LESSON LEARNED

Focus: Identifying and Sorting Irregular Polygons

Nova Scotia Assessment: Mathematics Grade 3

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

NOVA SCOTIA

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 3 (NSA-M3). This document is intended to support all classroom teachers at grades Primary – 3, 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 3 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 3

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 end of Grade 3. 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 3. 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 four areas that have been identified as the areas of focus for this Lessons Learned document. They are:

- Solving whole number addition and subtraction questions in context.
- Linear measurement.
- Identifying and sorting irregular polygons.
- Interpreting data represented in tables and graphs.

This section specifically addresses identifying and sorting irregular polygons. It begins with an overview of the student errors and misconceptions identified through the provincial assessment. This includes:

- Developing schema alongside attribute vocabulary

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.

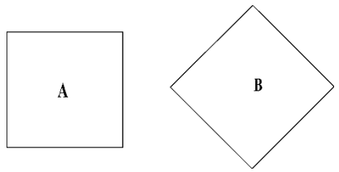
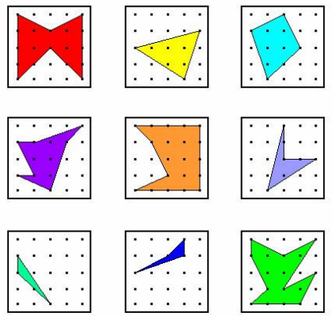
Identifying and Sorting Irregular Polygons

Alignment to previous Outcomes			Related Outcome
PG01: Students will be expected to sort 3-D objects using one attribute. **PG02:** Students will be expected to build and describe 3-D objects.	**1G01:** Students will be expected to sort 3-D objects and 2-D shapes using one attribute and explain the sorting rule. **1G02:** Students will be expected to replicate composite 2-D shapes and 3- D objects. **1G03**: Students will be expected to identify 2-D shapes in 3-D objects.	**2G03:** Students will be expected to recognize, name, describe, compare and build 2-D shapes, including triangles, squares, rectangles, and circles.	**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.

What conclusions can be drawn from the NSA: Mathematics in Grade 3?

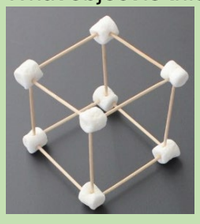
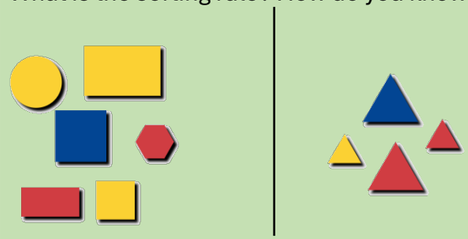
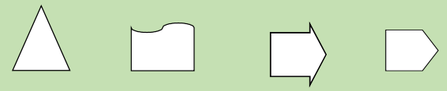
Students need to continue developing their knowledge of shapes by describing and sorting them according to their geometric attributes. Over half of the students had difficulty sorting and classifying irregular shapes. They need to focus on comparing the number of sides as the key attribute for classifying polygons. Students need more experience with irregular polygons, so that they begin to realize that a polygon, regardless of its dimensions, or position in space, remains the same shape. Vocabulary is also important as it associates with common shapes. For example, when students were asked to determine the perimeter of a polygon when the image was not provided, over half of the students responded incorrectly.

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

Developing Schema alongside Attribute Vocabulary	
Misconceptions/Errors in Student Work	**Possible Next Steps in the Classroom**
Some students incorrectly believe that the orientation of a geometric figure, changes the figure itself. Students recognize that shape A is square but think that shape B is not a square.  Unfamiliarity with irregular shapes and their names also pose difficulty for students in identifying and comparing the shapes. Common attributes are difficult to identify. For example, students misidentify the following are all pentagons. 	Provide students with various sizes of a polygon. Have students count the number of sides and identify the polygon. By 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. Some examples include:  Students should also find examples of polygons in the world around them. Sort the shapes according to the number of sides as the key attribute for classifying polygons. This can also be turned into a game where pairs of students must guess a sorting rule. Venn diagrams or Carroll diagrams may be used to help with the sorting.

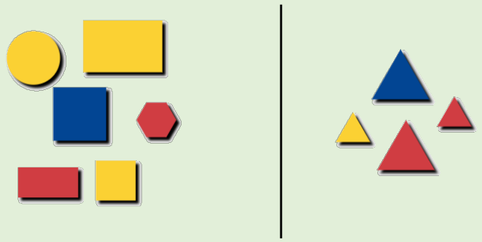
Activities to Support Lesson Planning			
Opportunities for students to look at, touch, compare, and create various types of regular and irregular polygons and objects supports the development of an understanding of the 2D shapes and 3D objects in the world around us. Simple search and find activities, building blocks and construction activities, along with drawing activities that include specific polygons helps in engaging students with the attributes and vocabulary of shapes and objects.			
Grade P	**Grade 1**	**Grade 2**	**Grade 3**
Knowledge: Have students identify objects around the classroom or in nature that resemble a specific given object (e.g., cylinder, cone, sphere, cube). Ask, for example, what makes it a cube? Application: Sort the objects into two groups. What is the sorting rule? What makes the objects the same/different? Analysis: Play eye-spy: I see an object that has 5 faces. What is it?	Knowledge: Identify/Draw all the shapes you see on this prism. Application: Sort the following objects/shapes using your own sorting rule. What is the rule? How are the objects/shapes the same/different? Analysis: A certain object is made up of 2 squares. What could it be?	Knowledge: Provide images of a series of regular and irregular shapes from the real world. Have students identify the shapes. Application: Provide students with two objects/shapes (e.g., cube and triangular prism or square and rectangle). How are these prisms/shapes different? How are these prisms/shapes the same? Analysis: Copy this shape (e.g., square). Draw a shape that is different from the shape in one way, but the same in another way. How are they different? How are they alike?	Knowledge: Provide images of a series of regular and irregular shapes from the real world. Have students identify the shapes. Application: Create 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. Analysis: Using tangrams or pattern blocks, create a large square. Create a shape with at least one triangle and one quadrilateral. What do you call this shape?

What are some sample questions to help support assessment?

Cognitive Level	Grade P	Grade 1	Grade 2	Grade 3
Knowledge	Sort the objects.  What object is this called? How do you know? 	What is the sorting rule? How do you know?  Construct a triangular prism. What shapes did you combine to make your prism?	Name and describe the shapes you see in the diagram.  Construct a diagram using the following shapes: circle, square, rectangle and triangle.	Which shape is a quadrilateral? Hexagon? Name the other shapes?  Which figure is not a polygon? 

Application

What is the sorting rule? How do you know?

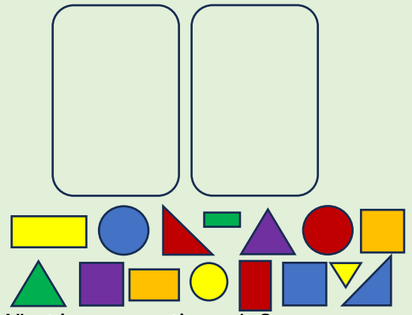


Construct a triangular prism. What shapes did you combine to make your prism?

Cut out the following images. Sort them. Have a partner determine your sorting rule. Switch.

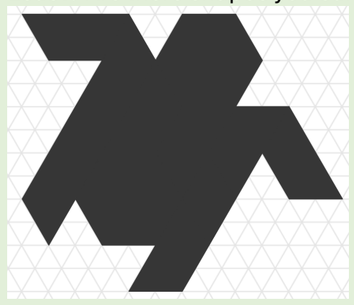
Construct a house using toothpicks and marshmallows. What shapes did you construct/combine to build your house? How many different shapes did you construct?

Sort the following shapes.

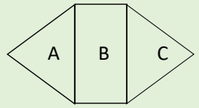


What is your sorting rule?

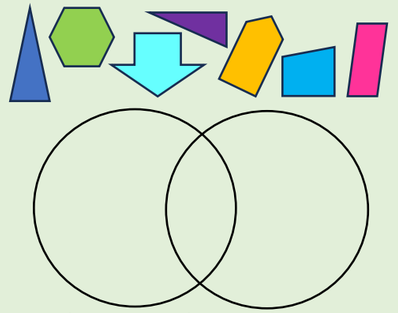
Fill in the image using pattern blocks. What shapes are you using to fill in the image? Can you recreate it using different shapes? What would be the shape you would use the most? Least? Are there shapes you cannot use? Why?



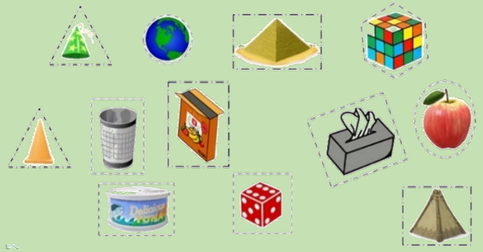
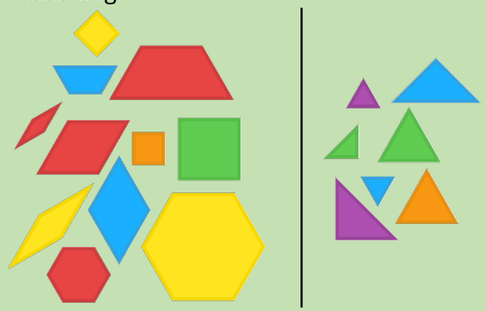
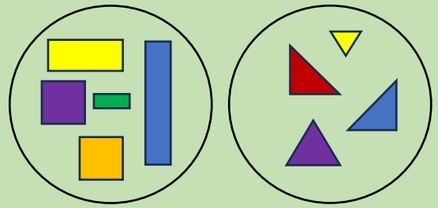
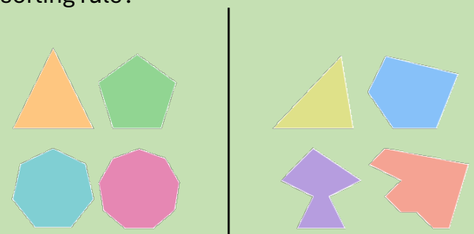
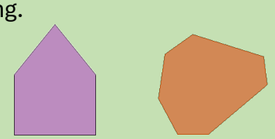
Which polygon results when the geometric figures of A, B, and C are joined in this way?



Sort the following shapes.

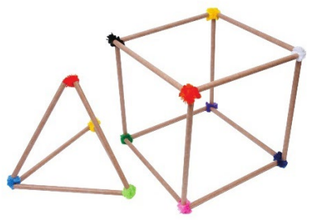
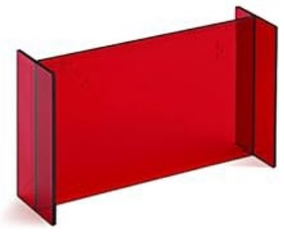
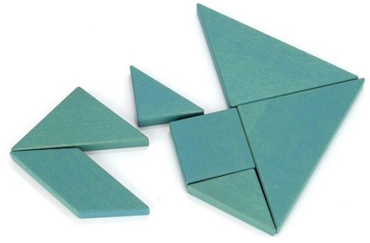


What is your sorting rule?

Analysis	Cut out the following images. Sort them. Have a partner determine your sorting rule. Switch.  Construct a house using toothpicks and marshmallows. What shapes did you construct/combine to build your house? How many different shapes did you construct?	Sort the shapes in a different way. Explain your reasoning.  Construct a pyramid and a prism using toothpicks and marshmallows. What shapes did you construct/combine to build each object? How many different shapes did you construct? How are the objects the same and different?	These shapes have been sorted. What is the sorting rule?  Where would you place the following shapes for sorting? 	These shapes have been sorted. What is the sorting rule?  Where would you place the following shapes for sorting. 

Supporting Resources

Manipulatives and models to Support Learning

Pattern Blocks	Straws and Pipe Cleaners	Geoboards	Miras	Tangrams
				

Print and Electronic Resources

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 (2019a). Mathematics Primary Curriculum Guide. Halifax, NS: Author.

Department of Education and Early Childhood Development (EECD), Province of Nova Scotia (2019b). Mathematics 1 Curriculum Guide. Halifax, NS: Author.

Department of Education and Early Childhood Development (EECD), Province of Nova Scotia (2013a). Mathematics 2 Curriculum Guide. Halifax, NS: Author.

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

Fiore, M. and Lebar, M. L.. (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.

SanGiovanni, John. (2016). *Mine the Gap for Mathematical Understanding, Grades K-2*. 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.

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 K–3*. Boston: Pearson Allyn & Bacon.

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