MA.5.AR.3.2

Overarching Standard: ***MA.5.AR.3: Analyze patterns and relationships between input and outputs.***

Benchmark of Focus

MA.5.AR.3.2: Given a rule for a numerical pattern, use a two-column table to record the inputs and outputs.

> *Examples:* The expression $6 + 2x$, where x represents any whole number, can be represented in a two-column table as shown below.

Input (x)	0	1	2	3
Output	6	8	10	12

Benchmark Clarifications

Clarification 1: Instruction builds a foundation for proportional and linear relationships in later grades.

Clarification 2: Rules are limited to one or two operations using whole numbers.

Related Benchmark/Horizontal Alignment

- MA.5.GR.4.2

Vertical Alignment

Previous Benchmarks	Next Benchmarks
MA.4.AR.3.2	MA.6.AR.3.3

Purpose and Instructional Strategies

The purpose of this benchmark is to relate patterns to a two-column table for students to record inputs and outputs. It is related to MA.5.AR.3.1 where students determine rules from given patterns. This is the first grade in which students record inputs and outputs two-column tables, and this work helps build the foundation for proportional relationships (MA.6.AR.3.3) in middleschool and functional relationships starting in Grade 8.

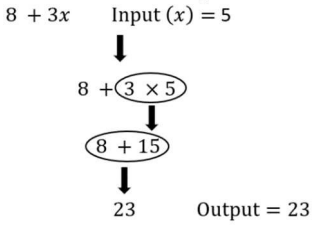
- Instruction of this benchmark should be paired with MA.5.AR.3.1. Organizing patterns into input and output tables lays the foundation for students to explore proportional and linear relationships in later grades (MTR.5.1).
- During instruction, teachers can relate the idea of "inputs" and "outputs" on a two-column table to a machine. The input is the term number, and the output is the corresponding term's value. Students are to find what the machine does to determine the output.
- Instruction should make connections between representing the information in a two-column table and as ordered pairs on a coordinate plane (MA.5.GR.4.2).

Common Misconceptions or Errors

- Students may make computational errors when calculating the output for a given rule and input.
- Students may confuse input and output values when recording the values in a two- column table.

Strategies to Support Tiered Instruction

- Instruction includes opportunities to record each step when calculating the output for a given rule and input.
    - For example, for the rule $8 + 3x$ students record the steps to calculate the output using an input of 5 and the order of operations.



- Instruction includes using highlighters when recording inputs and outputs in a two- column table. Students highlight the "inputs" label in the table and all corresponding inputs using one color. Then, students highlight the "outputs" label in the table and all corresponding outputs using a different color.
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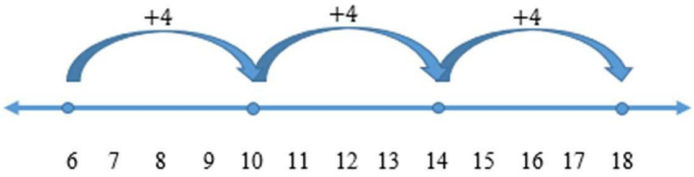

Questions to ask students:

What are the features of the following pattern: start with 3 and add 5.

- Sample answer that indicates understanding: The next three numbers in the pattern are as follows: 3, 8, 13, 18. The features of this pattern include the sequence growing, an alternating even and odd numbers and the alternating digits of 3 and 8 in the ones position.

How do the features of the input/output table work?

- Sample answer that indicates understanding: The input/output table helps to organize both the value put 'in' and then the corresponding value based upon it.

Given the rule 4 + 3x, what are the two missing outputs from the table?

Input (x)	0	1	2	3	4
Output	4	7	10	?	?

- Sample answer that indicates understanding: If following the rule 4 + 3x, the two missing outputs could be found in the following manner: 4 + (3 × 3) = 13 and 4 + (3 × 4) = 16.

Instructional Tasks

Instructional Task 1

The Math Machine makes two-column tables when the user tells it a rule. Jacob tells theMath Machine to create a table using the rule "10 + 2x." Unfortunately, the machine is malfunctioning and only some of the table is correct.

Part A: Identify which values are incorrect and complete the table correctly.

Input (x)	0	1	2	3
Output	12	12	22	32

Part B: Extend your table to show the outputs for x = 10, 11 and 12.

Instructional Items

Instructional Item 1

What is the missing value in the two-column table below?

Rule: $40 - 3x$

Input (x)	0	1	2	3
Output	?	37	34	31

Achievement Level Descriptors

<table>
<tr><th>Benchmark</th><th>Context</th><th>Assessment Limits</th></tr>
<tr><td>MA.5.AR.3.2 Given a rule for a numerical pattern, use a two-column table to record the inputs and outputs. Example: The expression 6 + 2x, where x represents any whole number, can be represented in a two-column table as shown below.
<table>
<tr><td>Input (x)</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Output</td><td>6</td><td>8</td><td>10</td><td>12</td></tr>
</table>
Clarification 1: Instruction builds a foundation for proportional and linear relationships in later grades. Clarification 2: Rules are limited to one or two operations using whole numbers.</td><td>Mathematical</td><td>Items may use coefficients to represent multiplication. Two-column tables can be configured vertically or horizontally.</td></tr>
<tr><th>ALD 2</th><th>ALD 3</th><th>ALD 4</th><th>ALD 5</th></tr>
</table>

Given a rule for a numerical pattern, uses a two-column table to record the missing outputs when given all inputs and some of the outputs	Given a rule with one procedural step involving addition or subtraction for a numerical pattern, uses a two-column table to record the outputs when given the inputs.	Given a rule for a numerical pattern, uses a two-column table to record the inputs and outputs.	N/A

Additional Resources:
CPALMS Resources

Khan Academy: Patterns with Numbers

YouTube: Input and Output Tables

Resources/Tasks to Support Your Child at Home:

Given the rule 12x, fill in the next three inputs and outputs:

Input (x)	2	4	6	8	10
Output	12	48	?	?	?