Tangram Tactics!

Discover fractions, decimals, and percents with Tangrams!

Topics: Parts of a Whole, Equivalent Fractions, Decimals, and Percents

Materials List

- ✓ Square piece of paper, at least 12 cm x 12 cm (5” x 5”), 1 per student.
- ✓ Scissors
- ✓ Rulers
- ✓ Pens or pencils

This activity can be used to teach:

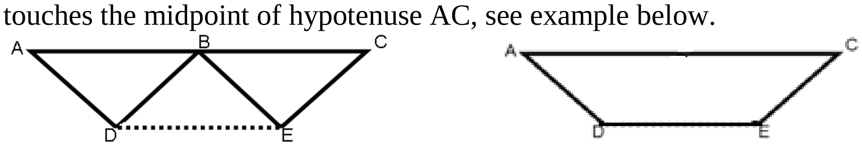
- Fractions & Decimals (Common Core Math Standards: Numbers & Operations – Fractions, Grade 4, 1, 2, 3, 6, & 7; Grade 5, 1; Numbers & Operations Base 10, 7)
- Geometry (Common Core Math Standards: Geometry, Grade 4, 2; Grade 5, 3, 4, 5, & 6; Grade 6, 1; Grade 8, 1, 2, & 4)
- Ratios & Proportions (Common Core Math Standards: Ratios & Proportions, Grade 6, 1-3; Grade 7, 1-2)
- Mathematical Practices: Common Core Math Standards: Grades 3-8

Tangrams not only make interesting pictures, but when described mathematically, they reveal geometric fractions, decimals, and percents!

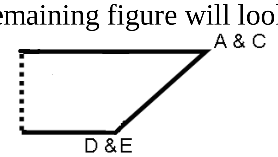
To Do and Notice

Note: It is important to follow each step in order. Teachers should provide guidance according to students’ abilities.

1. Take the paper square and fold in half along a diagonal. (Later the original square will be referred to as the “whole square”.) Cut along the diagonal creating 2 triangles.
   - What type of triangle was created?
   - What part of the whole square is one of these triangles?
   - How can the size of the triangle to the whole square be represented mathematically (fraction, decimal, and percent)?
2. Fold **one** of the triangles in half by folding along a line going from the right angle to the center of the hypotenuse. Cut along the fold to create two congruent right isosceles triangles. These triangles will be referred to as “large triangles”.
   - What part of the whole square is each of the large triangles?
   - How can the value be represented mathematically (fraction, decimal, and percent)? Write the values on each large triangle. Set the triangles aside.
3. Take the uncut triangle from step 1 and fold the right angle vertice B over, so the corner touches the midpoint of hypotenuse AC, see example below.



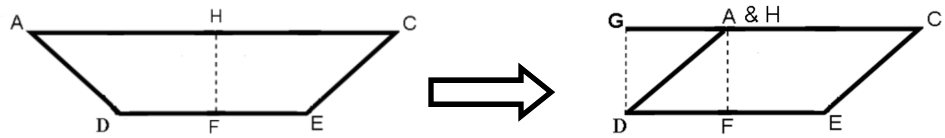
   - Are each of the 4 small triangles (ABD, BCE, BDE, and the triangle under BDE) equivalent?
   - What part of the whole square is each small triangle mathematically?
4. Unfold, cut off, and save the triangle BDE. This triangle will be referred to as the “medium triangle”.
   - Write the values found earlier on the cut triangle. Set the triangle aside.
   - What is the name for the remaining shape, ACED?
   - What part of the whole square is ACED mathematically?
5. Fold ACED in half. The remaining figure will look like:



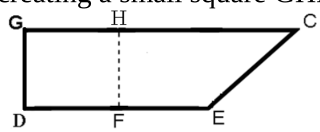
   - What part of the whole square is the folded shape?

Written by Jeanne Lazzarini (RAFT); Inspired by Tsing Bardin and Mary Laycock

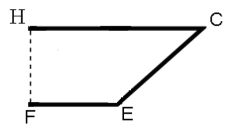
6. Unfold ACED. Bring vertice A to the fold and crease along line GD as shown below:



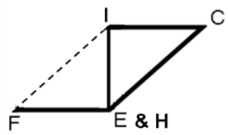
7. Unfold and cut out triangle AGD. This triangle will be referred to as a small triangle.
   - What part of the whole square is triangle AGD mathematically?
   - Write the values on the triangle and set aside.
8. Take GCED and cut along the fold HF creating a small square GHFD.



   - Fold the small square in half along a diagonal.
   - Compare triangle AGD from step 6 with the triangle formed by folding the small square.
   - What part of the whole square is the small square GHFD mathematically? Unfold the small square and write the values on the square. Set the square aside.
9. Look at the remaining shape HCEF:



   - Bring vertice H to meet vertice E. Unfold and cut along the crease line FI.



   - What part of the whole square is triangle FIH mathematically? Compare triangle AGD to triangle FIH. Write the values on the triangle and set aside.
   - How many triangles the size of FIH would be needed to create the shape FICE?
   - What is the name for the shape FICE? What part of the whole square is shape FICE mathematically? Write the values on FICE and set aside. This shape will be referred to as the "parallelogram".
   - What do you notice about the size of the parallelogram, the small square, and the medium triangle?
   - Use all 7 of the tangram pieces that have been created to recreate the whole square. What other shapes can be created? Add up the fraction, decimal, or percent on all 7 pieces – do they add up to 1 (or 100%)?

The Math Behind the Activity

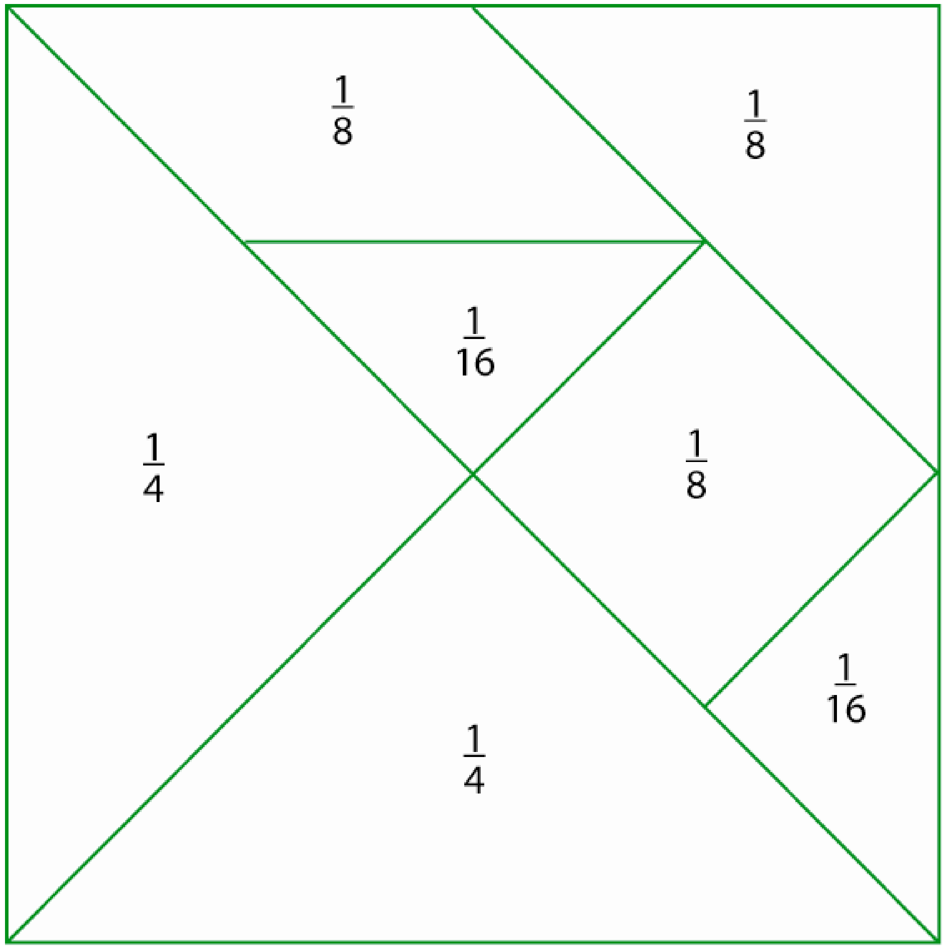
This activity investigates equivalency using a tangram and comparing the pieces to the whole. A Tangram consists of seven pieces; 2 large right isosceles triangles, 1 medium right isosceles triangle, 2 small right isosceles triangles, 1 small square, and 1 parallelogram. Each piece is called a "tan" where the word "tangram" in Chinese means "the seven boards of cunning". Notice how each tan relates to the other 6 tans. This leads to observations on the relationships between parts and the whole, and to equivalency in decimal, percent, and fractional forms.

Taking it Further

- Create shapes with a particular value. For example, make a tangram picture having the area of 5/8. Which pieces can be used?
- Use combinations of selected pieces to create a Right Isosceles Triangle or a Quadrilateral (a polygon with four sides and four angles). See page 3 for suggested combinations.

Web and Other Resources (Visit www.raft.net/raft-idea?isid=613 for more resources!)

- Tangram Geometry in Metric, by Juanita Brownlee, Activity Resources Company, Inc., 1975
- More on fractions and Tangrams - http://mathforum.org/paths/fractions/e.fraclessons.html#tan
- Khan Academy resources - www.khanacademy.org/math/arithmetic/fractions
- Teacher designed math courses – https://njctl.org/courses/math



- <u>Form a Right Isosceles Triangle using only</u>:
  a. Two 1/4th size triangles
  b. Two 1/16th size triangles
  c. Two 1/16th triangles plus the parallelogram
  d. The 1/8th size triangle plus two 1/16th triangles
  e. Two 1/16th size triangles, one 1/4th triangle, and the parallelogram
  f. Two 1/16th size triangles, one 1/4th size triangle, and one small square
  g. Two 1/16th size triangles, and one small square
  h. Two 1/16th size triangles, one 1/8th triangle, and one 1/4th triangle
  i. Two 1/16th size triangles, one 1/8th triangle, one small square, and the parallelogram
  j. One 1/16th, one 1/8th, and one 1/4th size triangles, plus the parallelogram
  k. One 1/16th, one 1/8th, and one 1/4th size triangles, plus the small square
  l. All Seven pieces

- <u>Form a Quadrilateral (a polygon with four sides and four angles) using only</u>:
  a. Two 1/4th size triangles
  b. Two 1/8th size triangles
  c. Two 1/8th size triangles and the parallelogram
  d. Two 1/8th size triangles and the small square
  e. Two 1/4th size triangles, one 1/8th triangle, and two 1/16th size triangles
  f. Two 1/4th size triangles, two 1/8th size triangles, and one small square
  g. Two 1/4th size triangles, two 1/16th size triangles, and one parallelogram
  h. One 1/4th size triangle, two 1/16th size triangles, and one small square
  i. All Seven pieces