

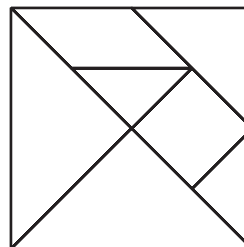
Project: "Puzzling" Shapes

For use with Chapter 6

OBJECTIVE Use a tangram puzzle set to create polygons and analyze their measurements.

MATERIALS ruler, thin cardboard or construction paper, scissors, and a small plastic bag; or a set of tangrams

INVESTIGATION Tangrams are considered to be an ancient Chinese puzzle. A tangram puzzle set can be made by cutting a square into the pieces indicated in the diagram.

**Exploring Tangrams**

- What do you notice about each of the following?
 - the two large right triangles
 - the legs of the medium right triangle
 - the longer sides of the parallelogram
 - the sides of the small square and the legs of the small right triangles
- Create your own tangram puzzle set. Draw a 4-inch by 4-inch square and the remaining line segments as shown in the diagram above.
- What are the polygons with the fewest sides and with the most sides that you can build using all seven pieces? Name your polygons based on the number of sides they have. Draw a sketch to support your answers.
- Is it possible to form each of the shapes listed below using exactly two tangram pieces? three pieces? four pieces? five pieces? six pieces? seven pieces? Draw a small sketch of each one you formed, showing the pieces you used.

| | |
|--|-----------------------------------|
| a. square | b. rectangle that is not a square |
| c. parallelogram that is not a rectangle | d. trapezoid |

Analyzing Measurements

- Find the area of each tangram puzzle piece when the area of the

| | |
|---|---|
| a. small triangle is 1 square unit? | b. small triangle is $\frac{1}{2}$ square unit? |
| c. small triangle is $\frac{1}{4}$ square unit? | d. small square is 1 square unit? |
| e. small square is $\frac{1}{2}$ square unit? | f. small square is $\frac{1}{4}$ square unit? |
| g. entire square is 1 square unit? | h. entire square is 16 square units? |

PRESENT YOUR RESULTS Your project report should include all of your sketches and measurement data. Also, include a written summary of your work showing calculations. Discuss how you approached the problems and how successful you were in finding an approach that helped you find as many polygons as possible. What techniques did you use to organize your work?

Project: Teacher's Notes

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- GOALS**
- Identify, name, and describe both convex and concave polygons.
 - Find the areas of polygons.

MANAGING THE PROJECT Students enjoy working in pairs when using the tangram pieces. This is also a good project for students to share with family. Students may or may not be familiar with the tangram puzzle pieces. Once the diagram for the puzzle has been analyzed and the students have their own set, have them explore the relationships of the pieces to each other and to the original tangram square. Also, you might want to have students create some shapes to get them started. You can help students to think creatively about building the polygon with the most sides by reviewing convex and concave polygons. Encourage students to look for non-obvious solutions, such as positioning pieces so that they only touch at their vertices. You might also want to review how to name polygons with many sides.

RUBRIC The following rubric can be used to assess student work.

- 4 The student identified the triangle as the shape that could be created with the fewest sides and also built and named a polygon with at least 12 sides. The student drew sketches to show how each type of quadrilateral in Exercise 4 could be created using from two to seven tangram pieces. The student completed an organized table of data for the indicated areas. The summary of the student's work showed accurate and complete calculations. The report indicated that the student developed an organized, thoughtful strategy for finding polygons.
- 3 The student identified the triangle as the shape that could be created with the fewest sides and also built and named a polygon with at least ten sides. The student drew sketches to show how the types of quadrilaterals in Exercise 4 could be created using from two to seven tangram pieces, but was missing a few of the answers. The student completed an organized table of data for the indicated areas with one or two errors. The summary of the student's work showed mostly accurate and complete calculations with a few errors. The report indicated that the student developed a somewhat organized strategy for finding polygons.
- 2 The student was unable to find the polygon with the fewest sides (the triangle) or did not find a polygon with ten or more sides. Students drew sketches to show how some of the quadrilaterals in Exercise 4 could be created using from two to seven tangram pieces. The table of data for the indicated areas was poorly organized with some missing or incorrect data. Student summary did not show any evidence of an organized strategy.
- 1 Students created and named one shape for Exercise 3. Students drew sketches to show how only a few of the quadrilaterals in Exercise 4 could be created using from two to seven tangram pieces. Table of data for areas contains numerous errors. Summary is missing.