ACTIVITY 1

Tangram Fractions

Materials:

- ☒ Student copies of tangram masters
- ☒ transparencies of tangram masters
- ☐ scissors

Overview: Students will analyze standard and nonstandard tangrams to determine the fractional values of the pieces. Students will compare the pieces to see how they relate to one another.

Vocabulary: congruent, triangle, rectangle, square, parallelogram, trapezoid, polygon

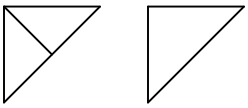
PROCEDURE

Skills:

- Describing and naming polygons
- Studying congruence
- Comparing fractions

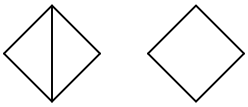
1 This activity works best when students work in groups of two to four. This fosters important dialogue that facilitates understanding. Display a transparency of tangram 1. Students should have individual copies. You may wish to distribute scissors for this activity as some students find it helpful to cut the pieces for comparison.

2 Ask the students, "If the entire square tile has a value of 1, what is the value of the region a?" They can see that it is $^1/_4$ since four of the large triangles can fit in the square.



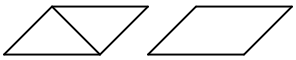
2c = b

3 Next ask them to evaluate the medium-sized triangle, region b. Since two b's will fit into one a, b is $^1/_2$ of a or $^1/_8$ of the whole. Another way to see this is by showing that the tile can be cut into eight b's.

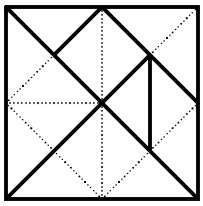


2c = d

4 Ask the students to find the values of the other regions. When they find answers, ask them to justify them. They may do this verbally, by rearranging pieces on their desks or the overhead projector, or by drawing on the image projected onto the board. They will see that the small triangle c is $^1/_{16}$ of the tile since two of them can fit into b. Since two small triangles also fit into the square, d is equal to b. Two c's also fit into the parallelogram e, so b, d, and e are all $^1/_8$. This is shown in the margin.



2c = e



5 Another way to show the relationships among the polygons is by drawing lines to subdivide the tangram into the smallest unit (in this case, c) as shown in the margin. It is then easy to

see that c is $^1/_{16}$ of the tile. Regions b, d, and e are each $^2/_{16}$ or $^1/_8$ of the tile, and region a is $^4/_{16}$ or $^1/_4$ of the tile. This cut-up method will not work on all of the tangram patterns however.

6 Have students explore the other tangram patterns. The first six involve fractions that are based on halves such as $^1/_4$, $^1/_8$, and $^1/_{16}$. Halves are easier to work with conceptually than thirds or fifths. For this reason, only the last two tangrams involve thirds or fifths. Also, in the first three tangrams, all areas use unit fractions; that is, their numerators are one. This changes in tangrams four, five, and six. Again this represents another conceptual step for students.

7 You may wish to have students name each polygon by its characteristics instead of by its letter. For example, in tangram one, region a is the large isosceles right triangle. Regions b and c are also isosceles right triangles. Region d is a square and e is a parallelogram. They can display their answers using these names as shown here.

region	name	fraction
a	right isosceles triangle	¼

Remind them that triangles are always described by their angles and their sides. There are three classifications of each:

<u>angles</u>

acute – all three angles are less than 90º

right – one angle is exactly 90º

obtuse – one angle is more than 90º

<u>sides</u>

equilateral – all three sides are equal

isosceles – two sides are equal

scalene – no sides are equal

Students can check their work by adding all the fractions for the regions of a tangram. These should add up to one (whole tangram).

Geometric Thought

There is evidence that children must pass through a series of levels of geometric understanding on their way to having a successful experience in high school geometry. These levels of understanding are a result of classroom experiences that can be nurtured through hands-on activities and extended to deeper levels of sophistication.

Journal Prompts:

Explain how polygons b, d, and e are alike and how they are different.

Why does the cut-up method only work on some tiles but not on others?

Homework:

You may wish to assign unfinished tangrams as homework.

Another option is to have students make a tile of their own and write fractions for each region. It should be made of at least seven sections of at least five different shapes. This should be drawn on a 4" or a 6" square. You may wish to pass out grid paper for this task.

Taking a Closer Look:

Rename a region in each tangram equal to one. For example in tangram 1, assume the parallelogram has a value of one. What is the fractional value of each other region?

You may also ask students to find decimal values for each tangram. In addition, you can have students write percent values for each region as shown for tangram 1 below.

Region:	Fraction:	Decimal:	Percent:
a	¼	.25	25%

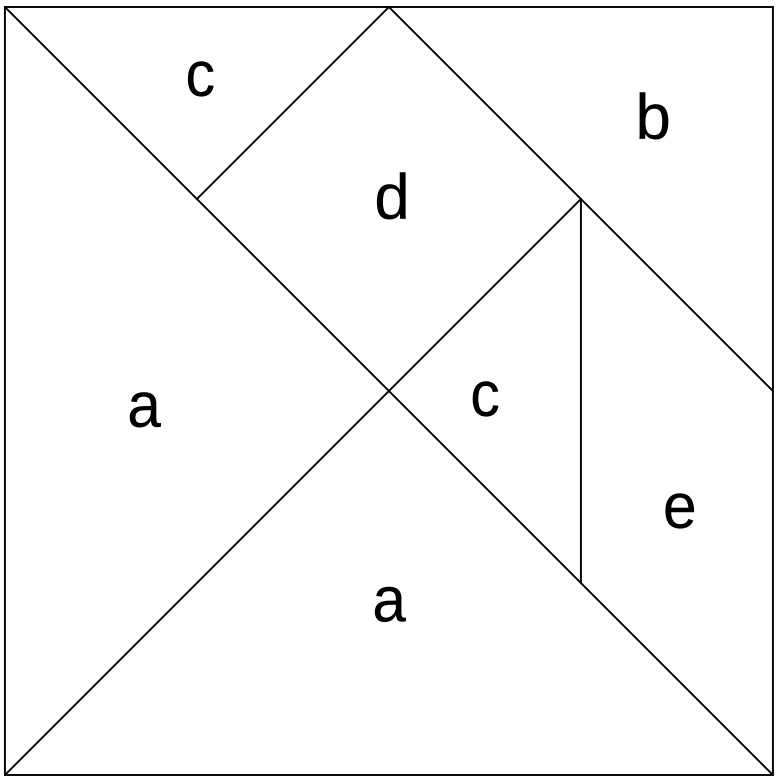
Assign a cost or value to various regions. If the medium-sized triangle of tangram one sells for $1.37, what is the cost of each region and the whole tile? If tangram two costs $5.64, what would each piece cost?

Tangram 1	
Region	Fraction
a	$^1/_4$
b	$^1/_8$
c	$^1/_{16}$
d	$^1/_8$
e	$^1/_8$

Assessment:

By allowing students to work in groups and by asking them to rationalize their answers, you will be able to assess their levels of understanding.

Homework can be assessed after collecting it, or you may wish to have students trade papers and solve each other's puzzles.



Tangram 1

Piece	Name	Fraction	Decimal	Percent
a				
a				
b				
c				
c				
d				
e				
	Total			