Second Level – Exploring Number
Algebraic Thinking Homework Cards

AT2.1 I have explored a range of patterns using the same steps

Make snakes Ask children to draw three snakes, split into many sections, and to write a sequence in each snake, e.g. by counting on or back in steps of the same size, like those used in the lesson. For more of a challenge you could state that the fifth number in each sequence must be a particular number, e.g. 27 or 54, and say that at least one sequence must be descending.

AT2.1 I have explored a range of patterns using the same steps

Trail puzzles *squared paper* Using a small piece of squared paper, children write a wiggly number sequence from adjacent square to adjacent square. Sequences can be counting on or back in constant steps of any size from any number. Several different sequences could be written from side to side across the page or from top to bottom. The remaining squares are randomly filled with numbers. The puzzles can be swapped at school for other children to find and follow the sequences.

AT2.2 I have explored a range of patterns using different steps

What's the rule? Give children a range of sequences to explore and ask them to find the start number and rule, such as:
- 6, 7, 9, 12, 16, 21, 27, … (start at 6, then add 1, 2, 3, 4, 5, ...)
- 50, 49, 46, 41, 34, 25, … (start at 50, then take 1, 3, 5, 7, 9, ...)
- 1, 3, 9, 27, 81, 243, … (start at 1, then multiply by 3 each time).

Encourage children to write notes on the patterns in each sequence, e.g. every pair of numbers alternates between odd and even.

AT2.2 I have explored a range of patterns using different steps

True or false? Give children the following puzzle to investigate:
A sequence starts at 3. The terms grow by adding 2, 4, 6, 8, 10 and so on. Every number in the sequence will have a units digit of 3, 5 or 9.
Do you think the statement is true or false?

AT2.3 I have investigated how a function machine can be used to represent a single operation

Functions quiz Ask children to design their own function machines and work out inputs and outputs. From these, they can devise a quiz, by keeping one piece of information hidden, e.g. by not giving the input, the function or the output. The quizzes can be used in the next lesson as revision.

AT2.3 I have investigated how a function machine can be used to represent a single operation

How it works Children write an explanation about how a function machine works in their learning logs. In their explanation they include diagrams to illustrate the process and use key words such as input, function and output. Can they also explain how to find an input if they know the function and the output?

AT2.4 I have explored what values make an equation balance or not

Inequalities quiz Ask children to create their own inequalities quiz by choosing a secret number, *n*, and writing a range of clues using inequalities that could identify it. Explain that the inequalities should involve a range of operations and that it should be possible to identify the exact number chosen using the clues.

AT2.4 I have explored what values make an equation balance or not

Missing-number quiz Ask children to create their own true equations that involve several operations on each side of the equals symbol. From these, they devise a quiz, by keeping one number hidden, to create missing-number statements. The quizzes can be used in the next lesson as revision.

AT2.5 I can solve simple equations with letters representing unknown values using my known

What's unknown? Give children a range of equations to explore, like those in the lesson, and ask them to find the value of the letter. Encourage children to make notes on the strategies they used to find the unknown values.

AT2.5 I can solve simple equations with letters representing unknown values using my known

Letter quiz Ask children to create their own true equations that involve several operations on each side of the equals symbol. From these, they devise a quiz, by replacing one number with a letter, to create equations with an unknown value. The quizzes can be used in the next lesson as revision.

AT2.6 I have explored different visual patterns and how they relate to number patterns

A, B or C? drawing materials or computer with graphics software Ask children to draw or create on a computer four terms in a visual pattern. Children write three possible number sequences that might relate to it, labelled A, B and C, one of which must be correct. Sequences could ascend or descend in equal or unequal steps. These can be used as puzzles to be examined at school.

AT2.6 I have explored different visual patterns and how they relate to number patterns

Get stacking Ask children to imagine a stack of tins, with one tin on the top level, two on the second, three on the third, etc. with 10 levels altogether. Ask them to investigate the total number of tins in the stack and to make notes on how the relationship between number and visual patterns can be used to help find the answer.

AT2.7a I have investigated and re-created well-known number patterns – Square numbers

True or false? Ask children to write six true and six false statements about square numbers, e.g. 80 is a square number; 9 squared is 99; the number after 49 in sequence of square numbers is 64, etc. These can be used in class for others to identify which are true and which are false.

AT2.7a I have investigated and re-created well-known number patterns – Square numbers

Which year? *calculator (optional)* Ask children to investigate which year closest to the current year is a 4-digit square number. They use a written method or calculator to square different 2-digit numbers to find the one whose square is closest to this year. (Answer is 2025, which is 45^2.)

AT2.7b I have investigated and re-created well-known number patterns – Cube and triangular numbers

True or false? Ask children to write six true and six false statements about cube and triangle numbers, e.g. *100 is a cube number; 10 cubed is 1000; the number after 8 in the sequence of cube numbers is 27*. These can be used in class for others to identify which are true and which are false.

AT2.7b I have investigated and re-created well-known number patterns – Cube and triangular numbers

Which year? *calculator (optional)* Ask children to investigate which year closest to the current year is a 4-digit cube number. They use a written method or calculator to cube different small 2-digit numbers to find the one whose cube is closest to this year. (Answer is 2197, which is 13^3.)

AT2.7c I have investigated and re-created well-known number patterns – Pascal's triangle

Make a poster poster-making materials Ask children to make a poster of all they have discovered about Pascal's triangle and the patterns it contains, including any other information about Pascal himself that they have researched.

AT2.7c I have investigated and re-created well-known number patterns – Pascal's triangle

Odds and evens *APM 449, coloured pens* Give children a copy of Pascal's triangle or ask them to write out the first eight rows. Ask them to colour the odd and even numbers in different colours and to describe what they are doing by writing notes in their learning logs on what patterns they notice.

AT2.7d I have investigated and re-created well-known number patterns – Fibonacci

7th number Ask children to use the Fibonacci sequence starting with 1, 2, 3, 5 (note only one 1). Ask them to investigate the relationship between the 7th term of this sequence and the sum of the first 10 numbers in the sequence. (Answer: they should discover that the sum is exactly 11 times the 7th term.)

AT2.7d I have investigated and re-created well-known number patterns – Fibonacci

Make a poster *poster-making materials* Ask children to make a poster of all they have discovered about Fibonacci numbers and the patterns the sequence contains, including any other information about Fibonacci himself that they have researched.

AT2.8 I can work out the input or output values of a two-step function machine

Function quiz Ask children to design their own function machines and work out inputs and outputs. From these, they devise a quiz, by keeping one piece of information hidden, e.g. by not giving the input, the function or the output. The quizzes can be used in the next lesson as revision.

AT2.8 I can work out the input or output values of a two-step function machine

Order, order Ask children to investigate the different outputs that can be generated by putting in the same inputs for functions that involve these three operations: *× 2, + 1 and – 3*. For example, if the input is 5 and the function machine is *+ 1, × 2, – 3* the output is 9, but if the function machine is *– 3, + 1, × 2* the output is 6. Ask children to investigate all possible variations of the three operations and make notes about what they discover.

AT2.9 I can create and simplify expressions using symbols and letters

Pyramid puzzle Ask children to draw a pyramid-shaped wall with four bricks in the bottom row, three bricks above it, then two bricks and finally one brick in the middle at the top. In the bottom row they write these expressions: n, $2n + 5m$, $5n - 3m$ and $4m$. They add adjacent expressions, simplifying where appropriate, and write the total in the brick above. In this way, they write an expression in every brick. What is the expression in the top brick?

AT2.9 I can create and simplify expressions using symbols and letters

Quiz time Children write an expression, e.g. $2m + 4m + 2 - 3m$, and give four multiple-choice options for the simplified answer, e.g. (A) $9m + 2$; (B) $6m + 2$; (C) $3m + 2$; (D) $8m - 3$. They do this for three expressions, then bring them into class to use in a quiz.

AT2.10 I can describe and continue a range of different number sequences

True or false? Pose the following problem: *A sequence starts at 5. The terms grow by adding 2, 4, 6, 8, 10, etc. Every number in the sequence will have the units digit 5, 7 or 1. Do you think the statement is true or false? How do you know?*

AT2.10 I can describe and continue a range of different number sequences

What's the rule? Give children a range of sequences such as those investigated in the lesson to explore and ask them to find the rule. Encourage them to write notes on the patterns in each sequence, e.g. the numbers alternate between odd and even, and to continue the sequences further.

AT2.11 I can solve simple equations using a function machine

What's unknown? Give children a range of equations to explore, like those in the lesson, and ask them to find the value of the letter. Encourage them to make notes on the strategies they used to find the unknown values.

AT2.11 I can solve simple equations using a function machine

Letter quiz Ask children to create their own true equations that involve several operations on each side of the equals symbol. From these, they devise a quiz, by replacing one number with a letter, to create equations with an unknown value. The quizzes can be used in the next lesson as revision.

AT2.12 I can solve simple equations by balancing both sides

Two methods Give children some one-step equations. They solve them using both function machines and by balancing both sides. Children write the examples and notes in their learning logs to explain how each method works and, if they prefer one method over the other, why.

AT2.13 I can solve word problems by creating and solving equations

Make up an equation Children make up an equation of their own and then write a story to go with it. They solve it using either a function machine or the balancing method.

AT2.13 I can solve word problems by creating and solving equations

Try triangles Ask children to solve the following word problem:

A scalene triangle has angles of sizes a, 6a and 5a. What is the size of each angle?

Ask children to use their knowledge of the sum of angles in a triangle (180°) to make an equation and solve it using the balancing method or a function machine to find the value of a, and therefore the size of each angle.
