, 3, 5	8

For the independent activity, have hexagons and counters available for the students to model the pattern.

Shareback

Select students to share who have noticed different patterns in relation to adding different consecutive Fibonacci numbers. For example, adding three consecutive Fibonacci numbers results in an odd number OR adding three consecutive Fibonacci numbers results in twice the third number.

Connect

What other patterns can you notice using the numbers from the Fibonacci sequence?

Suggested Learning Outcomes

Continue a growing pattern.

Identify the patterns in the Fibonacci sequence when adding consecutive numbers.

Develop generalisations expressed in words related to the patterns they have noticed in the Fibonacci sequence.

Independent Tasks

Eva and Hone have been put in charge of organising tables and seats for their school graduation night dinner.

They've worked out that 198 people are coming.

One Table   Two Tables   Three Tables

How many people can be seated at 5 tables, 11 tables, 22 tables?

Represent how the pattern grows using a table of data or graph.

How many tables do Eva and Hone need to organise for 198 people?

Can you find the relationship between the number of tables and chairs in words or symbols and justify how the rule works with your representation.

Anticipations

Solutions, Misconceptions

Task 9

Function machines are clever machines which transform numbers.

What are the rules for the function machines with the following results:

Machine B

In	Out
8	4
9	5
16	12
14	10
20	16
7	3
18	14

Other function machines have more than one input
Work out the results for Machine C using the following rules:

Machine C

In	Out
4	
8	
1	
20	
0	
100	

What is the rule for machine D?

Machine D

In	Out
10	28
6	16
8	22
11	31
2	4
5	13
19	52
12	34

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In a pattern, the relationship between the ordinal position (e.g., first, second, and third) and the corresponding element is more useful for finding the pattern's rule than the relationship between successive elements.

Identifying the rule of a pattern brings predictability and allows generalisations to be developed.

Generalisations can be expressed with both words and symbols.
Variables are symbols that take the place of numbers, or ranges of numbers.

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Teacher Notes

To launch the task, draw a function machine input and output diagram on the board:
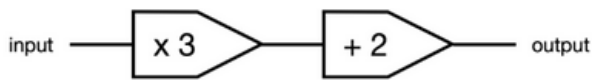
Ask the students to work out the rule for the function machine results shown in this table:

Machine A

In	Out
2	11
9	18
15	24
10	19
7	16
3	12
5	14

Ask the students to work out the rule together for the first function table. Use prompts such as "how do you get from 2 to 11?" or "how do you get from 9 to 18?".

During the task present each function machine and table separately and then ask the students to share their response before you move to the next function machine.

Expect students to represent using diagrams notating the table of data to recognise how the pattern is changing.

Shareback

Select students to share for each function machine who identify the rule and explain their reasoning.

Connect

Ask the students to make their own function machine rules and create a table to show the results. Ask the students to try and guess the rule for other students' function machines.
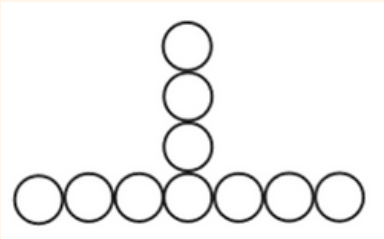
Suggested Learning Outcomes

Identify a rule for a function machine.

Follow a rule for a function machine.

Independent Tasks

This is Pattern 3.

Draw what you think Pattern 2 and Pattern 1 would look like.

How many different patterns can you see in this drawing?
Show all the patterns that you can see.

Continue the pattern for Pattern 4 – 10.

Use a table of data to represent the pattern and explain the patterns that you have found.

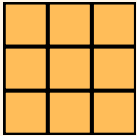# Anticipations

Solutions, Misconceptions

Task 10

How many squares are in position one?

How many squares are in position two?

How many squares are in position three?

What do you notice about the pattern and how it grows?

Draw and describe Pattern 4 and Pattern 5.

How many squares do they each have?

How many squares would there be for position 10?

How many squares would there be for position 12?

Teacher Notes

Facilitate students to notice that the number of squares includes both the small squares and squares made from these. For example, position 2 has 5 squares with 4 small squares that make up one large square as well.

Position the students to identify the different squares using colours to show these.

Expect the students to use different representations and diagrams including numbers and a table of data. A table of data may be introduced or modelled to support the students.

Patterns are sequences (repeating or growing) made of numeric or spatial elements governed by a rule.

Patterns exist both in the world and in mathematics. The same pattern structure can be found in many different forms (e.g., numbers, shapes, colours, and rhythm).

A pattern can be described using a rule or you can create a pattern from a rule. To find the rule for a pattern, you need to identify the unit of the pattern (what is repeated or what grows).

In a pattern, the relationship between the ordinal position (e.g., first, second, and third) and the corresponding element is more useful for finding the pattern's rule than the relationship between successive elements.

Identifying the rule of a pattern brings predictability and allows generalisations to be developed.

Generalisations can be expressed with both words and symbols.

Variables are symbols that take the place of numbers, or ranges of numbers. They have different meanings depending on whether they are being used as representations of quantities that vary or change, representations of specific unknown variables, or placeholders in a generalised expression or formula.

Shareback

Select students to share who have noticed different patterns in relation to the different elements of the patterns.

Connect

How would you find the number of squares for position 100?

Suggested Learning Outcomes

Reproduce a pattern using objects, drawings, or symbols.

Continue a growing pattern.

Develop generalisations expressed in words related to a growing pattern.

Independent Tasks

Complete the following assessment tasks (attached at the end of the document) as the independent activity:

Task 1: Flower pattern

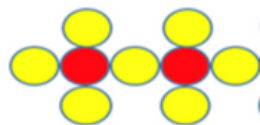Task 2: Square tiles pattern

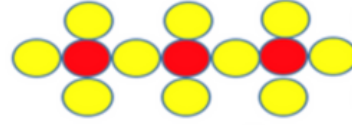# Anticipations

Solutions, Misconceptions

Assessment Task 1 - Algebra - Year 5-6

Position One   Position Two   Position Three

Look at this pattern. Can you:

- Show how the yellow circles grow using a picture, a table, ordered pairs, and/or a graph.
- Describe the pattern in words and/or numbers.
- Show how you work out the number of yellow circles for the following pattern numbers: Pattern 5; Pattern 10; Pattern 50.
- Write the rule for the number of yellow circles in words or symbols.

Assessment Task 2 - Algebra - Year 5-6

Position five

Look at this pattern. Can you:

- Draw position four, three, and six.
- Show how the grey squares grow using a table of data and/or a graph.
- Describe the pattern in words and/or numbers.
- Show how you work out the number of grey squares for the following pattern numbers: Pattern 5; Pattern 10; Pattern 50.
- Write the rule for the number of grey squares in words or symbols.