

# Teacher Package

## Mathematics Exemplar Task Grade 7 – Geometry and Spatial Sense Teacher Package

- Title:** The Geometer's Sketchpad\*
- Time requirement:** 270 minutes (total)
- two periods of 45 minutes each for pre-task 1
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  - two periods of 45 minutes each for the exemplar task

### Description of the Task

This task requires students to:

- draw a variety of polygons;
- construct a variety of polygons;
- transform figures using The Geometer's Sketchpad;
- determine the sum of the angles in a variety of polygons;
- determine which regular polygons will tile a plane;
- tessellate the plane using The Geometer's Sketchpad.

Students will use The Geometer's Sketchpad to draw different polygons and find the sum of their interior angles. They will transform each of the polygons they have drawn and observe the results. Then they will summarize what they know about the sum of the interior angles of different polygons. Next, students will construct various regular polygons, describe how to determine the size of their angles, and determine which of the regular polygons will tile a plane. Students will use The Geometer's Sketchpad to investigate whether any triangle and any quadrilateral will tile a plane.

\*The Geometer's Sketchpad software is licensed to the Ontario Ministry of Education (1999).

### 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. identify, describe, compare, and classify geometric figures (7m47);]
2. explore transformations of geometric figures (7m50);
3. understand, apply, and analyse key concepts in transformational geometry using concrete materials and drawings (7m51);
4. use mathematical language effectively to describe geometric concepts, reasoning, and investigations (7m52);
5. explain why two shapes are congruent (7m58);
6. create and analyse designs that include translated, rotated, and reflected two-dimensional images using concrete materials and drawings, and using appropriate computer applications (7m62);
7. identify whether a figure will tile a plane (7m63);
8. construct and analyse tiling patterns with congruent tiles (7m64).

### Teacher Instructions

#### Prior Knowledge and Skills Required

To complete this task, students should have some knowledge and skills related to the following:

- the freehand tools of The Geometer's Sketchpad (menus, the difference between drawing and constructing a figure)
- creating tiling patterns using concrete materials
- the following terms: *tile, plane, transform, reflect, translate, rotate, congruent, regular polygon, tessellate*

#### 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.

\*The rubric is reproduced on page 82 of this document.

**Accommodations**

Accommodations that are normally provided in the regular classroom for students with special needs should be provided in the administration of the exemplar task.

**Materials and Resources Required**

Before students attempt a particular task, provide them with the appropriate materials from among the following:

- a copy of the Student Package (see Appendices 1 and 2) for each student
- paper
- access to computers
- 5 x 5 geoboards
- rulers and compasses (optional)
- straws (optional)

**The Geometer's Sketchpad**

The prepared lessons included on The Geometer's Sketchpad CD-ROM may be helpful for teachers. These prepared lessons provide step-by-step instructions for the menus as well as for other activities involving The Geometer's Sketchpad. The pull-down *Help* menu is also an excellent resource for both students and teachers. Students can print out their work.

**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 tasks and to model strategies useful in completing the task.

**Pre-Task 1: Constructing Polygons With The Geometer's Sketchpad**

Familiarize students with constructing a figure using The Geometer's Sketchpad. Have students follow steps 1 to 5:

1. Construct a quadrilateral. Use one of the vertices as a centre of rotation to rotate the quadrilateral  $180^\circ$ . Undo the rotation so that only your original quadrilateral remains. Construct a point near your figure.
2. Mark this point as a centre of rotation and rotate the quadrilateral  $180^\circ$ .  
After step 2, ask students:
  - “How are the two rotated quadrilaterals alike? How are they different? How would you account for the similarities and differences?”
  - “If we chose a different vertex around which to rotate the quadrilateral, what would the image look like? Why?”
3. Undo the last rotation, draw a line beside the quadrilateral, mark it as a *mirror line*, and then reflect the quadrilateral.

4. Undo the reflection so that only the original figure remains. Mark one of the sides of the quadrilateral as a mirror line and then reflect the quadrilateral. Compare the reflection image with the original figure (pre-image).
5. Undo the reflections so that only the original quadrilateral remains. Translate the quadrilateral in any direction so that the translated image does not overlap the original figure. Compare the two figures.

At the end of the task, allow time for discussion about what students learned and about any problems that they encountered using The Geometer's Sketchpad.

**Pre-Task 2: Investigating Angles and Congruent Polygons**

Tell students that they have just been given a square plot of land, represented by a 5 by 5 geoboard. (If a 5 by 5 geoboard is not available, the 5 by 5 geopaper found in Appendix 2 can be used.)

Pose the following question: “In how many different ways can the square plot of land represented by the 5 by 5 geoboard be divided into two congruent regions?”

After students have shown the number of ways that this can be done, ask them: “What transformation(s) would be required to map one shape onto the other?”

Have students discuss their solutions.

**Exemplar Task**

1. Distribute a copy of the Student Package to each student.
2. Remind students about the rubric and make sure that each student has a copy of it.
3. It is important that students work on their own while doing these tasks. If necessary, however, have small groups of students work on the task at different times.
4. Set students to work on the task. Students can use the space provided in the Student Package or additional sheets of paper for their responses. Computer printouts are encouraged.
5. The problem that the students will solve independently is provided in the worksheets in Appendix 1.



3. a) Use *The Geometer's Sketchpad* program to **construct** different **regular** polygons. Describe how you determined the size of each of the angles of a **regular** polygon.

- b) How would you use this information to determine the size of each of the angles of a regular 50-sided polygon?

4. Some shapes can be used to tessellate a plane surface. You have just constructed some regular polygons. Will all regular polygons tessellate? Give reasons why they will or will not tessellate.

5. Use *The Geometer's Sketchpad* to test your predictions. What do you notice?

6. Use *The Geometer's Sketchpad* to investigate whether any triangle (e.g., isosceles, scalene, right, etc.) will tessellate. Any quadrilateral (e.g., chevron, kite, trapezoid, etc.) will tessellate. What do you notice? Summarize your findings.

**Appendix 2**

**Geopaper**

