

Teacher Package

Mathematics Exemplar Task Grade 4 – Geometry and Spatial Sense Teacher Package

Title: From Shapes to Shapes

Time requirements: 195 minutes (total)

- Pre-task 1 – 45 minutes × 1
- Pre-task 2 – 30 minutes × 1
- Pre-task 3 – 30 minutes × 1
- Exemplar task – 45 minutes × 2

(The pre-tasks and exemplar task may be completed on four separate days. Time requirements are suggestions, and may vary.)

Description of the Task

Students will discover and use relationships among various geometric shapes to solve problems and develop their spatial visualization skills.

Students will use anywhere from 1 to 10 pattern block pieces to build trapezoids, and record their arrangements. Students will then determine whether trapezoids of specified perimeters can be built, and record their results. Next, students will use pattern blocks to build triangles and hexagons; show how many triangles will cover the shapes built; and show why they agree or disagree with a statement about the relationship between pattern block triangles and trapezoids. Then students will build trapezoids worth specified sums of money, given a value for one trapezoid. Finally, students will place pattern blocks side by side in a specified way to make angles; measure and name the angles made; and determine the kinds of angles that cannot be made by so placing the pattern blocks.

Teachers should note that the concept of congruency is reviewed with students in the pre-tasks. The final task, however, does not include questions that address students' understanding of the concept explicitly.

Expectations Addressed in the Exemplar Task

Note that the codes that follow the expectations are from the Ministry of Education's *Curriculum Unit Planner* (CD-ROM).

Students will:

1. solve problems using geometric models (4m61);
2. investigate the attributes of three-dimensional figures and two-dimensional shapes using concrete materials and drawings (4m62);
3. use language effectively to describe geometric concepts, reasoning, and investigations, and coordinate systems (4m67);
4. identify and sort quadrilaterals (e.g., square, trapezoid) (4m71);
5. identify similar and congruent figures using a variety of media (4m73);
6. construct congruent figures in a variety of ways (4m74);
7. discover geometric patterns and solve geometric puzzles with and without the use of computer applications (4m75);
8. measure angles using a protractor (4m76);
9. use mathematical language to describe geometric ideas (e.g., line, angle) (4m77);
10. discuss ideas, make connections, and articulate hypotheses about geometric properties and relationships (4m80).

Teacher Instructions

Prior Knowledge and Skills Required

Before attempting the task, students should have had experience with the following:

- sorting and classifying two-dimensional shapes according to certain criteria (e.g., number of sides, number of pairs of parallel sides)
- the meaning of *parallel* and *congruent*
- using pattern blocks and recording on pattern block paper
- measuring and naming angles
- determining the perimeter of polygons

The Rubric*

The rubric provided with this exemplar task is to be used to assess students' work. The rubric is based on the achievement chart given on page 9 of *The Ontario Curriculum, Grades 1–8: Mathematics, 1997*.

Before asking students to do the task outlined in this package, review with them the concept of a rubric. Rephrase the rubric so that students can understand the different levels of achievement.

Accommodations

Accommodations that are normally provided in the regular classroom for students with special needs should be provided when the exemplar tasks are administered.

Materials and Resources Required

- Rubric – one copy for each student
- Overhead transparency of the rubric, for review with the students (optional – see General Instructions, point 2)
- Student package (see Appendix 1)
- Pattern blocks
- Overhead pattern blocks (if available)
- Overhead projector
- Pattern block triangle paper (see pages 15 and 16 in this Teacher Package).
- Paper and pencils
- Coloured pencils
- Protractors

Classroom Set-up

For the pre-tasks, students may be arranged in pairs or in small groups in such a way that everyone can see the overhead.

For the pre-tasks and the exemplar task, students need a large surface area on which to construct shapes with pattern blocks.

Students may need to work on the exemplar task at different times if a large supply of pattern blocks is not readily available.

Students work individually and independently for the exemplar task.

General Instructions

1. The rubric for this task should be used to assess the students' work.
2. Before administering these tasks, review the rubric with the class. Give each student a copy of the rubric, or create a transparency to use with the class.
3. The pre-tasks are intended to ensure that students have the knowledge required to complete the exemplar task.
4. Provide students with an ample supply of pattern blocks and access to coloured pencils for recording.
5. Provide ample time for the students to become familiar with using the pattern blocks, if they have not used these manipulatives before.
6. The times suggested for the pre-tasks and the exemplar task may vary.
7. All of the students' work must be completed at school.

Task Instructions**Introductory Activities**

The pre-tasks are designed to review and reinforce the skills and concepts that students will be using in the exemplar task and to model strategies useful in completing the task.

Pre-task 1: Building Hexagons (45 minutes × 1)

1. Display the pattern blocks on the overhead projector. Ensure that students know the names of the six different pattern block pieces (hexagon, trapezoid, rhombus [beige and blue], square, triangle).
2. Place a hexagon on the overhead projector.
3. Ask the students: "How many blocks have I used?"
4. Continue to build hexagons using 2 blocks (i.e., with 2 trapezoids), 3 blocks (i.e., with 1 trapezoid, 1 blue rhombus, and 1 triangle), 4 blocks (two choices, i.e., with 2 blue rhombi and 2 triangles, or 1 trapezoid and 3 triangles). After building a hexagon using 4 blocks, ask the students: "Are there any other ways to build a hexagon using 4 blocks?"
5. Have the students continue exploring this task for 5 and 6 blocks. Ask them to trace around each block in their solutions.
6. Have the students share their findings on the overhead projector.
7. Discuss with the students the meaning of the word *congruent*.
8. Discuss how different pattern block arrangements can produce congruent hexagons.

*The rubric is reproduced on page 108 of this document.

Pre-task 2: Measuring Angles (30 minutes × 1)

Have the students determine the size and name of each interior angle of the pattern block pieces.

Pre-task 3: Investigating Trapezoids (30 minutes × 1)

1. Display on the overhead projector a trapezoid made with pattern blocks.
2. Count the number of blocks in the design.
3. Ask the students to display a pattern block piece (red trapezoid) that is similar to the shape shown on the overhead projector.
4. Identify both shapes as trapezoids.
5. Discuss the similarities and the differences between the two trapezoids.
6. Record the responses on a chart.
 - **Similarities:** four-sided, one set of parallel sides, no angles that are equal to a right angle
 - **Differences:** number of blocks used for construction, size
7. Make sure that students know what a trapezoid is: a four-sided figure with exactly one pair of parallel sides.

Exemplar Task (45 minutes × 2)

1. Hand out the student package. (See Appendix 1 for the worksheets containing the task the students will work on independently.)
2. Remind students about the rubric, and make sure that each student has a copy of it.
3. Tell the students that they will be working independently on the assigned tasks.
4. Encourage students to record their arrangements.
5. Set the students to work on the task.

Appendix 1

Exemplar Task

1. Susan was experimenting with pattern blocks to see what shapes could be made with the various pattern block pieces. After attempting to build trapezoids from the pattern block pieces, she said that she does not think it is possible to make trapezoidal shapes with 1, 2, 3, ..., 10 pattern block pieces.
 - a. Find out if she is correct. Use pattern blocks to build trapezoids that can be made with 1 block, 2 blocks, ..., 10 blocks.

Record all of the arrangements you have made on the pattern block paper. For pattern block paper, see the last two pages.

- b. If the length of the longest side of a pattern block trapezoid represents 1 unit, show why you can or cannot build trapezoids with the following perimeters: 5 units, 5.5 units, 7 units, 10 units, 12 units.
Record your answers on the pattern block paper.

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2. You have just seen that you can use different numbers of pattern blocks to build trapezoids. Cynthia wondered whether it would be possible to build triangles and hexagons using pattern blocks.
- a. Show how you can build triangles or hexagons using pattern blocks. Use the back of the page if needed.

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b. For each of the shapes you have built, show how many triangles would cover it.

c. Luciano said that if he knew how many trapezoids it takes to cover a shape, he could tell you how many triangles it would take to cover the same shape.

Show why you agree or disagree with his statement.

3. a. If the trapezoid is worth \$0.25, experiment to see if you can build trapezoids that are worth:

\$1.00; \$2.50; \$4.00; \$6.50

Record your answer on the paper provided.

b. Build some more trapezoids and state the cost of each. Describe any patterns you notice.

4. By placing pattern blocks side by side *with sides touching sides of equal length*, we can create different angles.

- a. How many different angles can you form by placing a pattern block alongside other pattern blocks?

Draw your angles in the space below. Measure and name the angles.

Measure the angles and record your angles on the paper.

- b. Which angles cannot be made this way? Suggest reasons why you think these angles cannot be made.

