Utah's Largest Math Event 2009-2010

Tangram Puzzle

5th/6th Grade

Standard III: Students will use spatial and logical reasoning to recognize, describe, and analyze geometric shapes and principles.
5th Objective 1: Describe relationships between two- and three-dimensional shapes and analyze attributes and properties of geometric shapes.
6th Objective 1: **Identify and analyze attributes and properties of geometric shapes to solve problems.**
Intended Learning Outcomes: 1. Develop a positive learning attitude toward mathematics. 2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems. 3. Reason logically, using inductive and deductive strategies and justify conclusions. 4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics. 5. Connect mathematical ideas within mathematics to other disciplines and to everyday experiences. 6. Represent mathematical ideas in a variety of ways.

Background Information

Geometry not only provides a means for describing, analyzing, and understanding structures in the world around us but also introduces an experience of mathematics that complements and supports the study of other aspects of mathematics such as number and measurement. Geometry offers powerful tools for representing and solving problems in all areas of mathematics (Navigating through Geometry, NCTM, 2002).

Learning with understanding is essential to mathematical literacy. Mathematical literacy is having procedural and computational skills as well as conceptual understanding. Mathematical proficiency has five interwoven and interdependent strands: understanding, computing, applying, reasoning, and engaging (National Research Council, 2002). This activity is intended to promote mathematical literacy geometric proficiency within your students.

Materials

4" x 4" piece of construction paper for every student plus a few extras for errors
an envelope for every child
a pair of scissors for every student

Invitation to Learn

A long time ago in China, there lived a man called Tan. Tan's greatest possession was a fine ceramic tile. One day Tan was carrying his tile to show the emperor. He tripped and the tile fell and broke into seven geometric shapes: two large triangles, a medium size triangle, a square, and a parallelogram. Tan spent the rest of his life trying to put the tile back together again. He was not successful, but he did succeed in creating many different geometric designs.

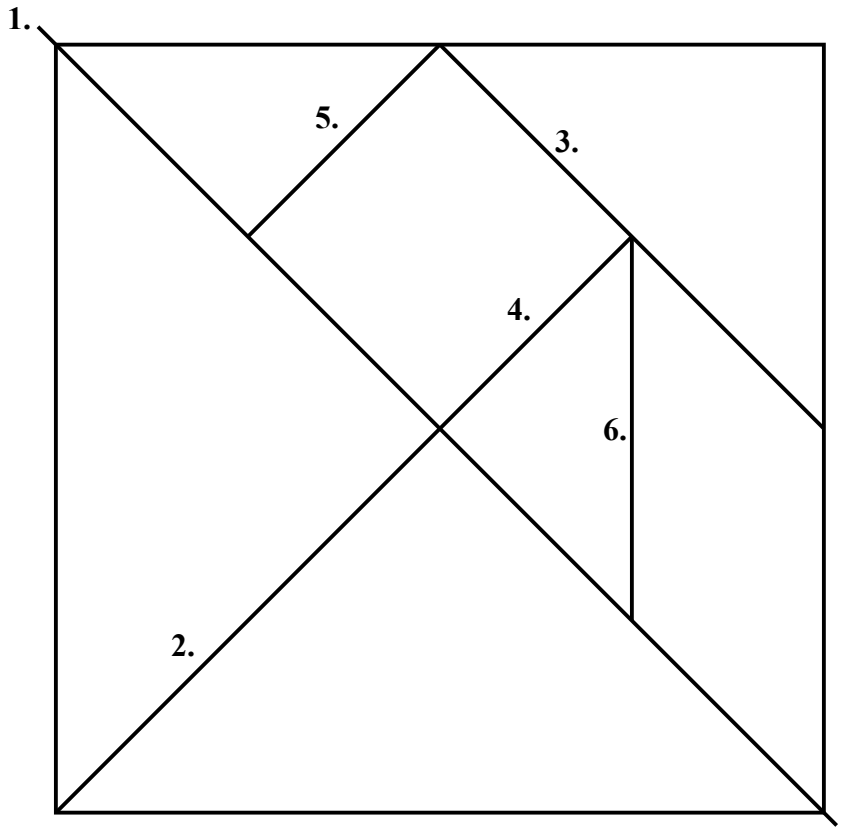
Tan enjoyed creating the designs. His friends also enjoyed trying to recreate his designs. Tan's puzzles, later called tangrams, were passed on through generations and from country to country.

Instructional Procedures

Activity 1

When working with tangrams, students are often asked to form a square by putting the pieces together. This often results in frustration. This task allows student to cut the pieces to form a square convincing them that a square can be made. Give each student a 4" x 4" piece of paper. Read the following directions to your students as you demonstrate the process while they follow along.

1. Fold the square in half along a diagonal. Unfold and cut on the crease.
2. Take one of the halves and fold it in half forming two smaller congruent triangles. Unfold and cut on the crease. Set those two pieces aside.
3. Take the remaining large triangle and touch the top point of the triangle so that it touches the middle of the bottom edge. You should now have a small triangle and a trapezoid. Unfold and cut on the crease. Put the small triangle in the pile with the other two triangles.
4. Take the trapezoid and fold it in half so you have two congruent trapezoids with each side looking something like a shoe. Unfold and cut on the crease.
5. Take one of the shoes with the longest part at the bottom and fold it in half so you have a square on one side and a triangle on the other. Unfold and cut on the crease. Put the pieces in the pile with all you other shapes.
6. Take the other shoe with the longest part at the bottom. Do you see where the laces would tie if it were really a shoe? Fold it down so that it touches the heel. You should have a small triangle on one side and a parallelogram on the other. Unfold and cut on the crease.
7. You should have seven pieces altogether.



Have the students attempt to reassemble the square. If students finish early, have them create a triangle using all seven tangram pieces.

When students have completed the activity, pull them back together for a whole group discussion. Ask the following questions:

- Do you have any advice for someone who was not able to reassemble the square or triangle?
- Did you have to use any slides, flips, or turns (rotations) to reassemble the square or triangle?

Have them put all seven pieces in an envelope to save it for the next day's activity.

Activity 2 (Qualifying Problem for ULME)

Activity 1 is a foundational activity for completing this activity.

Students must work individually on this task.

- Construct squares using 2 pieces, 3 pieces, etc., all the way up to 7 pieces.
- Sketch your solutions and explain your thinking on the sheet provided.
- Which arrangements are not possible? Why?

Students must explain their thinking process by:

1. Producing a visual representation of their thinking (ex. organized list, table, or sketch of manipulatives used for exploration).
2. Writing a description of the reasoning and justification of the process and solution. Use additional paper if needed.

Name: Teacher:
Grade:

It's All In the Pieces

Utah's Largest Math Event 2009 (qualifier)

Construct squares using 2 pieces, 3 pieces, etc., all the way up to 7 pieces. Sketch your solutions and answer the questions below.

# of pieces	Solution	# of pieces	Solution
2		3	
4		5	
6		7	

1. Explain your strategy for assembling the different squares. _____

2. Are there any amounts that are not possible to make a square with? Which amounts? Why is it impossible? _____