High Attainers Guidance – Sequences

Year 7

#MathsEveryoneCan

White Rose Maths

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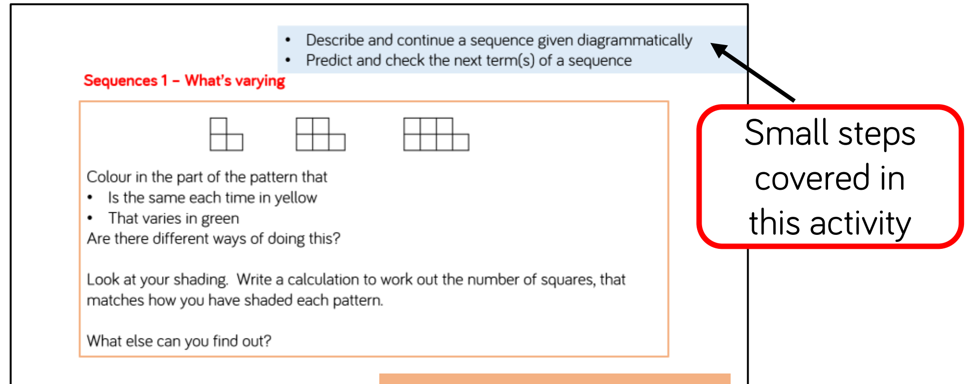
How these materials work

For each block in the KS3 curriculum, we are providing activities to challenge higher-attaining students to think more deeply about the underlying mathematics. These mostly address two or three of the small steps at a time, and can be used either alongside the main teaching of the steps or at the end of the block as appropriate for your students. In many cases, the activities could be used with many students, not just high attainers, by providing appropriate scaffolding.

A notes page is provided for each activity, giving ideas and prompts for how to use them in the classroom.

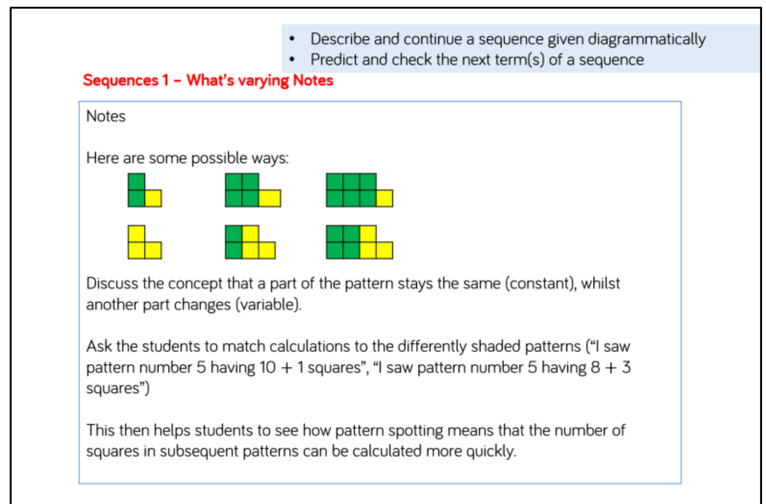


Student version

In this block…

The key purpose of this block is to support students to notice and describe patterns, so developing their algebraic thinking. In these activities the focus remains the same, with some more challenging aspects of the KS2 curriculum such as negative numbers and fractions, interleaved. It is still not expected that students should find an algebraic rule for the nth term of a linear sequence as this is covered in Year 8 as a Higher step and for all students in Year 9. They may notice connections between the position in the term and the numerical value or may also notice that e.g. the hundredth term is 99 differences greater than the first term.

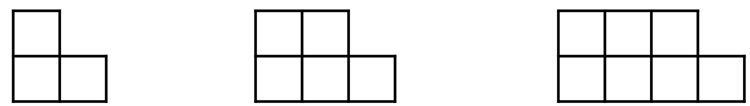
Students should be encouraged to notice what stays the same and what varies in each sequence or pattern. They should also focus on making connections between different representations of a sequence. This is an ideal opportunity to encourage mathematical talk whilst developing the mathematical behaviours of predicting, conjecturing, organising and classifying information.



Teacher notes

- Describe and continue a sequence given diagrammatically
- Predict and check the next term(s) of a sequence

Sequences Activity 1 - What's varying?



Colour in yellow the part of the pattern that stays the same each time.

Colour in green the part of the pattern that varies.

Are there different ways of doing this?

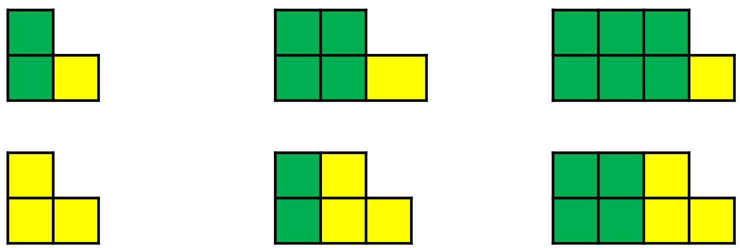
Write a calculation to work out the number of squares, that matches how you have shaded each pattern.

Use your pattern to work out how many squares there are in the 12th pattern, 50th pattern and 100th pattern? What else can you find out?

- Describe and continue a sequence given diagrammatically
- Predict and check the next term(s) of a sequence

Sequences Activity 1 - What’s varying? Notes

Here are some possible ways:



Discuss the concept that a part of the pattern stays the same (constant), whilst another part changes (variable).

Ask the students to match calculations to the differently shaded patterns (“I saw pattern number 5 having 10 + 1 squares”, “I saw pattern number 5 having 8 + 3 squares”)

This then helps students to see how pattern spotting means that the number of squares in subsequent patterns can be calculated more quickly.

- Describe and continue a sequence given diagrammatically
- Predict and check the next term(s) of a sequence

Sequences Activity 2 - Fractions

$$\frac{1}{12}, \frac{5}{24}, \frac{1}{3}, \dots$$

Use a grid to draw a diagram that could represent this sequence.

What would be the next term?

Is 1 a term in this sequence? Why?/Why not?

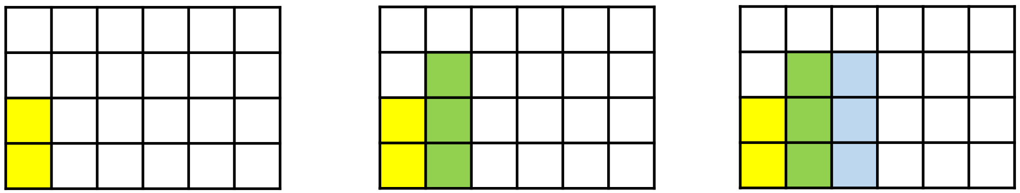
Will $2\frac{1}{7}$ be a term in the sequence? Explain your answer.

What else can you find out?

- Describe and continue a sequence given diagrammatically
- Predict and check the next term(s) of a sequence

Sequences Activity 2 – Fractions Notes

One example of how students may choose to represent the sequence is:



$\frac{1}{12}$ $\frac{5}{24}$ $\frac{1}{3}$

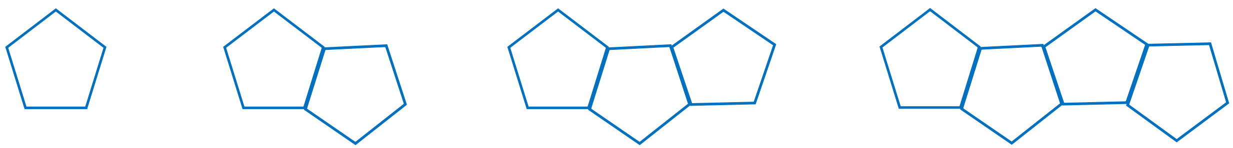
In this representation, students have worked out that the common difference is $\frac{1}{8}$ and that this is equivalent to $\frac{3}{24}$

Students should be encouraged to say what they notice about the denominator of each fraction in the sequence and to consider how this helps them to know which numbers are definitely not in the sequence.

- Describe and continue a sequence given diagrammatically
- Predict and check the next term(s) of a sequence

Sequences Activity 3 – Perimeter

All sides of the pentagons have length 1 cm.



What's the perimeter of each pattern?

What do you notice about the sequence of the perimeters?

What pattern number has a perimeter of $4 + 3 + 3 + 3 + 3 + 3 + 3 + 4$?
Explain how you know.

What pattern number has a perimeter of $(4 \times 2) + (3 \times 8)$
Explain how you know.

- Describe and continue a sequence given diagrammatically
- Predict and check the next term(s) of a sequence

Sequences Activity 3 – Perimeter Notes

- This activity interleaves perimeter (a concept covered in KS2). Other topics could be interleaved include angles, time, mass etc.
- The activity encourages students to think of quick ways of working out terms in the sequence. Students can relate back to Activity 1 and look at what stays the same and what varies.
- Asking students to generate 'easy' questions (e.g. 'What's the next term in the sequence?') and 'hard' questions (e.g. Is '37 in the sequence? Explain your answer.') helps to promote creativity and continues to build understanding.
- The activity can be extended by looking at different shapes and/or different arrangements of shapes.

- Represent sequences in tabular and graphical forms
- Recognise the difference between linear and non-linear sequences

Sequences Activity 4 – Card Sort

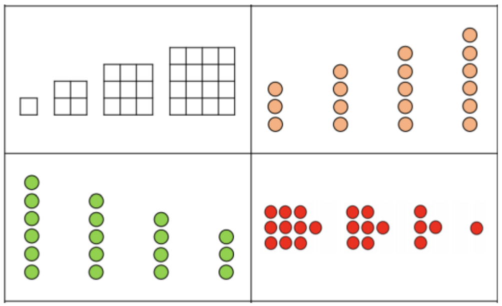
Sort the cards into groups.

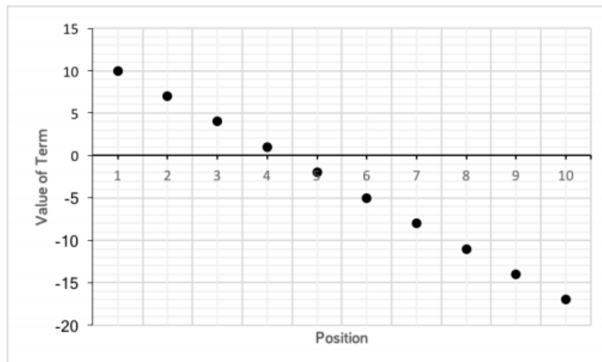
Position	1	2	3	4	5
Term	6	5	4	3	2

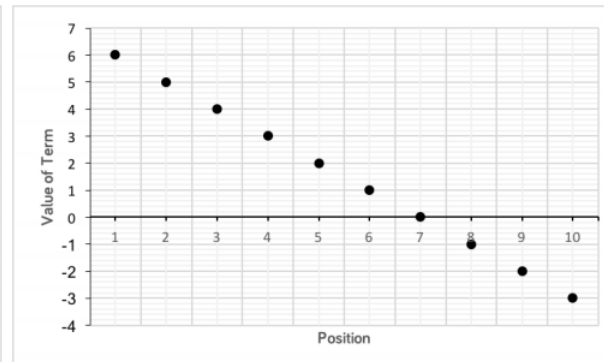
Position	1	2	3	4	5
Term	1	4	9	16	25

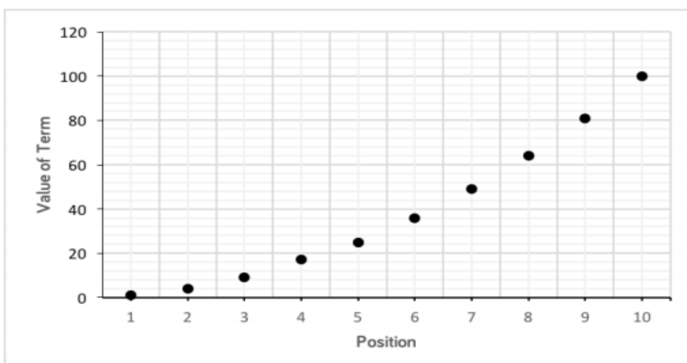
Position	1	2	3	4	5
Term	3	4	5	6	7

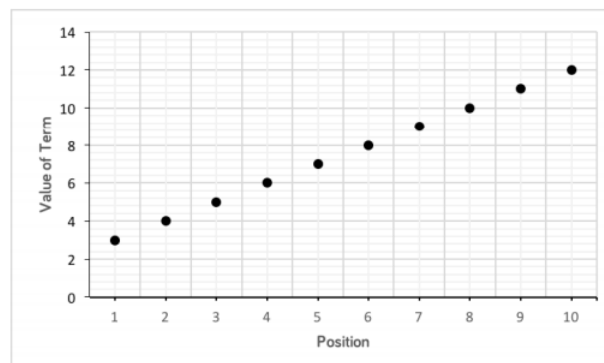
Position	1	2	3	4	5
Term	10	7	4	1	-2











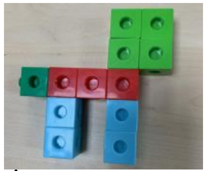
Investigate other sequences by creating your own diagrams, tables and graphs.

- Represent sequences in tabular and graphical forms
- Recognise the difference between linear and non-linear sequences

Sequences Activity 4 – Card Sort Notes

You could vary the number of cards in this activity, adding extra or removing some to change the level of challenge.

Notice that the different representations show different numbers of terms. Also, on some of the graphs, terms with negative values are included. Students could consider how to represent these diagrammatically (e.g. using a different colour counter to represent −1). In addition, the scales on the graphs are different thus drawing student attention to the importance of checking this. Finally, students could be asked questions such as 'what's the same and what's different about each set of cards', or 'which set of cards is the odd one out and why'.

Students could be given a prompt, for example  , and then asked to use this to generate their own sequence. They could then create their own set of matching cards.

- Continue numerical linear sequences
- Continue numerical non-linear sequences

Sequences Activity 5 – Growing Quickly?

A

Here are two sequences.

2, 22, 42, 52, … 2, 4, 8, 16, …

- Which sequence will have a term greater than100 first?
- Do geometric sequences always grow faster than an arithmetic sequences? Give examples. Justify your reasoning by representing your sequences on a graph.

B

A linear sequence and a geometric sequence both have the same first and third terms.
Give examples of sequences for which this statement is true.
How would the graphs of these sequences look?

C

Here is a geometric sequence. $1, \frac{1}{4}, \frac{1}{16}, \ldots$

Find the next three terms in the sequence.
Is -1 in the sequence? Is 2 in the sequence? Is 0 in the sequence?
What do you notice about this sequence?

- Continue numerical linear sequences
- Continue numerical non-linear sequences

Sequences Activity 5 – Growing Quickly? Notes

These questions focus on the nature of linear and geometric sequences, considering the rate at which they increase (or decrease) in comparison to each other and when they have equal term values.

Teachers may want to use the cards labelled A, B and C sequentially with students, or allocate different cards to different pairs of students. Students could then be swapped between pairs so that conclusions are shared or could present their findings to the class

You could also interleave fractions and decimals. A calculator could be used to support students to explore these sequences further.

Students could also explore the idea of a 'limit' by considering sequences such as $1, \frac{1}{4}, \frac{1}{16}, \ldots$ where the values of the terms tend to 0

- Explain the term-to-term rule of numerical sequences in words

Sequences Activity 6 - Term-to-term

Here at the first two term values in a sequence.

10, 0.1 , …

- How many different sequences can you generate?
- What's the term-to-term rule for each?
- Organise your sequences into groups.
- What title would you give each group?

- Explain the term-to-term rule of numerical sequences in words

Sequences Activity 6 – Term-to-term notes

Again, sequences involving negatives, decimals or fractions could be used here.
After exploring the 'standard' sequences and reinforcing the vocabulary around these, students could explore two-step rules such as "Divide by 10 then subtract 0.9"
Spreadsheets can be used to explore long-term behaviour of the sequences

Sequences Activity 7– Missing numbers

A

Here are two linear sequences. Work out the missing values

1.5, ___, ___, ___, ___, 6, ___

___, −8, ___, ___, 22, ___, ___

B

Here is a sequence

3, ___, 12, ___, ___

Work out the missing numbers in the sequence if it is

- Linear
- Geometric
- Fibonacci

What happens if you change the position of the term with value of 12 in the sequence?

Sequences Activity 7 – Missing numbers Notes

You may decide to use the cards A and B sequentially with the students, or give them to different pairs and ask students to present their conclusions to each other.

When exploring linear sequences, support students to generalise the number of constant differences. A number line is useful in supporting this thinking.

Provide further linear sequences involving decimals and negatives when students are working out missing term values.

The activity on Card B can be extended by asking students to think about what would happen if they change one aspect of the sequence (e.g. the position of the term with a value of 12, or the position of the term with a value of 3)