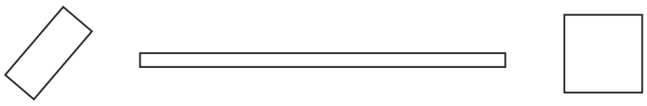
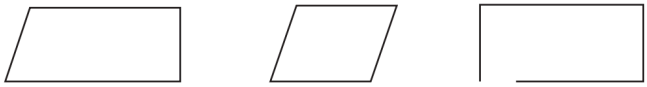
Grade 2 - Geometric Reasoning

Contents

📋 Developmental Tracking Sheet

What to look for from the end of Gr 1:	**Diagnostic Thinking Tasks:** (sample tasks to uncover students' current understandings)
• Investigates and identifies visible attributes of 2D shapes and 3D figures • Creates and applies sorting rules for 2D shapes and 3D objects based on **one** attribute	1. Have students play "Which One Does Not Belong?", where they each identify a sorting rule, select different shapes or objects that follow the rule and one that does not, and put them all in a "sorting circle". Next, have students share their sort in a small group. Each of the group members shares their sort, and the others identify the shape or object that does not belong and explain why. Emphasize that shapes and objects have many sortable attributes and that the same group of shapes or objects can be sorted in different ways. Draw out the idea that whether something belongs in the sorting circle depends on the sorting rule. 2. Give students a rule, and ask them to use a geoboard to make a shape that satisfies this rule; for example, the shape must have four sides. A sorting rule might result in more than one shape. Discuss the similarities and differences for the shapes that the students make. 3. Have students explore and discuss examples and non-examples of various shapes: Why are these rectangles?  Why are these not rectangles? What could be done to each shape to make it a rectangle?  (A Guide to Effective Instruction in Mathematics, Kindergarten to Grade K-3, pg. 20)

Next Steps for Learning:

- Based on what you saw and heard, what is next for you and your students?
- Does a starting point now stand out more clearly in the grade-level sample problems or MathUP Connections?

Resources to Address Grade-Level Expectations

MathUP Connections

Note: To ensure the links below work, first sign into MathUP in a separate tab

- Describing and Sorting Shapes, Lessons 1-3
- Composing and Decomposing Shapes, Lessons 1-2

Building Fluency Lessons

- **Shape Flash:** Provide students with whiteboards. Flash a shape for two or three seconds, encouraging students to study the image. On their whiteboard, students draw the shape they remember seeing. Show the original shape and ask students to compare. Elicit from students the strategies they use to remember the shapes. (See Shape Flash Cards for example shapes from the Guide to Effective Instruction - Geometry.)
- **Guess My Rule:** Using a small set of shapes, sort them with a hidden rule. (Focus the rule on the properties of the shapes - i.e. shapes with right angles, and shapes without right angles.) Present your sorted set to the class, asking the students to guess your sorting rule. Encourage them to explain their thinking using examples from the sorted set. Variation: present one or two new shapes to add to your sort. Ask the students to explain where the new shapes belong.
- Revisit Math Talks from previous topics to consolidate student thinking in the areas of Number Representations, Patterns, and Addition and Subtraction.

Sample Problems and Explorations

Have students take a shape hunt or geometry walk in the classroom, school, playground, at home, or in magazines. Have students identify 2D shapes, documenting their discoveries and discussing with classmates. Possible prompts: "Which shapes did you see more of? Why do you think that shape is more popular? "

A Guide to Effective Instruction in Mathematics, Polygons on Parade, pg. 91-94 - students use geoboards to create polygons matching given criteria. The class set of polygons is sorted in various ways, allowing students to uncover geometric properties and classes of shapes. (Properties of polygons.)

What's My Rule? - Students are provided with a bag containing a variety of polygons. Students sort their collection (all or part of the set) using a rule of their choice. Students explain their sorting rule using examples from their sorted set. Variation: Students create a sorted set and keep it secret. Sorted sets are exchanged with a partner, and the partner tries to figure out the sorting rule. (Properties of polygons.)

Tangram Puzzles - Students use a set of tangram pieces to cover the outlines on Tangram Puzzles (Guide, pg 121-125). When students complete a puzzle, have them trace around the tans inside the outline on the blackline master. Ask students to print the name of the shape (e.g., triangle, square) inside each tan. (See also the digital tangram puzzles at: tangrams) Variation: Have students create their own tangram puzzle to represent an object, then trace around the outside. Puzzles could be exchanged with a friend. Also, see pattern block templates at pattern shapes (compose and decompose shapes.)

Pizza Parlour Game - Payers, in turn, spin the spinner, take the pattern block indicated by the spinner, and place the pattern block on their game board. As the game progresses, students may trade a group of pattern blocks for one pattern block that matches the shape of the group. Explain that if a player cannot use the pattern block indicated on the spinner, then he or she passes their turn. The game ends when one player's pizzas are ready to serve. Prompt students to notice that the size of the pizzas (area) remains the same, regardless of which pieces are used to form the pizza shape.
(Pizza Parlour Game Board, and Pizza Parlour Spinner)

Shapes Within Shapes - students use smaller shapes (square colour tiles or green pattern block triangles) to compose larger shapes. A Guide to Effective Instruction, pg. 111. Prompt students to notice that the area of the shapes they make remains the same (if they use all the pieces), regardless of how the pieces are organized as they form different shapes. (Compose and decompose shapes.)

Pattern Block Symmetry Game - Students compose symmetrical shapes using pattern block pieces. (symmetry, composing shapes)

Spinning Shapes - students play a game to see who can complete a pattern block design first. Pattern block pieces can be traded for a congruent shape (e.g. a red trapezoid could be traded for three green triangles, because they can be used to form the same shape). (Students learn to compose and decompose shapes.)

In Pins - students use geoboards to solve challenges posed by the teacher. Focus student conversations on the properties of the shapes they create in response to the challenges. Some example prompts include:

- make a triangle with one interior pin (a pin inside the shape, not touching an elastic band)
- make a triangle with two interior pins
- make a quadrilateral with 3 interior pins
- make a hexagon with 1 interior pin

Students might record their shapes with a ruler on dot paper

The shapes could be examined to find:

- shapes that have congruent side lengths (“These shapes all have one side that is three units long.”)
- shapes that have congruent angles (“Both these shapes have right angles.”)
- shapes that are totally congruent.

Extensions - Are there any in-pin shapes that are impossible to create? (e.g. a square with 3 interior pins)
(Properties of 2-D shapes)

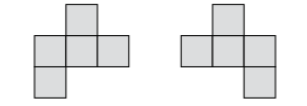
Have students cut out and sort a wide variety of two-dimensional shapes, including concave and convex shapes, shapes that have congruent (equal) side lengths but different angles, shapes with curved and straight sides, shapes with different side lengths, and shapes with different numbers of sides. (See BLM: Grade 2 E1.1 for a sample of assorted shapes). Have them identify their sorting rules, supporting them in using the correct vocabulary. Guide them in noticing that the orientation of a shape does not change it; for example, an “upside-down” triangle is still a triangle because it still has three sides and three angles. Have them re-sort the shapes using a different sorting rule to emphasize that the sort depends on the attribute being sorted for.

Have students play “Which One Doesn’t Belong?” by showing them four shapes and asking them to identify one shape that does not belong. Have them share their reasoning and their sorting rule. Emphasize that shapes have many sortable attributes and that the same group of objects can be sorted in different ways. Draw out the idea that whether something is included in the sort depends on the sorting rule.

Show students a two-dimensional shape on a geoboard. Place students in groups of four. Have the first student recreate the shape on their group’s geoboard, make one change to the shape, and then pass the geoboard to the next student in the group. Repeat until all four group members have made a change. Have students in the group identify the resulting shape and describe how it is different from the original shape and how it is the same.

Provide students with a variety of shapes. Have them sort these shapes based on whether they think they are symmetrical or not. Then ask them to visualize (predict) the line of symmetry, share their prediction verbally with peers, and verify by using their own strategy, such as paper-folding or using a reflection tool (e.g., a mirror). Have students adjust their sort as necessary.

A pentomino is a shape made of five squares that share a full side or sides with one other square. Have students, in pairs, draw all the different pentominoes on 2 cm × 2 cm grid paper. Tell them that there are 12 pentominoes to find. As they draw their pentominoes, they should eliminate ones that are congruent, so they are left with only unique pentominoes. After they have completed the task, discuss the strategies they used to ensure that their pentominoes were unique.



These pentominoes are not unique because they are congruent.

Have students make two congruent shapes on a geoboard. Ask them to change either an angle or a side length on one of the shapes. Now ask them to compare the two shapes, identifying the angles and the side lengths that are still equal, and describe what effect the change had on the shape's other angles or side lengths (or even the number of sides). Discuss how the two shapes are no longer congruent.

Models and Tools

Concrete Learning Resources Tools:

- pattern blocks
- tangrams
- pentominoes
- polygons plastic shapes (include regular and irregular shapes in sorting activities)
- colour tiles
- geoboards and elastics
- Blackline Master polygons

Virtual Learning Resources and Tools:

- pattern blocks
- tangrams
- pentominoes
- polygons
- colour tiles
- geoboard

Expectation Cluster

E1 describe and represent shape, location, and movement by applying geometric properties and spatial relationships in order to navigate the world around them

- E1.1 sort and identify two-dimensional shapes by comparing number of sides, side lengths, angles, and number of lines of symmetry
- E1.2 compose and decompose two-dimensional shapes, and show that the area of a shape remains constant regardless of how its parts are rearranged
- E1.3 identify congruent lengths and angles in two-dimensional shapes by mentally and physically matching them, and determine if the shapes are congruent

⭐ **Connections to *Essential Key Concepts*** ⭐

B1 demonstrate an understanding of numbers and make connections to the way numbers are used in everyday life

- B1.2 compare and order whole numbers up to and including 200, in various contexts

☼ **Related Mathematical Processes**

Reasoning and Proving, Connecting

Resource list of texts referenced in the preparation of these plans, and available in all WRDSB schools.