Just In Time Quick Check

Standard of Learning (SOL) 5.18

Strand: Patterns, Functions, and Algebra

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The student will identify, describe, create, express, and extend number patterns found in objects, pictures, numbers, and tables.

Grade Level Skills:

- Identify, create, describe, and extend patterns using concrete materials, number lines, tables, or pictures.
- Describe and express the relationship found in patterns, using words, tables, and symbols.
- Solve practical problems that involve identifying, describing, and extending single-operation input and output rules (limited to addition, subtraction and multiplication of whole numbers; addition and subtraction of fractions, with denominators of 12 or less; and addition and subtraction of decimals expressed in tenths or hundredths).
- Identify the rule in a single-operation numerical pattern found in a list or table (limited to addition, subtraction and multiplication of whole numbers; addition and subtraction of fractions, with denominators of 12 or less; and addition and subtraction of decimals expressed in tenths or hundredths).

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Just in Time Quick Check Teacher Notes

Supporting Resources:

- VDOE Mathematics Instructional Plans (MIPS)
  - 5.18 – Number Patterns: How Do They Grow? (Word) / PDF Version
- VDOE Algebra Readiness Formative Assessments
  - SOL 5.18 (Word) / PDF
- VDOE Algebra Readiness Remediation Plans
  - Determine the Rule (Word) / PDF
  - Number Patterns and Rules (Word) / PDF
- VDOE Word Wall Cards: Grade 5 (Word) | (PDF)
  - Patterns

Supporting and Prerequisite SOL: 5.4, 5.5b, 5.6a, 4.4b, 4.5b, 4.6a, 4.15, 3.3a, 3.4b, 3.4d, 3.5, 3.16

SOL 5.18 - Just in Time Quick Check

1) A number machine uses a rule to change input numbers to output numbers. The table shows the results:

Input	Output
4	7
5	8
6	9
8	?

What is the rule?
Based on the rule, what is the missing number in the table?

2) What is the 6th term in the pattern?

5, 10, 20, 40 …

3) The list forms a pattern that follows a rule.

$$\frac{1}{8}, \frac{3}{8}, \frac{5}{8}, \frac{7}{8}, \dots$$

What is the rule?
Based on the rule, what would be the next two numbers in the pattern?
Create a pattern of your own that follows the same rule.

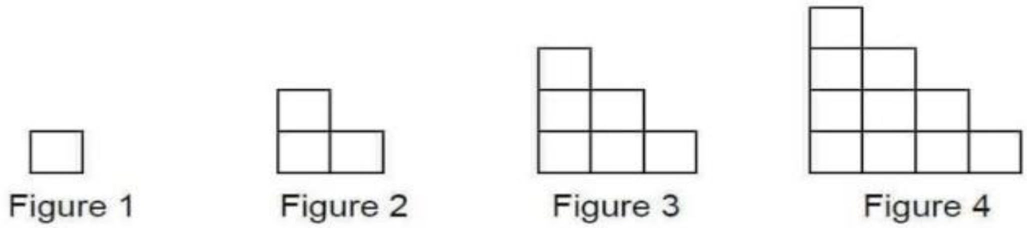
4) A number machine uses a rule to change input numbers to output numbers. The table shows the results:

Input	Output
8.0	7.5
5.5	5.0
?	3.5

Input	Output
2.0	1.5

What is the rule?
Based on this rule, what is the missing number in the table?

5) The figures below form a pattern. The pattern continues in the same way. How many squares are needed to make Figure 7?



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Common Errors/Misconceptions and their Possible Indications

1) A number machine uses a rule to change input numbers to output numbers. The table shows the results:

Input	Output
4	7
5	8
6	9
8	?

What is the rule?
Based on this rule, what is the missing number in the table?

A common misconception some students may have is to look for a relationship between the input numbers in the table rather than the relationship between input and output numbers. For example, in the input column (4, 5, 6) students may think each number is being increased by one. In the output column, students see 7, 8, 9, and think the next number in the table should be 9+1 = 10. It may be beneficial to help students look for the relationship between 4 and 7, 5 and 8, etc. Students often jump to conclusions without testing the generalization for all of the given data. Guide students to consider if their theory holds true with the final number in the table (8). Remind students that in order to be considered a rule, the relationship must hold true for all of the data provided.

2) What is the 6th term in the pattern?

5, 10, 20, 40 …

A common misconception for students is to disregard the term being asked about in the question. Students will often correctly generate the next term in the sequence (80), rather than the term the question asks them to find. Tools such as highlighters and drawing spaces and counting the number of terms can be helpful to redirect attention to the details of the question.

Students may also determine a rule by only looking at the relationship between one pair of values. For example, adding 20 would work between 20 and 40, so students may incorrectly determine the next numbers in the pattern are 60, 80, and so on. Remind students to determine the rule between all of the pairs of values. Modeling how to make notations on paper to show thinking would be beneficial.

Students may confuse additive and multiplicative relationships between quantities. Help students to make the connection that adding a number to itself is the same thing as doubling. Doubling means the same thing as multiplying by 2.

3) The list below forms a pattern that follows a rule.

$$\frac{1}{8}, \frac{3}{8}, \frac{5}{8}, \frac{7}{8}, \ldots$$

What is the rule?
Based on this rule, what would be the next two numbers in the pattern?
Create a pattern of your own that follows the same rule.
Some students may have trouble determining the rule and the next two numbers in the pattern because they struggle to understand that a fractional part is added each time. Patterns with fractions require students to apply what they know about patterns and connect that knowledge to what they know about adding, subtracting, and simplifying fractions, as well as improper fractions and mixed numbers. Extending the pattern results in

fractions that are greater than one whole. This may be a concept that needs to be further explored if students have difficulty determining the next numbers in the sequence.

Students may have difficulty creating a pattern of their own that follows the same rule due to their lack of understanding of unit fractions. For example, they may create a pattern similar to the following:

$$\frac{1}{4}, \frac{3}{4}, \frac{5}{4}, \frac{7}{4}, \ldots$$

Students may have a misconception that the denominator must stay the same and the numerator must follow the pattern of 1, 3, 5, 7…etc. Fraction manipulatives and focusing on the operation between each fraction would be beneficial. Revisiting determining the rule for patterns with whole numbers may be necessary.

**Be on the lookout for students who make the connection between $\frac{2}{8}$ simplified as $\frac{1}{4}$. The understanding that fractions can be simplified could lead to additional errors if students do not simplify correctly or confusion if students do not have a solid understanding of fractional operations. Strategic sharing and discussion of student-created patterns facilitated by the teacher could provide opportunities for building connections and solidifying conceptual understanding of fraction basics.*

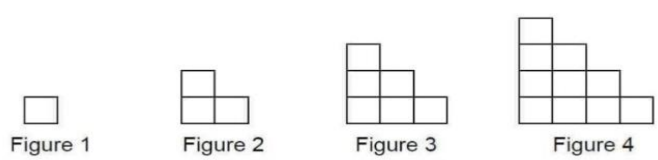
4) A number machine uses a rule to change input numbers to output numbers. The table shows the results:

Input	Output
8.0	7.5
5.5	5.0
?	3.5
2.0	1.5

What is the rule?
Based on this rule, what is the missing number in the table?

Students may incorrectly find a relationship between 8.5 and 5.5 – they may think they need to subtract 2.5 each time and not look at the relationship between input and output numbers. Students may also determine the rule as subtracting 0.5 but incorrectly determine the missing number to be 4.0 because they disregard the fact that they are determining the input, not output. Shifting their thinking to working backwards, knowing the rule is subtract 0.5 but to find the missing number 0.5 must be added, may be difficult for students.

5) The figures below form a pattern. The pattern continues in the same way. How many squares are needed to make Figure 7?



A common misconception some students may have is difficulty making the connection to what they know about patterns and applying that understanding to objects in a graphic. Because the question does not explicitly ask students to determine the rule, students may try to skip this step. It may be beneficial to break this problem down into a series of steps. Teachers may consider modeling how to show thinking on paper while solving, first *determining how many squares are in each figure and then determining how many squares are being added between Figure 1 and Figure 2, Figure 2 and Figure 3, Figure 3 and Figure 4.*

Some students may find the number of squares in Figure 5 or Figure 6, rather than the number of squares in Figure 7.

Students may also benefit from using manipulatives such as centimeter cubes or color tiles. Have students build Figure 1 and physically add the squares to the Figure using manipulatives. Have students draw each figure as they build it, making note of how many squares are added each time. Another option would be to have students color code the squares for each figure in the next figure so they can visually see the changes happening each time.

Transferring the numbers into an input/output table would help students make connections to previous work with patterns and provide them with an additional strategy to use when working with patterns containing objects in the future.