Using tables to explore patterns and graphs

Key focus

This objective develops students' ability to use tables as a tool for exploring relationships between variables. Students complete tables following given algebraic rules, discover rules from tables of values, predict graph behaviour by recognizing patterns in tables, and convert between tables, ordered pairs, and algebraic rules. The emphasis is on understanding how changes in one variable affect another and on using tables to understand the shape and direction of linear graphs.

Suggested teaching sequence

1. Start with a rule and a table: give a rule such as $y = x + 2$ and have students fill in a table with increasing x values. Record the values and look for patterns in the differences.
2. Identify constant differences: guide students to see that for a linear rule $y = mx + c$, the differences between consecutive y values are constant and equal to the slope m.
3. Read ordered pairs from tables: present a completed table and ask students to name the ordered pairs (x, y) and plot them. Observe that they form a straight line.
4. Discover the rule from a table: give a table of values with missing information and guide students to find the rule by examining differences: "How much does y increase when x increases by 1?"
5. Graph behaviour: ask students whether the line rises or falls by looking at whether the differences are positive (rises) or negative (falls). Connect this to the slope of the graph.
6. Multiple rules: present tables with different rules ($y = 2x$, $y = 5 - x$, $y = 2x + 1$) and have students identify patterns, predict the next point, and describe graph direction.
7. Convert between representations: show a rule and ask for a table, show a table and ask for the rule, show ordered pairs and ask for a rule or next pair.
8. Compare linear relationships: present two tables with different rules (e.g., $y = x$ vs. $y = 2x$) and ask which has a steeper graph or grows faster.
9. Extend to word problems: apply table methods to real situations (e.g., cost tables, distance-time tables, growth tables) where finding the rule helps predict future values.
10. Backward reasoning: given an ordered pair and the rule, find the corresponding x value; or given a point on the table, find earlier or later points.

Core examples to model

- Completing a table: for $y = 3x$, if $x = 0, 1, 2, 3$, then $y = 0, 3, 6, 9$. The differences are all $+3$. The graph rises steeply.
- Finding the rule: given the table with $(0, 1), (1, 3), (2, 5), (3, 7)$, identify the differences: $3 - 1 = 2$, $5 - 3 = 2$, $7 - 5 = 2$. So the rule is $y = 2x + 1$.
- Predicting the next point: from a table $x : 1, 2, 3, 4$ and $y : 4, 5, 6, 7$, the differences are constant ($+1$), so the next point is $(5, 8)$.

- Graph direction: table with $y = 5 - x$ gives points $(0, 5)$, $(1, 4)$, $(2, 3)$, $(3, 2)$. Differences are -1 (negative), so the graph falls from left to right.
- Comparison: table for $y = x$ (differences $+1$) grows slower than $y = 2x$ (differences $+2$), so the second graph is steeper.
- Backward reasoning: if the rule is $y = x + 6$ and the point is $(1, 7)$, work backwards to find $(0, 6)$, $(-1, 5)$, etc.
- Word problem: a shop sells apples at $2 per apple. The rule is cost $= 2 \times$ number. A table shows the cost for 0, 1, 2, 3 apples: 0, 2, 4, 6. The constant difference of $+2$ means the cost rises steadily.

Watch for

- Arithmetic errors in completing tables: students may make calculation mistakes when applying the rule. Encourage them to check their work by verifying that differences are consistent.
- Confusing x and y: emphasise that x is the input (independent variable) and y is the output (dependent variable).
- Not recognizing constant differences: students may fail to identify the pattern in differences, leading to incorrect predictions. Always ask them to find and check the difference.
- Misinterpreting graph direction: some students may incorrectly predict whether a graph rises or falls without checking whether differences are positive or negative.
- Writing the rule incorrectly: guide students to check by substituting values back into their proposed rule.
- Treating all rules as linear: some tables may have non-constant differences (quadratic or other), but foundation students should focus only on linear relationships.
- Not connecting table to graph: help students see that a table is data points, and plotting them shows the shape of the graph.

Checks for understanding

- Can students complete a table by applying a given rule to multiple x values?
- Can they read ordered pairs from a completed table?
- Can they identify the constant difference in a table?
- Can they predict the next point in a sequence by using the constant difference?
- Can they determine whether a graph rises or falls by examining differences in a table?
- Can they discover the rule connecting x and y from a table?
- Can they convert between a rule, a table, and ordered pairs?
- Can they explain the relationship between the constant difference and the slope of the graph?
- Can they apply tables to solve problems involving real-world linear relationships?