Working with Patterns

Arithmetic Sequences	Carry on a sequence and identify the term to term rule. Continue pictorial sequences. <u>Include fractional, decimal, negative and algebraic sequences.</u>	
Nth Term	Guide learners to generalise a rule for the nth term of both positive and negative sequences. Use the nth term to find terms and justify if a number is in the sequence.	Link to times tables
Draw Linear Equations	Draw linear equations focussing mainly on the link to sequences and substitution. At this point students do not need to draw higher demand equations.	

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Geometric and Fibonacci Sequences	Understand and identify different types of sequences. Find missing values in geometric and Fibonacci sequences.	Natural sequences in the world
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Key Knowledge/Prior Learning KS2/3 and Retrieval and Suggested Starters
• Solving 1 step equations • Understanding of inequality notation • Expanding single brackets. • Working with fractions, decimals and negative numbers. • Substitute a value into an expression. • Algebraic manipulation. • Calculations • Fraction calculations • Substitution • Is a number in a sequence • Solving equations

KS3 National Curriculum – what students will be practicing and Key Questions
• Identifying how a sequence continues and finding future terms. • Generate the nth term rule of a sequence and use the nth term of a sequence to generate terms. • Identify different types of sequences focussing on those that are not linear and incorporation algebraic manipulation into other sequences. • Draw linear equations involving skills of substitution and sequencing.

Specific Ambitious Knowledge
• Nth term by: Using a table Zeroth term method Formula method a + (n -1)d Substitution method (Identifying the link between linear sequences and linear equations). (See mathematical methods books for more info).

Key Vocabulary/Literacy Opportunities
• Linear • Arithmetic • Geometric • Fibonacci • Equal • Variable • Term • Coefficient • Substitution

- Indices
- “Nth”
- Constant
- Function

Key Formulae/Knowledge

Table Method

Example 2: Find the nth term of 70, 65, 60, 55…

Find the common difference. In this sequence the terms decrease by 5 each time. This tell us that the sequence is a translation of the negative 5 times table.

We write out the negative 5 times table next to the sequence.

n	1	2	3	4
Term	70	65	60	55
$-5n$	-5	-10	-15	-20

If we compare the second and third rows, we can see that each term in the sequence is 75 more than the equivalent term in the $-5n$ row. In other words, to get the sequence, we take $-5n$ and we add 75.

Algebraically, this can be written as $-5n + 75$ or equivalent.

Zeroth Term method

Method B: Zeroth Term Method

Example 1: Find the nth term of 2, 6, 10, 14, …

Find the common difference. Let's call this d. So here $d = +4$.

Now 'step back' from the first term. The first term is where $n = 1$ and we want the term where $n = 0$. So subtract 4 from 2. Let's call this 'zeroth term' z.

The nth term is $dn + z$.

Or if we call the first term a, we could say that the nth term is $dn + (a - d)$.

Here, $d = 4$ and $z = -2$ so the nth term is $4n - 2$.

Example 2: Find the nth term of 70, 65, 60, 55, …

Find the common difference. $d = -5$.

Find the zeroth term. This is the term before the first one. By looking at the pattern, this is straightforward. In fact, most primary school children would be able to do this. $z = 75$.

The nth term is $dn + z$. Here, $d = -5$ and $z = 75$ so the nth term is $-5n + 75$. We can write this more elegantly as $75 - 5n$.

Substitution Method

Method D: Substitution Method

Example 1: Find the nth term of 2, 6, 10, 14, …

All linear sequences have an nth term in the form $dn + c$ where d is the common difference and c is a constant.

Find the common difference d in the sequence 2, 6, 10, 14, … .

Here we have $d = +4$, so our nth term is $4n + c$.

To find the value of c we can use any term from the sequence. Say we use the first term, then we have $n = 1$.

$$nth\ term = 4n + c$$
$$1st\ term = 4(1) + c$$
$$2 = 4(1) + c$$

Solve this for c.

$$2 = 4 + c$$
$$\therefore c = -2$$

There is no need to repeat this process with another term, but here we will verify that the answer is correct by using the third term too. Now we have $n = 3$.

$$nth\ term = 4n + c$$
$$3rd\ term = 4(3) + c$$
$$10 = 4(3) + c$$
$$10 = 12 + c$$

Solving this we get $c = -2$ as before.

So now that we have $d = +4$ and $c = -2$ we know that the nth term is $4n - 2$

Formula Method

Method C: Formula Method

Example 1: Find the nth term of 2, 6, 10, 14, …

Use the formula $a + (n - 1)d$.

Find the first term ($a = 2$) and the common difference ($d = 4$).

Substitute $a = 2$ and $d = 4$ into the formula $a + (n - 1)d$.

Expand and simplify:

$$2 + (n - 1)4$$
$$= 2 + 4n - 4$$
$$= 4n - 2$$

Maths In Context (Historical, Real Life and Student Thinking Points)

Projects/Enrichment/Investigations