LESSON LEARNED

Focus: Identifying and Describing the Attributes of Objects and Shapes

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 identifying and describing the attributes of objects and shapes. It begins with an overview of the student errors and misconceptions identified through the provincial assessment. This includes aligning geometric vocabulary with corresponding attributes.

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.

Identifying and Describing the Attributes of Objects and Shapes

Alignment to previous Outcomes		Related Outcome	Alignment to upcoming Outcomes
3G01: Students will be expected to describe 3-D objects according to the shape of the faces and the number of edges and vertices. **3G02:** Students will be expected to name, describe, compare, create, and sort regular and irregular polygons, including triangles, quadrilaterals, pentagons, hexagons, and octagons according to the number of sides.	**4G01:** Students will be expected to describe and construct rectangular and triangular prisms.	**5G01:** Students will be expected to describe and provide examples of edges and faces of 3-D objects, and sides of 2-D shapes that are parallel, intersecting, perpendicular, vertical, and horizontal.	**6G01:** Students will be expected to construct and compare triangles, including scalene, isosceles, equilateral, right, obtuse, or acute in different orientations.

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

Students had difficulty when asked to draw upon their previous knowledge of shapes to assist them in their identification and descriptions of prisms and pyramids. Students require more experiences to identify and name common attributes between prisms such as parallel and perpendicular sides. Likewise, know what attributes make pyramids different from prisms. In doing so, be able to sort a given set of objects. Students need to be able to identify examples of shapes and objects in their environment. While students are more successful with knowledge type questions, they do require more exposure and experience with varied types of cognitive levels of questioning (knowledge, application, and analysis) to apply their higher order thinking skills when working with all geometry concepts.

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

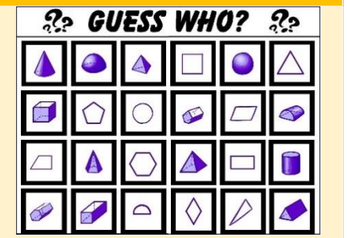
Aligning Vocabulary with Attributes	
Misconceptions/Errors in Student Work	**Possible Next Steps in the Classroom**
A common error or misconception that students encountered was identifying parallel and perpendicular faces of given objects. Students seem to be unfamiliar with the meaning of the vocabulary related to parallel and perpendicular and potentially experience working with different types of objects. This has resulted in students misidentifying objects that have perpendicular faces or parallel faces. For example, indicating that a pyramid has perpendicular and/or parallel faces or that a cylinder does not have parallel faces. In addition, a common error is relating the shapes they see in 2D like circles, rectangles, triangles, and squares to that of a prism rather than other objects like a cylinder or pyramids. This may be because students have not had enough experience working with different objects and talking about the various attributes of objects to be able to internalize what it looks like from different perspectives. This is evident when students associate faces with a shape rather than an object. For example, an object with rectangular faces is identified as a rectangle rather than a rectangular prism. ***Please note that while students investigate attributes of polygons, such as side lengths and vertices in P – 5, they will build on these experiences in Mathematics 6 as angles and other properties are investigated in greater depth. Students should continue to deepen their understanding and strengthen their skills in identifying, describing and sorting as they explore triangles.***	While the language of geometry is important, the teaching of mathematically correct geometric language should be done in the context of physical models rather than as definitions. It is important to note that students' ability to conceptualize shapes and objects develops through different stages, and that this development is fostered through many opportunities to visualize and analyse various shapes and objects. **Shapes /Polygons** Students should be provided with opportunities to draw upon their previous knowledge of shapes/polygons to assist them developing more detailed ways to describe objects. This can involve students comparing the number of sides as the key attribute for classifying polygons. Students should be able to name the specific polygons—triangle, quadrilateral, pentagon, hexagon, and octagon. Provide students with various sizes of a polygon. Have students count the number of sides and identify the polygon. Having a variety of these experiences with different polygons, students should begin to realize that a polygon, regardless of its dimensions, remains the same shape. Use geoboards to create irregular polygons. Students should start to generalize the characteristics that distinguish between various polygons. **Objects** There is a developmental sequence associated with how students think and reason geometrically. As levels of geometric thinking develop, students will notice more attributes of objects. Opportunities where students can investigate the faces and edges of objects will help students to construct their own understanding and make connections that make prisms and pyramids. Another way to have students explore the edges and faces of objects is to have them work in small groups construct various shapes and put them together to form prisms and pyramids. This can be done by stacking pattern blocks or using materials that lend themselves to skeletal models. Challenge students to build shapes with a certain number of edges, faces, and vertices. Determine what objects are possible or not possible. After students have constructed the objects, discuss the following questions: • Which solid has the most parallel faces? • Which solid has the least number of edges? • Which solids has only two parallel faces? • Which solids have eight intersecting edges? • Which solid has four sets of parallel faces?

Sample Activities for Lesson Planning

Lead a discussion that will have students describe shapes and/or objects using grade appropriate vocabulary and shapes/objects.
Then, have students work in pairs.

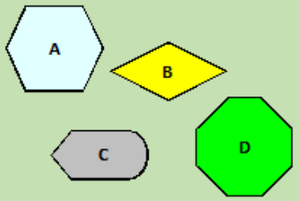
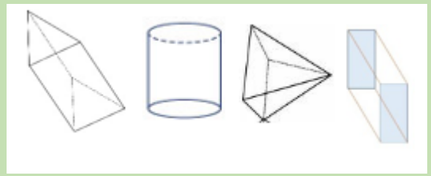
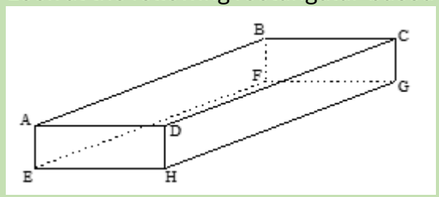
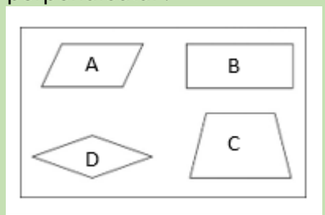
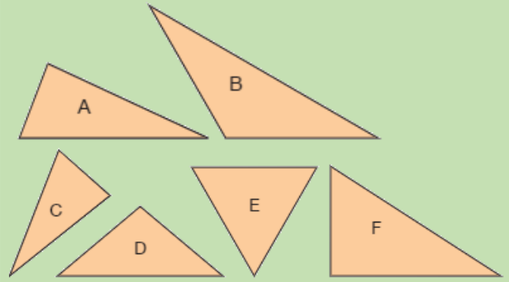
Without showing it to their partner, one student chooses a geometric shape/solid and describes it according to its attributes. The second student then tries to identify the shape/solid. Once the shape/solid is identified, students switch roles.

For grade 6 regarding triangles, discuss the vocabulary after students have investigated side lengths and angles using a sorting exercise.



Grade 3	Grade 4	Grade 5	Grade 6
Knowledge: Provide images of a series of regular and irregular shapes and/or objects from the real world. Have students identify the shapes and/or objects and list the common attributes. Application: Create/Draw an image using the following shapes: quadrilaterals, triangles, and circles. The image must also include at least three shapes that have 5 or more sides. OR Sort a series of objects. Have a partner identify the sorting rule. Switch. Have a partner sort a series of objects and you need to identify the sorting rule. What is similar / different about each sorting rule? What objects were included together or apart in both and why? Analysis: Build a tower that includes 9 vertices, 16 edges and 9 faces. What shapes and objects have you used for the tower? How would the tower change if you had 10 vertices? What shapes and objects would be used for this tower?	Knowledge: Provide images of a series of triangular and rectangular prisms from the real world. Have students identify the objects and list the common attributes. Application: Sort a series of objects that include triangular and rectangular prisms. Have a partner identify the sorting rule. Switch. Have a partner sort a series of objects and you need to identify the sorting rule. What is similar / different about each sorting rule? What objects were included together or apart in both and why? Analysis: Build a tower that includes at least one triangular prism and one rectangular prism. What shapes have you used for the tower? How would the tower change if you had more rectangles and triangles or vice versa? What shapes and objects would be used for this tower? Create your own tower and compare it to your partner's tower.	Knowledge: Provide images of a series of regular and irregular shapes and/or objects from the real world. Have students identify the shapes and/or objects and list the common attributes. Application: Sort a series of objects based on the edges and faces in terms of parallel, intersecting, perpendicular, vertical, and horizontal. Have a partner identify the sorting rule. Switch. Have a partner sort a series of objects and you need to identify the sorting rule. What is similar / different about each sorting rule? What objects were included together or apart in both and why? Analysis: Build a tower that includes 3 objects. One object has parallel faces, another has perpendicular edges and the third only has triangular faces. What objects and shapes have you used for the tower? How would the tower change if you built the tower with objects that had different faces or edges? What shapes and objects would be used for this tower?	Knowledge: Provide images of a series of triangles either drawn on a piece of paper or of images from the real world. Have students sort the triangles first according to the length of the sides and explain their sorting rule. Repeat having them sort the triangles according to the measures of the angles and explain their sorting rule. What do you notice about your sorting? Are the triangles sorted in the same way? Application: Draw an image using the following shapes: quadrilaterals, triangles, and circles. The following triangles must be used: scalene, isosceles, equilateral, right, obtuse, or acute. Analysis: Create a Mandala art on a piece of paper. The Mandala art must include at least one of each triangle: scalene, isosceles, equilateral, right, obtuse, and acute in different orientations. You must also include up to 4 different shapes that have sides that are parallel and/or perpendicular. The final design must have at least two lines of symmetry. How does your design differ from a partner? What decisions did you have to make with your design to meet all of the criteria?

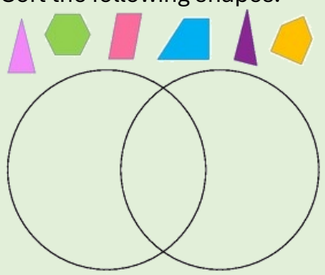
What are some sample questions to help support assessment?

Cognitive Level	Grade 3	Grade 4	Grade 5	Grade 6
Knowledge	Which figure is **not** a polygon?  Which shape is a quadrilateral? Pentagon? Hexagon?  What faces do you have on a cylinder, a cone, and a cube? What shapes do you see in this image? 	Name the prisms that best represents the following items: - Book - Chocolate bar - Number cubes - Roof - Slice of cake - Playing card - Tent Circle all the rectangular prisms.  	Which of these objects **does not** have parallel faces?  Look at the following rectangular-based prism.  Identify the parallel and perpendicular faces and edges. Which quadrilateral has two sides that are perpendicular?  	Identify the following triangles as acute, obtuse, or right and equilateral, isosceles or scalene.  What are the different ways you can sort triangles? What makes triangles congruent?

Application

What makes a cone different from a cylinder and different from a cube?

Sort the following shapes.



What is your sorting rule?

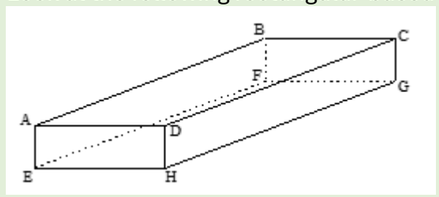
Sort the following objects in two different ways. Which objects have you included in the same groups both times and which ones are different? What makes both sorting rules the same or different?

What makes triangular prisms different from rectangular prisms? Can a triangular prism be a pyramid?

Sort the following objects in two different ways (below are examples of real-life objects that can be used for triangular and rectangular prisms). Which objects have you included in the same groups both times and which ones are different? What makes both sorting rules the same or different?

Construct the net of triangular prism and a rectangular prism. What makes them the same? Different? Use the correct vocabulary.

Look at the following rectangular-based prism.



Write a statement that is true about the faces and the edges. Write a statement that is false.

Construct a pyramid and a prism using toothpicks and plasticine. Compare the objects and describe the attributes shared by and that differ between both objects. Share your results with a partner. Do your findings differ?

What is the common attribute shared by the following objects?

What is a common attribute shared by the following shapes?

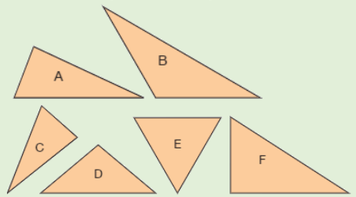
Construct the following triangles:

- an obtuse triangle with an angle of 130°
- a triangle with 3 cm and 4 cm sides that form a right angle
- an equilateral triangle with 10 cm sides
- an obtuse triangle with a 110° angle and one 5 cm side

Could you draw another one of each of the triangles with the same characteristics?

An isosceles triangle has one angle that measures 12°. Find the measures of the unknown angles.

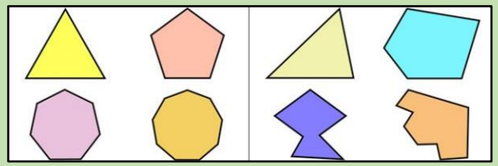
Sort the following triangles using a Venn diagram with 2 loops. Do any of the loops overlap? Sort them again using 3 loops. Do any of the loops overlap?



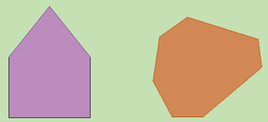
Can an obtuse triangle be an equilateral triangle? Explain.
Can a right triangle be an isosceles triangle? Explain.

Analysis

These shapes have been sorted. What is the sorting rule?



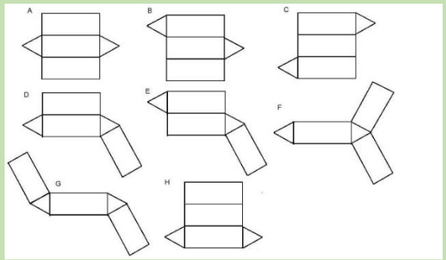
Where would you place the following shapes for sorting.



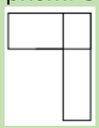
These objects have been sorted. What is the sorting rule?

If you had to add the objects below, where would you place them.

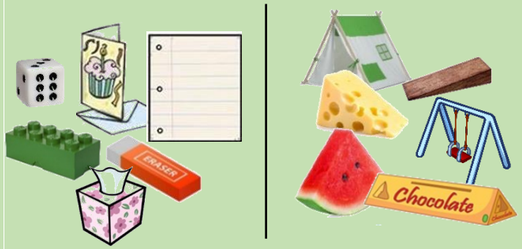
Which of the nets below could you use to create a triangular prism? Justify your selection.



This diagram is part of a net for a rectangular prism. Complete the net.



These objects have been sorted. What is the sorting rule?



If you had to add the objects below, where would you place them? Why?

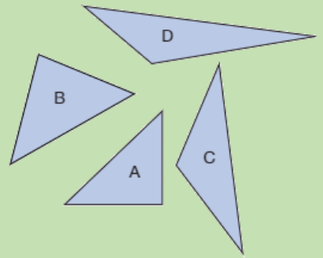
Do all pyramids share the same common attributes? Do all prisms share the same common attributes?

Construct two different objects that have parallel faces and intersecting edges. What other attributes does this object have? Compare the similarities and differences between the objects.

Can a student draw a triangle ABC that has a side length AB of 4.2 cm, angle A = 90° and angle B = 95°? How do you know?

One side of an obtuse triangle is 20 cm. What could be the values of the lengths of the other two sides? What could they not be?

A student drew the following triangles. Can the following conclusion be made: “All triangles must have at least two acute angles.” Why or why not?



Matina was organizing an activity with triangles. She sorted triangles, then placed them in 3 envelopes labelled A, B, and C. Each envelope contains one type of triangle: equilateral, isosceles, or scalene. Which type of triangle is in each envelope.

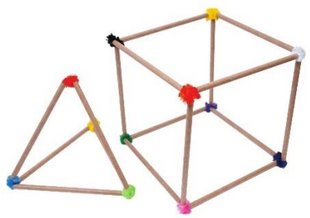
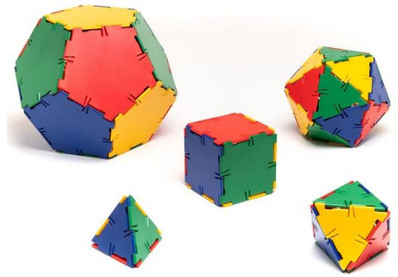
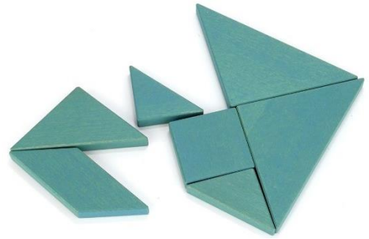
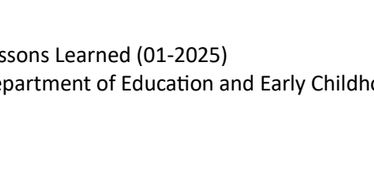
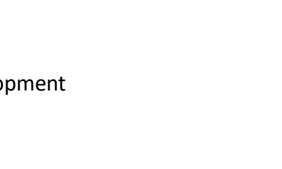
Clues:

- Envelope B does not contain any regular polygons.
- Envelope A has some right triangles.

All the triangles in envelopes A and C have a line of symmetry.

Supporting Resources

Manipulatives and Models to Support Learning

Pattern Blocks 	**Straws and Pipe Cleaners** 	**Objects/Blocks** 	**Polydrons** 	**Tangrams** 
Geoboards 	**Miras** 	**Linking Cubes**	**Ruler**	**Measuring Tape**

Print and Electronic Resources

(n.d). *Tasks*. Tasks Archive - YouCubed (retrieved Sept. 2023).

Bay-Williams, Jennifer M, et al. (2021). *Figuring out Fluency in Mathematics Teaching and Learning, Grades K-8: Moving beyond Basic Facts and Memorization*. Thousand Oaks, California, Corwin.

Cameron, Antonia. (2020). *Early Childhood Math Routines: Empowering Young Minds to Think*. Portsmouth, New Hampshire, Stenhouse Publishers.

Costello, D. (2021), *Making Math Stick: Classroom strategies that support the long-term understanding of math concepts*. Markham, ON: Pembroke Publishers.

Department of Education and Early Childhood Development (EECD), Province of Nova Scotia (2013). Mathematics 3 Curriculum Guide. Halifax, NS: Author.

Department of Education and Early Childhood Development (EECD), Province of Nova Scotia (2014a). Mathematics 4 Curriculum Guide. Halifax, NS: Author.

Department of Education and Early Childhood Development (EECD), Province of Nova Scotia (2014b). Mathematics 5 Curriculum Guide. Halifax, NS: Author.

Department of Education and Early Childhood Development (EECD), Province of Nova Scotia (2014c). Mathematics 6 Curriculum Guide. Halifax, NS: Author.

Fiore, Mary, and Maria Luisa Lebar. (2016). *The Four Roles of the Numerate Learner*. Pembroke Publishers Limited.

Marks Krpan, C., (2017), *Teaching Math with Meaning Cultivating Self-Efficacy Through Learning competencies, Grades K - 8*. Toronto, ON: Pearson Education Canada. (Chapters 5 and 6 – Communication and Thinking)

Moss, J., Bruce, C., Caswell, B., Flynn, T., Hawes, Z. (2016). *Taking Shape: Activities to Develop Geometric And Spatial Thinking*. Pearson Canada Inc.

Newton, Nicki. (2021). *Guided Math in Action: Building Each Student's Mathematical Proficiency with Small-Group Instruction*. London, Routledge.

Parrish, S., (2010), Number Talks Helping Children Build Mental Math and Computation Strategies. Portsmouth, NH: Heinemann.

SanGiovanni, John. (2018). *Mine the Gap for Mathematical Understanding, Grades 3-5*. Corwin Press.

SanGiovanni, John, and Jennifer Rose Novak. (2018). *Mine the Gap for Mathematical Understanding Common Holes and Misconceptions and What to Do about Them*. Thousand Oaks, California, Corwin, a SAGE Company.

Small, M. (2009). *Making mathematics meaningful to Canadian students, K–8*. Toronto, ON: Nelson Education Ltd.

Small, M (2012). *Eyes on Math: A Visual Approach to Teaching Math Concepts*. Toronto, ON: Nelson Education Ltd.

Van De Walle, J.A. (2001). *Elementary and middle school mathematics teaching developmentally fourth edition*. New York, NY: Addison Wesley Longman.

Van de Walle, J.A. and Lovin, L. (2006). *Teaching student-centered mathematics grades 3–5*. Boston: Pearson Allyn & Bacon