LESSON LEARNED

Focus: Understanding the Relationship Between Area and Perimeter

Nova Scotia Assessment: Mathematics Grade 6

“For learners to succeed, teachers must assess students’ individual abilities and characteristics and choose appropriate and effective instructional strategies accordingly.”
– Helene J. Sherman

Purpose of this Document

This Lessons Learned document was developed based on an analysis of the Item Description Reports for the Nova Scotia Assessment: Mathematics in Grade 6 (NSA-M6). This document is intended to support all classroom teachers at grades 3 - 6, and administrators at the school, region, and provincial levels. The focus of the document is to help educators work through the process of taking in the information provided by the data analysis and see how it can inform lesson design and assessment in the classroom.

It is suggested that school teams make use of this resource in concert with their school's Item Description Report provided by the Department of Education and Early Childhood Development to all regional centres for education. These reports include student achievement data at the school, regional centre, and provincial level for all questions appearing on the Mathematics in Grade 6 Assessment. By analyzing their own performance on groupings of questions dealing with similar outcomes, schools can identify areas of strength and areas where changes in instruction and/or assessment might be made. This process is designed to foster continued discussions, explorations, and support for mathematics focus at the classroom, school, regional centre, and provincial levels that are all based on valid and reliable data.

This document specifically addresses some of the areas that students across the province found challenging based on provincial assessment data. It is essential that teachers consider assessment evidence from a variety of sources to inform the next steps most appropriate for their students. Effective classroom instruction and assessment strategies are responsive to the individual learners within a classroom.

This document highlights those outcomes where students seem to require additional support. It provides some information about student performance on the assessment in addition to suggested classroom instruction strategies. Sample assessment items are included for each topic explored.

Overview of the Nova Scotia Assessment: Mathematics in Grade 6

Nova Scotia Assessments are large-scale assessments that provide reliable data about how well all students in the province are learning the mathematics curricula. It is different from many standardized tests in that all questions are written by Nova Scotia teachers to align with curriculum outcomes and the results reflect a snapshot of how well students are learning these outcomes. These results can be counted on to provide a good picture of how well students are learning curriculum outcomes within schools, regions and in the province. Since the assessments are based on the Nova Scotia curriculum, and are developed by Nova Scotia teachers, results can be used to determine whether the curriculum, approaches to teaching and allocation of resources are effective. Furthermore, because individual student results are available, these, in conjunction with other classroom assessment evidence, help classroom teachers understand what each student has under control and identify next steps to inform instruction.

The assessment provides information about mathematics for each student and complements assessment data collected in the classroom. This assessment is administered at the beginning of grade 6. It is designed to provide detailed information for every student in the province regarding their progress in achieving a selection of mathematics curriculum outcomes at the end of Grade 5. Information from this assessment can be used by teachers to inform their instruction and next steps in providing support and intervention for their students.

Lessons Learned Overview

Provincial assessments and examinations generate information that teachers can use to help inform classroom instruction and assessment. Following the analysis of each assessment or examination, patterns and trends are identified. These include areas of strength and areas for growth. The Lessons Learned documents specifically highlight concepts where growth is still needed.

There are six areas that have been identified as the areas of focus for this Lessons Learned document.

They are:

- Solving whole number multiplication and division questions in context
- Representing decimals
- Relating fractions and decimal
- Generalizing to extend patterns
- Understanding the relationship between area and perimeter
- Identifying and describing the attributes of objects and shapes

This section specifically addresses understanding the relationship between area and perimeter. It begins with an overview of the student errors and misconceptions identified through the provincial assessment. This includes the properties of perimeter and area and how they influence dimensions of shapes.

Strategies are then outlined that are designed to enhance student comprehension, drawing from researched best practices. The strategies emphasize the integration of essential models, tools, and interconnections to facilitate the transition between concrete, pictorial, and abstract representations of concepts, highlighted by the importance of deliberate planning and purposeful questioning. To support both assessment and instruction, sample lesson activities are presented alongside a series of cognitive-level questions, providing educators with ideas for addressing knowledge gaps and fostering strategic reasoning and problem-solving skills. Each section culminates with a selection of print and online resources, as well as recommended manipulatives to support professional learning and student understanding of that topic.

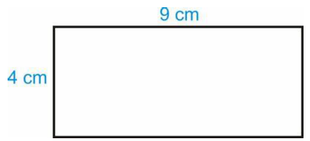
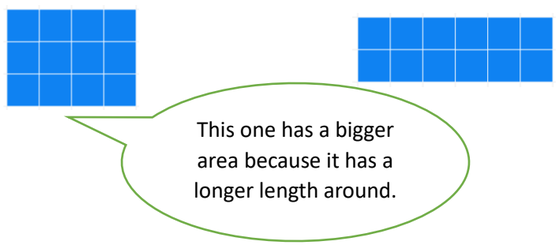
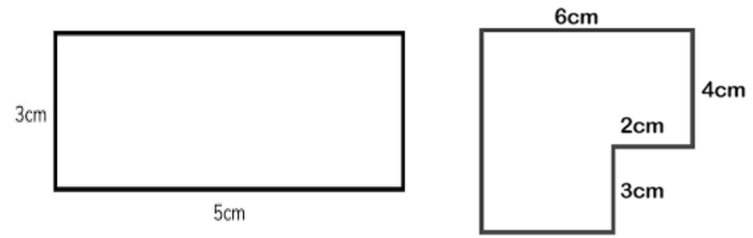
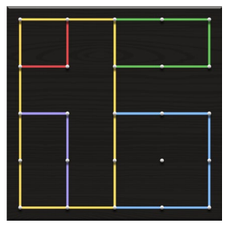
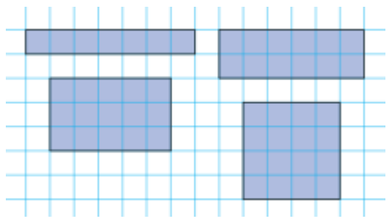
Understanding the Relationship Between Area and Perimeter

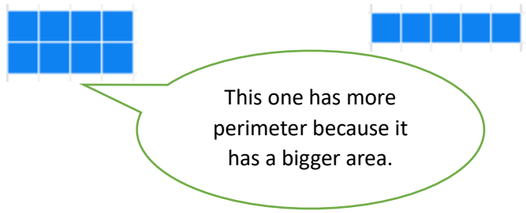
Alignment to previous Outcomes		Related Outcome	Alignment to upcoming Outcomes
3M05: Students will be expected to demonstrate an understanding of perimeter of regular, irregular, and composite shapes by estimating perimeter using referents for centimetre or metre (cm, m) measuring and recording perimeter (cm, m) create different shapes for a given perimeter (cm, m) to demonstrate that many shapes are possible for a perimeter	**4M03:** Students will be expected to demonstrate an understanding of area of regular and irregular 2-D shapes by: • recognizing that area is measured in square units • selecting and justifying referents for the units square centimetre (cm^2) or square metre (m^2) • estimating area using referents for cm^2 or m^2 • determining and recording area (cm^2 or m^2) constructing different rectangles for a given area (cm^2 or m^2) in order to demonstrate that many different rectangles may have the same area	**5M01:** Students will be expected to design and construct different rectangles, given a perimeter or an area or both (whole numbers), and make generalizations.	**6M03**: Students will be expected to develop and apply a formula for determining the • perimeter of polygons • area of rectangles • volume of right rectangular prism

What conclusions can be drawn from the NSA: Mathematics in Grade 6?

Perimeter and area are two key concepts in measurement. Assessment results show that students generally succeed in finding the perimeter and area of regular geometric shapes when all necessary measurements are provided. However, difficulties arise when some dimensions are missing, like what is seen in the grade 3 provincial assessment. In these cases, students often forget to account for unlabeled sides or struggle to calculate missing lengths. Students also experience challenges when estimating area and when solving problems that combine perimeter and area, particularly in application and analysis questions. For example, questions requiring the use of the relationship between perimeter and area to determine a missing dimension proved difficult. Additionally, students had limited success predicting how changes in a figure's shape would affect its perimeter or area while keeping one of these measures constant.

Why is this an area of need and how can we support students?

Properties of Perimeter and Area	
Misconceptions/Errors in Student Work	**Possible Next Steps in the Classroom**
A common error is students forgetting to include the measures of unlabeled sides. In the example below, the student has only added one of the lengths and one of the widths when determining the perimeter of the object.  P = 4 + 9 = 13 cm Some students may continue to focus on linear dimensions of an object to decide which has a greater area. This leads to them having a limited understanding that the area of a shape does not change if it is cut up and rearranged to make a different shape. In the example below, the student thinks the rectangles have different areas since their perimeters are different.  Or that the rectangles below have different perimeters when the areas are different.	Provide opportunities for students to practice their understanding of perimeter by giving them examples with unlabeled side lengths. This will also support problem solving with composite shapes. Before students begin to calculate the perimeter, encourage them to label any side lengths that do not already have labels. Discuss why these labels were not originally provided on the diagram. Emphasize that the perimeter is the entire distance around the shape. Examples of possible rectangles and composite shapes include the following:  It is important that students have many opportunities to construct rectangles of different areas and perimeters concretely and pictorially. Students should learn about area and perimeter together. Focus on: • the perimeter and area are two different but related concepts. • it is possible for rectangles of a certain area to have different perimeters. • it is possible for rectangles with the same perimeter to have different areas. • the closer the shape is to a square, the larger the area will be. • for any given perimeter, the rectangle with the smallest possible width will result in the least area. Have students develop a chart to observe these patterns between the areas and perimeters. Geo-boards or grid paper can be used to create various rectangles all with the same perimeter. Students should be working toward the realization that rectangles of different dimensions can have the same perimeter.  



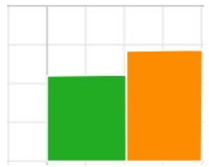
Full understanding has yet to be achieved in that rectangles of the same area can have different perimeters and that rectangles with the same perimeter can have different areas.

When provided with opportunities to estimate an area, some students ignore partial squares, while others describe the area of any partial square as one half. Further, students consider the sum of the areas of any partial squares to be 1 whole instead of the true value.

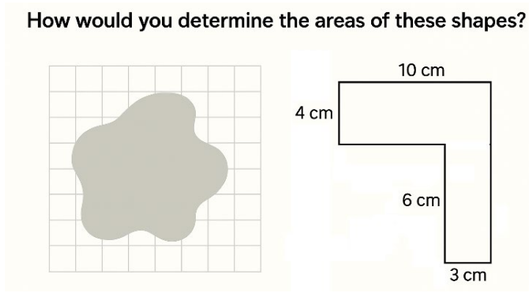
Many students struggle when asked to determine a missing dimension given a perimeter or area. When they only have opportunities to compute perimeter or area from provided dimensions, they often rely on memorized formulas without understanding what the numbers represent.

Students should also determine the area of each of these rectangles to understand that though each of these rectangles has the same perimeter, the area of each of the rectangles is different.

When estimating for area, students should be provided with opportunities that allow for areas that are different than 1 whole on a grid. Students can compare the areas of two rectangles like the one below. They should recognize that the areas are different.

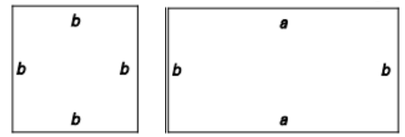


When determining area, students can track whole and partial squares and combine partial squares to make a whole. Experiences that ask students to develop their own approach to determine the area of irregular shapes should help to support an understanding of the area formula and square units.

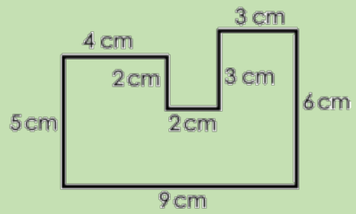
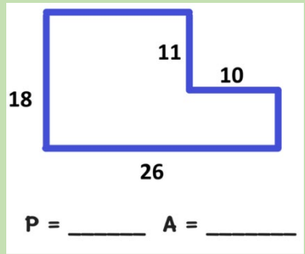
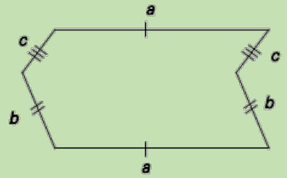
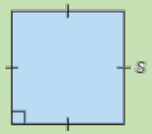
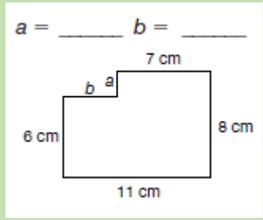


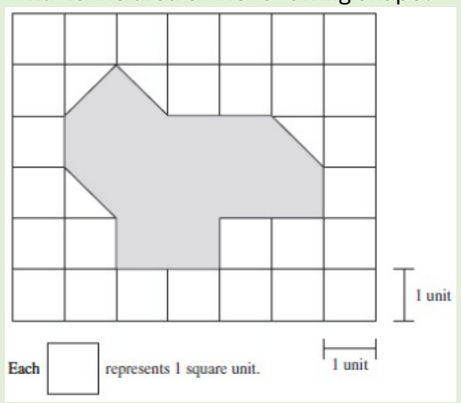
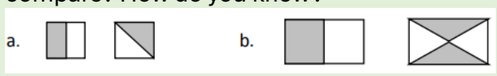
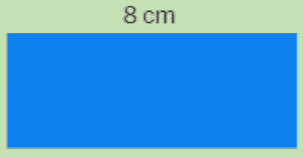
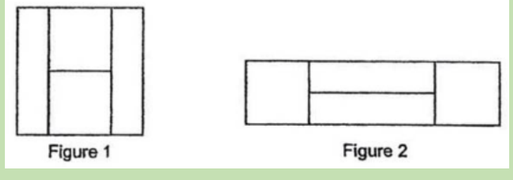
Solving for a missing dimension requires students to connect the perimeter procedure to the structure of the shape and recognize the relationships among length, width, area, and perimeter.

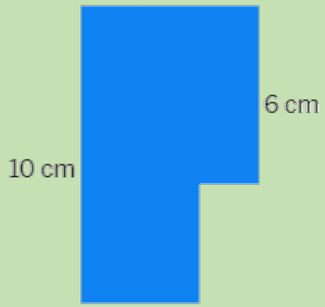
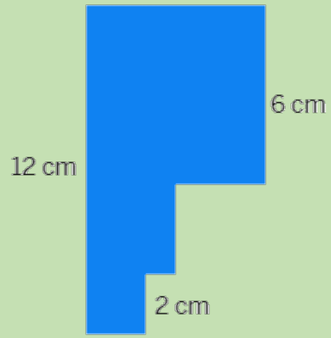
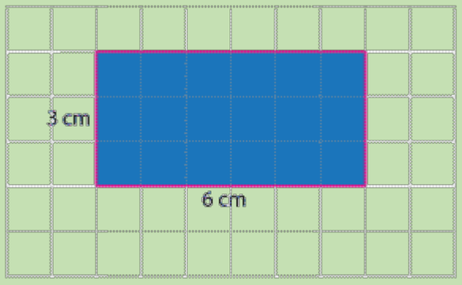
This type of problem also introduces inverse operations and early algebraic reasoning, promoting flexibility and problem-solving skills. Students learn that perimeter and area are related but not dependent in the same way (e.g., different shapes can share the same perimeter but have different areas). Beyond computation, students are expected to design shapes under given constraints, which deepens conceptual understanding. Providing tasks that involve analysis-level questions and optimization problems supports this growth and helps students develop a more robust understanding of measurement.

Sample Activities for Lesson Planning			
Grade 3	**Grade 4**	**Grade 5**	**Grade 6**
Draw 3 different rectangles with a perimeter of 12 cm. OR Draw 3 different shapes with the perimeter of 12 cm. OR Draw 3 different shapes with a perimeter of 12 cm with at least one being a composite and/or irregular shape. Knowledge: What shapes did you draw? What are the side lengths? Application: What do you notice about the shapes you drew? How are they the same/different? How do they compare to others in the class? Analysis: How can you have different shapes with the same perimeter? Find different shapes in the classroom that have a perimeter of about 12 cm. How can you make sure they are about 12 cm? How do they compare?	Draw 3 different rectangles with an area of 12 cm^2. OR Draw 3 different shapes with an area of 12 cm^2. OR Draw 3 different shapes with at least one being a composite shape with an area of 12 cm^2. Knowledge: What shapes did you draw? What are the side lengths/dimensions? Application: What do you notice about the shapes you drew? How are they the same/different? How do they compare to others in the class? Analysis: How can you have different shapes with the same area? Find or build different shapes in the class with an area of about 12 cm^2. How can you make sure they are about 12 cm^2? How do they compare?	Ask students to draw a rectangle with not much area but a lot of perimeter. Knowledge: What are your dimensions? Why did you choose those dimensions? Application: How does your rectangle compare to those of your classmates? How do your dimensions differ? Analysis: Draw as many different rectangles as possible with an area of 12cm^2. What do you notice? When do you have the largest and smallest area/perimeter? Can you generalize your findings to your partner/class? Prove your conjecture (i.e., use a different area). Is this true for all rectangles?	Provide students with the following shapes.  Arrange the shapes to create various combinations of different composite shapes. Knowledge: In terms of the variables, what are the dimensions? Perimeters? Areas? Application: How do your dimensions, perimeters and areas compare to your classmates? What do you notice about the variables and operations used? Analysis: Generalize your findings to your partner/class? What is an efficient strategy to determine the perimeter of a polygon? Area of a polygon? How could you use this information to help you determine the volume of prisms?

What are some sample questions to help support assessment?

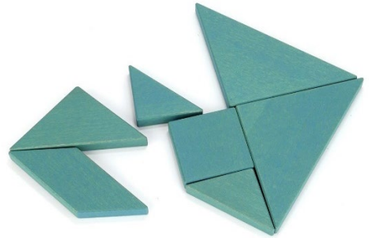
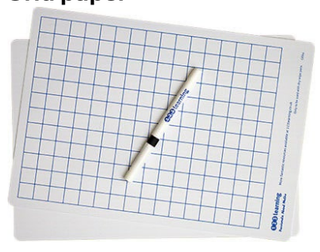
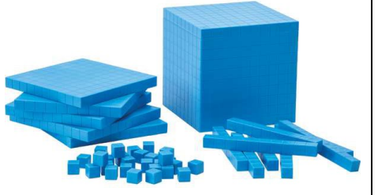
Cognitive Level	Grade 3	Grade 4	Grade 5	Grade 6
Knowledge	What is the perimeter of this shape?  A six-sided shape has a perimeter of 60 cm. Use centimetre grid paper to show what the shape looks like. Draw a shape with a perimeter of 12 cm.	What is the area of this shape?  Draw a polygon with an area of 12cm^2? Draw a rectangle with an area of 12cm^2?	Tom drew two rectangles, A and B. The dimensions of A are 3 cm by 4 cm. The dimensions of B are 2 cm by 5 cm. What can you say about their areas? Solve for the missing lengths, perimeter and area.  Use grid paper and draw a rectangle with an area of 14 cm^2 and a perimeter of 18 cm.	What is the expression for the perimeter of the shape below? Solve for the perimeter if a = 6 cm, b = 3 cm, and c = 2 cm.  A square has a side length *s*. Write a formula for the area of the square.  Determine the lengths of sides *a* and *b*. Solve for the perimeter and area. 

Application	Draw 3 different shapes with a perimeter of 12 cm. What do you notice? How can you estimate the perimeter of a playing card? What tools or personal referents could you use? Estimate and then measure. Compare your estimate and the measure. Is there something you could do differently next time? A rectangle has a perimeter that is about 5 times as long as one of its sides. What could the dimensions of the rectangle be? Use grid paper. Explain your thinking.	What is the area of the following shape?  How do the areas of the shaded sections compare? How do you know?  The area of a certain rectangle is 24 cm^2. Write the dimensions of three or more possible rectangles. On grid paper, draw the rectangles to show that each shape has the correct area.	The perimeter of a rectangular garden is 120 m. What are the possible measurements (length and width) of this garden? How do they compare? Which is the largest? Smallest? The area of a rectangle is 24 cm^2. What are the possible measurements of the dimensions of this rectangle? How do they compare? Which is the largest? Smallest? The area of rectangle A is twice the area of rectangle B. The perimeter of rectangle A is 20 units greater than the perimeter of rectangle B. What could the dimensions of the two rectangles be? Construct your rectangles to show you are correct.	A rectangular prism has a volume of 192 cm^3. The prism is 16 cm high. What is the area of its base? What are possible dimensions of the area of its base? The top of your desk measures 68 cm long and 50 cm wide. What is the area of your desk? If you are working on a puzzle that measures 2500 cm^2 when complete, will it fit? What are the dimensions of the puzzle? Using grid paper, show that a taller rectangle can have less area than a shorter one.
Analysis	What are the missing side lengths if the perimeter is 26 cm?  	You cut a square piece of paper measuring 12 cm in length into 2 square pieces and 2 rectangular pieces as shown in figure 1. You arrange the pieces to form a large rectangle as shown in figure 2. What is the perimeter of the large rectangle in figure 2?  	Mr. MacDonald wants to construct an enclosed rectangular kennel for his dog. The perimeter of the kennel is 20 m. One side of the kennel will be the wall of the house. The kennel must have the biggest possible area. What is the area of the kennel? The perimeter of a rectangular wall is 12 m. Its width is 2 m. What is the area of the wall?	A teen mowed two lawns. One lawn was 10 m × 12 m, and the other was 15 m × 10 m. The teen charges $3 for each 10 m^2. How much did she charge to mow the two lawns?

	The figure below is made up of two squares. What is the perimeter of the composite shape?  A rectangle's perimeter is greater than 10 cm. What do you know about the length and width of the rectangle?	The area of a rectangular carpet is 18 m^2. What is the largest perimeter of the rectangular carpet? Construct a polygon with more than five sides and an area between 20 cm^2 and 30 cm^2. Explain how you know the area of your polygon is correct. What is a reasonable estimate for the area of a paper plate? How do you know?	When might you care more about knowing the area of something than about its perimeter? When might you care more about knowing the perimeter of something than about its area? When might you need to know both the area and the perimeter of something? What is a reasonable estimate for the area of a local ice rink? How do you know?	The figure below is made up of three squares. What is the area of the composite shape?  A rectangle with a length of 6 cm and a width of 3 cm is shown below.  If you double the length and the width, what happens to the area?

Supporting Resources

Manipulatives and Models to Support Learning

Geoboards	Square tiles	Pattern Blocks	Tangrams	Grid paper	Base-ten blocks
					

Print and Electronic Resources

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