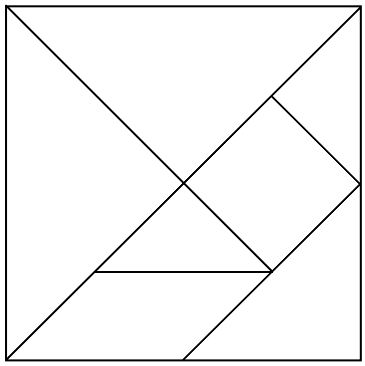
Making a Tangram

The figure on the right is called a tangram.



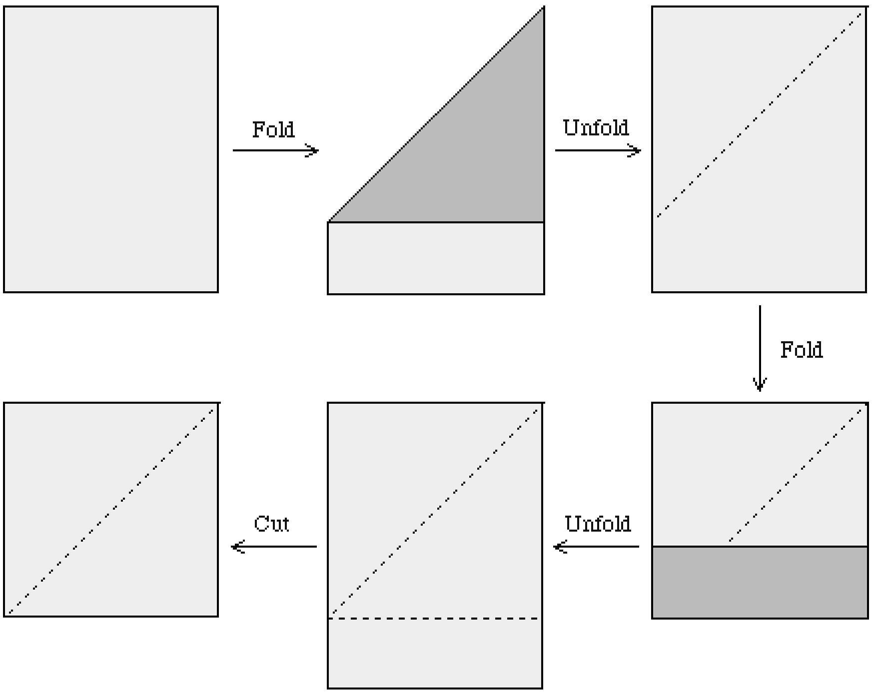
It consists of seven pieces:

- a small square
- two small triangles
- two large triangles
- a medium-size triangle
- a parallelogram

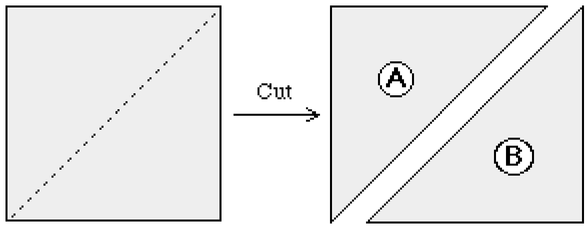
1. Identify and name each of the seven pieces in the tangram.

2. You can make your own set of tangrams from a single piece of paper. Just follow these simple steps:

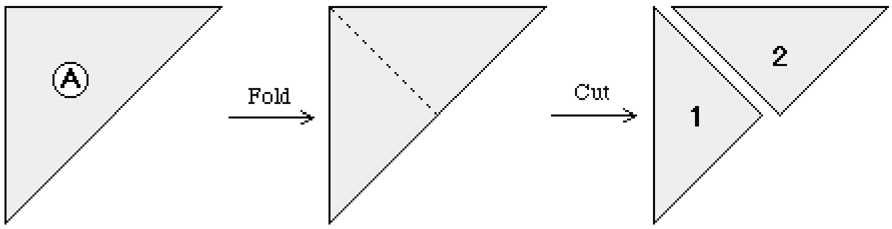
A. Fold a rectangular piece of paper so that a square is formed. Cut off the extra flap.



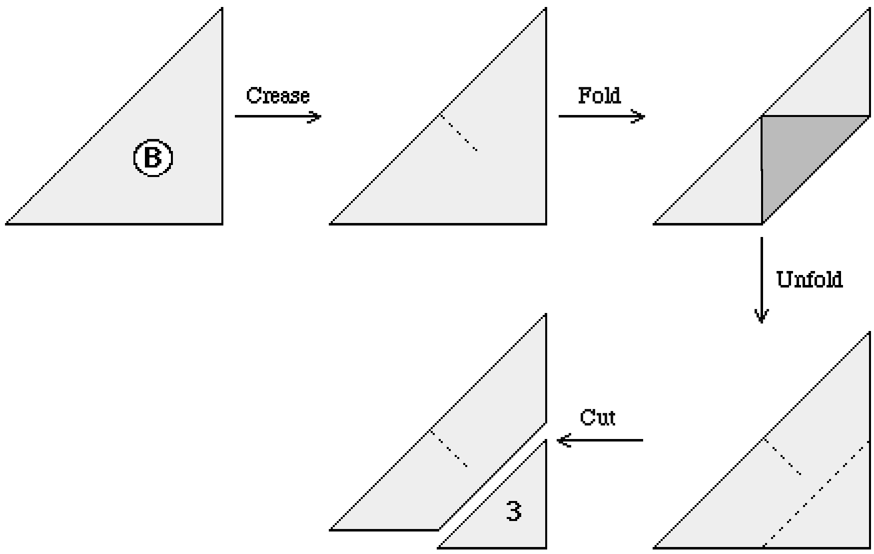
B. *Cut the square into two triangles.*



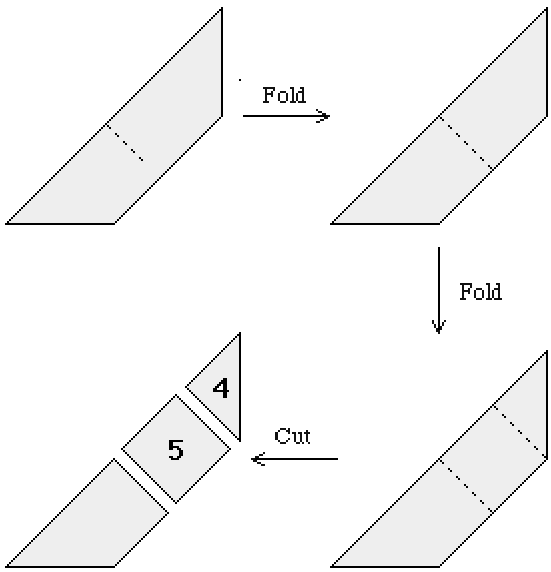
C. *Take one triangle and fold it in half. Cut the triangle along the fold into two smaller triangles.*



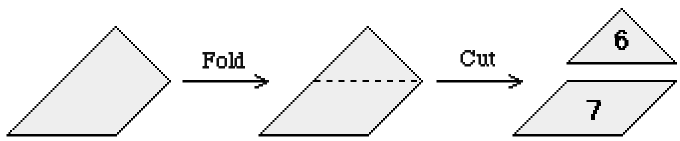
D. *Take the other triangle and crease it in the middle. Fold the corner of the triangle opposite the crease and cut.*



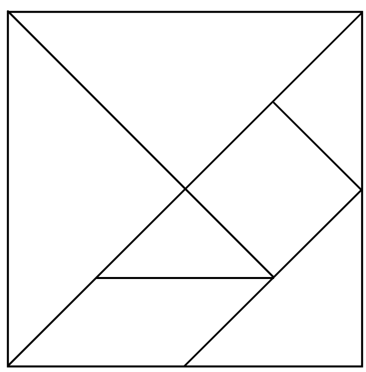
E. Fold the trapezium in half and fold again. Cut along both folds.



F. Fold the remaining part and cut it in two.



G. Now arrange your 7 pieces to form a tangram.

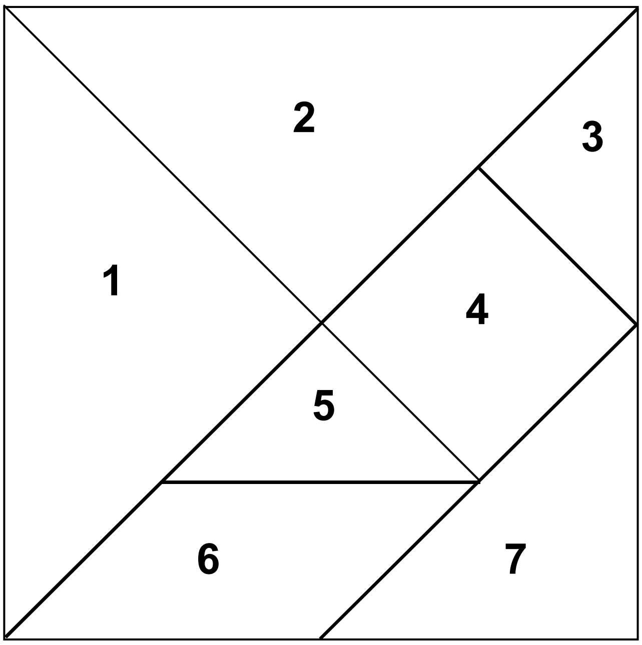


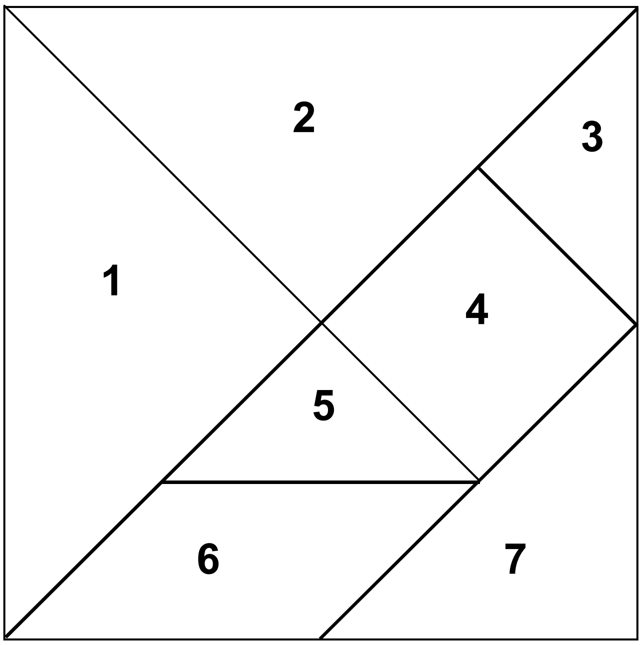
Teacher Notes: Making a Tangram

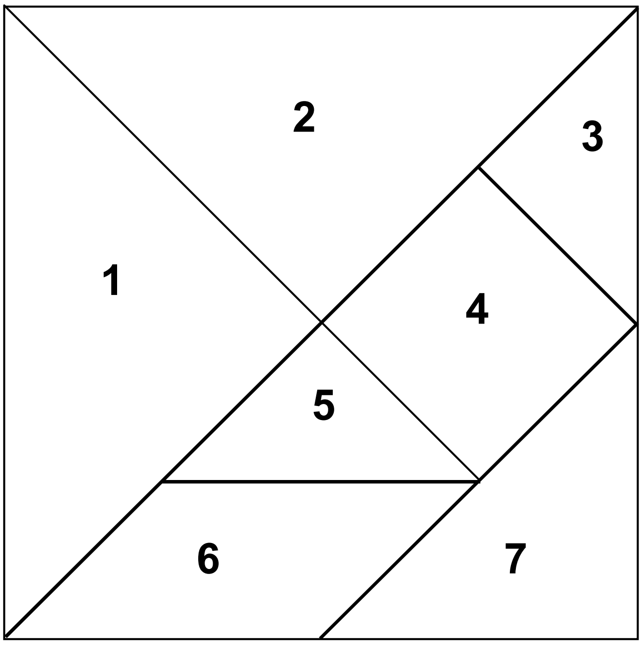
This activity requires that learners interpret instructions given in 2-dimensions. The teacher should provide assistance where necessary.

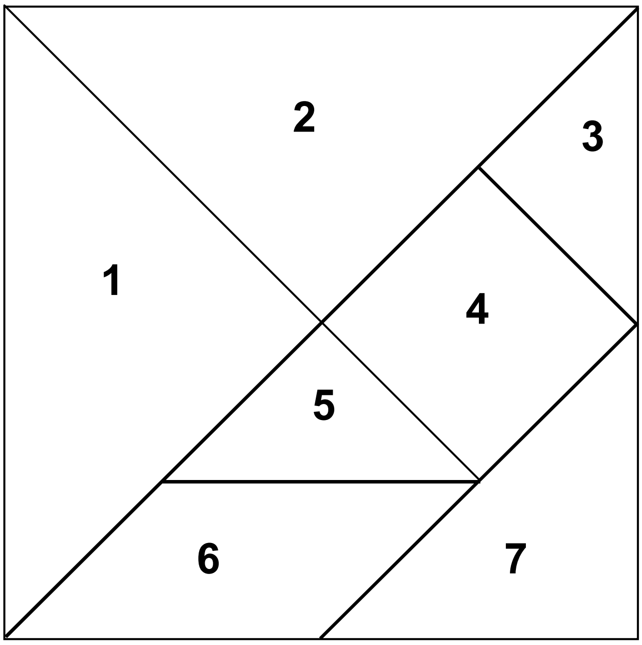
Source:
http://forum.swarthmore.edu/trscavo/tangrams/construct.html

Tangram Template



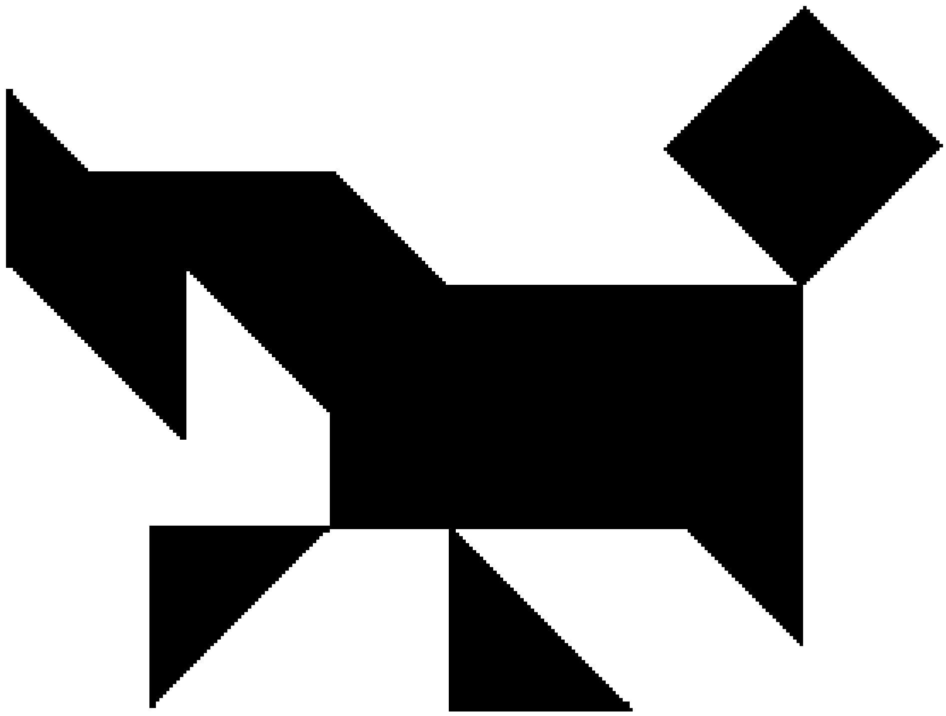




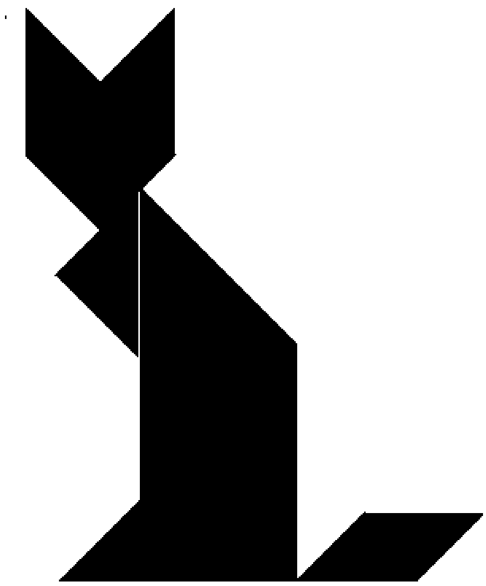


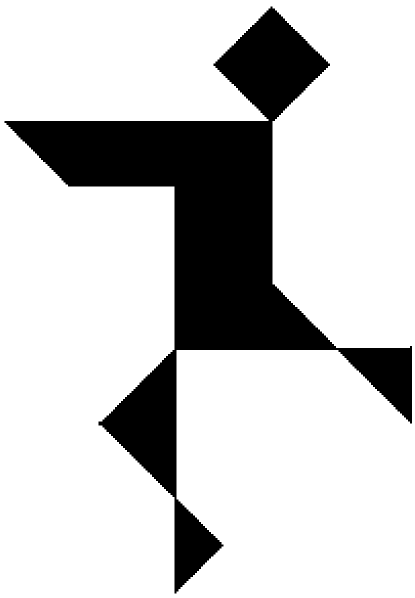
A Horse

Use all your tangram pieces to make a horse like this:



Now use your tangram pieces to make these pictures.





Now use your tangram pieces to make your own pictures. Try to use **all** the pieces. Give each picture a name.

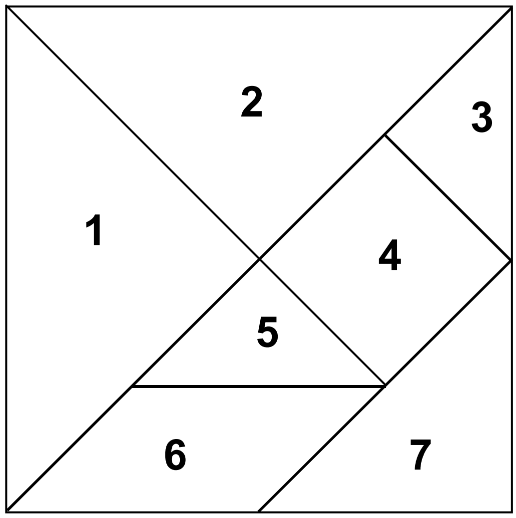
Teacher Notes: A Horse

This activity is for learners to get used to working with the pieces of the tangram. They should be encouraged to use the appropriate terminology when talking about the different geometrical figures.

Learners can be asked how they moved the figures to make them fit – they will have had to turn some figures, for example, figure 4 to make the head of the horse. Figure 6, the parallelogram, needs to be flipped over to make the tail. This is the informal language of transformations (a 'flip' is a reflection and a 'turn' is a rotation).

Learners in the higher grades can be asked why figure 6 has to be flipped and not figure 4 – they will have to focus on the properties of these figures.

Making New Figures 1



1. Use figures 3 and 5 to make a square the same size as figure 4. How do you know that the figure you have made is a square?

2. Use figures 3 and 5 to make a triangle the same size as figure 7.

3. Use figures 3, 5 and 7 to make a square. How do you know that the figure you have made is a square?

4. Use figures 3, 4 and 5 to make a rectangle. How do you know that the figure you have made is a rectangle?

5. Use figures 3, 4 and 5 to make a triangle the same size as figure 2. Is there only one way?

6. Now use figures 3, 5 and 6 to make a rectangle. How do you know that the figure you have made is a rectangle? Is there more than one way?

Teacher Notes: Making New Figures 1

The tangram is a very rich tool for exploring a range of geometrical figures and concepts, for example,

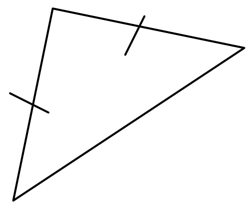
- *In creating the required figures and justifying the figures they have made, learners have to focus on the **properties of figures***
- *In creating figures that are the same size and shape as other (as in question 1), learners are creating **congruent** figures. This also provides an opportunity for comparing the **area** of the different figures*
- *In creating larger figures learners are required to **transform** the figures and can be encouraged to describe these movements.*

The first activity focuses on figures that will be familiar to most learners, for example, squares, rectangles and triangles. Other figures are studied in the activity “Making New Figures 2(b)”. Although learners might not recognise the name of a figure, drawings can be given to show what figure must be made (as shown in the activity “Making New Figures 2(a)” below. This can also be used as an opportunity to reinforce terminology.

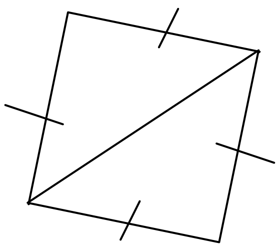
The aim of this activity is to focus the learners on the properties of the different geometrical figures This is important in preparing learners for thinking on the van Hiele analysis level. It is also a useful context to reinforce the correct mathematical terminology for the different figures and geometrical concepts.

In each case learners should be challenged to consider whether there is more than one way of making the required figure.

For question 1 a learner on the visual level will claim that the figure s/he has made "looks like square", but s/he should be encouraged to look at the sides and the angles. For example, by folding triangle 3 a learner will be able to see that two sides of this triangle are equal as shown below:

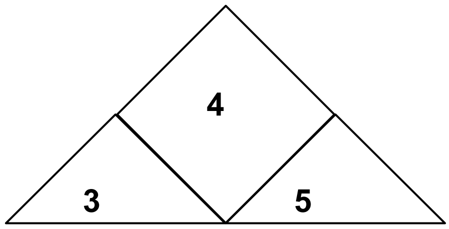


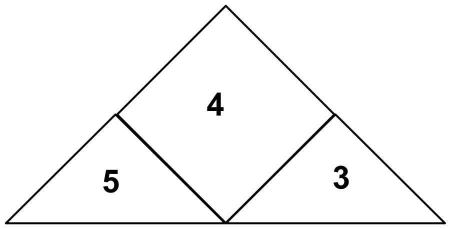
Figures 3 and 5 are the same size and shape (this can be seen by placing the one directly on top of the other) - the teacher can indicate that these are known as "congruent" triangles. Thus all the sides of the new figure are equal as shown:



In the higher grades the learners' attention can also be focused on the angles of the square - by measuring and then folding to determine which angles are equal. Equal angles can also be determined by rotating the square. The word diagonal can be used to describe the line joining the opposite vertices. Learners should also note the line symmetry across the diagonal line.

In questions 5 and 6 learners should be challenged to consider in what way the different arrangements are actually different. For example, the following triangles can be made in question 5:





Triangles 3 and 5 are congruent so the above two arrangements are congruent. It is only the labels on the triangles that are different.

Making New Figures 2(a)

1. Use figures 3 and 5 to make a parallelogram the same size as figure 6. Is there more than one way? How do you know the new figure is a parallelogram?

2. Use figures 3, 5 and 6 to make a parallelogram. Is there more than one way? How do you know the new figure is a parallelogram?

3. Use figures 3, 5 and 6 to make a rectangle. Is there more than one way? How do you know the new figure is a rectangle?

4. Use pieces 1, 3, 4 and 5 to make a rhombus.

5. Use pieces 1 and 7 to make a trapezium.

6. Use pieces 1, 2, 3, 5 and 6 to make a rectangle.

7. Use pieces 1, 3, 4 and 5 to make **a five-sided shape**. What do we call this shape?

8. Use **smaller** figures to make each of the following figures. In each case explain how you know you have made required figure.
   (a) figure 1
   (b) figure 7

9. Yusuf says it is not possible to make the square made with figures 1 and 2 **without using figure 1 or 2**. Do you agree with Yusuf?

10. Now use your tangram pieces to make as many different geometrical figure as you can. Try to give each figure a name.

Making New Figures 2(b)

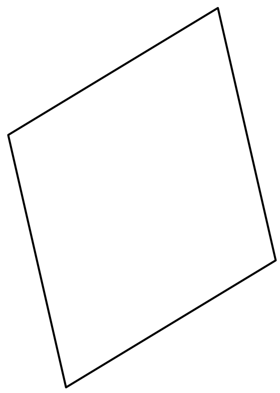
1. Use figures 3 and 5 to make a figure the same size and shape as figure 6. Is there more than one way? Do you know the name of this figure?

2. Use figures 3, 5 and 6 to make a figure the same shape as this:

   Is there more than one way?

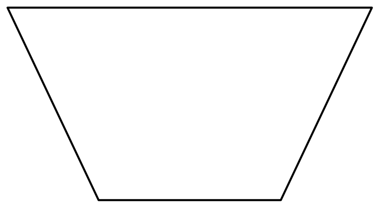
3. Use figures 3, 5 and 6 to make a rectangle. Is there more than one way? How do you know the new figure is a rectangle?

4. Use pieces 1, 3, 4 and 5 to make a figure the same shape as this:



   Do you know the name of this figure?

5. Use pieces 1 and 7 to make a figure the same shape as this:



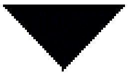
   Do you know the name of this figure?

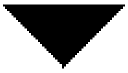
6. Use pieces 1, 2, 3, 5 and 6 to make a rectangle.
7. Use pieces 1, 3, 4 and 5 to make **a five-sided figure**. What do we call this figure?
8. Use **smaller** figures to make each of the following figures. In each case explain how you know you have made required figure.
   (a) figure 1
   (b) figure 7
9. Yusuf says it is not possible to make the square made with figures 1 and 2 **without using figure 1 or 2**. Do you agree with Yusuf?
10. Now use your tangram pieces to make as many different geometrical figure as you can. Try to give each figure a name.

Teacher Notes: Making New Figures 2(a) and (b)
The teacher should select the appropriate activity here.

*In question 10 learners should be encouraged to consider as many different polygons as possible – more quadrilaterals, including trapeziums and **irregular** quadrilaterals. Polygons (regular and irregular polygons) with more that four sides should also be considered. Learners might not know the correct vocabulary for their new figures and the teacher should provide guidance here.*

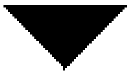
Geometrical Figures and Fractions

1. How many  are in  ?

2. How many  are in  ?

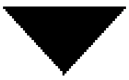
3. How many  are in  ?

4. How many  are in  ?

5. If  = 1, then  =

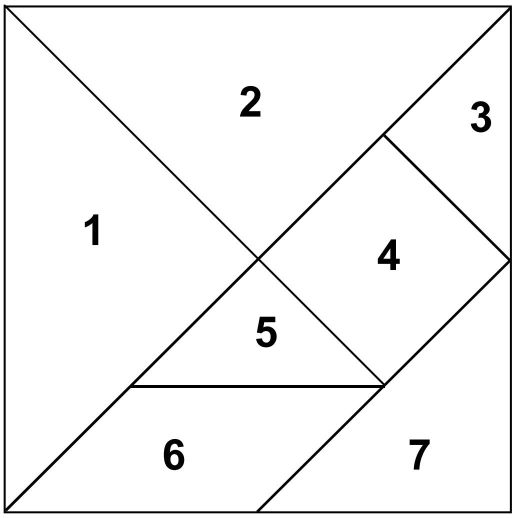
6. If  = 1, then  =

7. If  = 1, then  =

8. If  = 1, then  =

Adapted from http://math.rice.edu/~lanius/Patterns/add.html

Geometrical Figures and Fractions



1. If Triangle 1 is $\frac{1}{4}$ of the whole tangram, what fraction of the whole tangram is Triangle 2?

2. What fraction of the whole tangram is Triangle 7? Why do you say so?

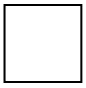
3. Why is Triangle 3 called $\frac{1}{16}$ of the whole tangram?

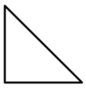
4. What fraction of the whole tangram is Triangle 4?

5. What fraction is the parallelogram of the whole tangram?

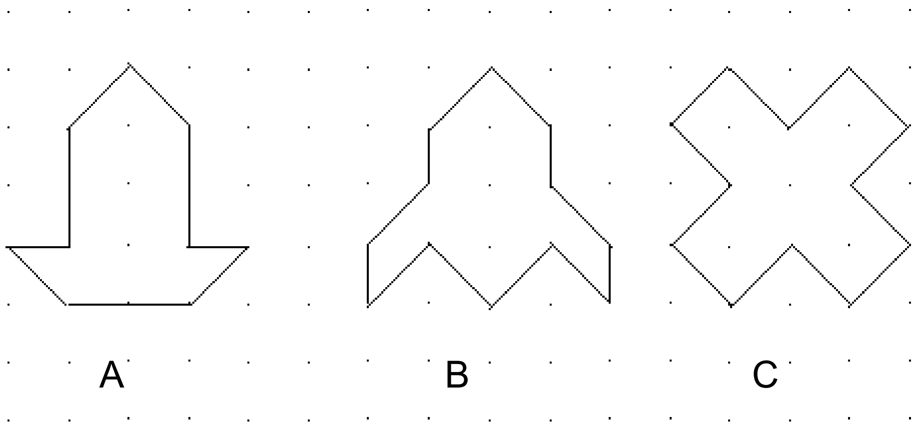
6. Can you write a fraction name for each tangram piece and show that, if you add all the fractions you will get 1?

Geometrical Figures and Area

1. If the area of  is 1 square centimeter ($1\ cm^2$),

   what is the area of  ?

2. Haadiya says she can find the area of each of the following drawings by using the area of both the square and triangle showed above. Can you help her?

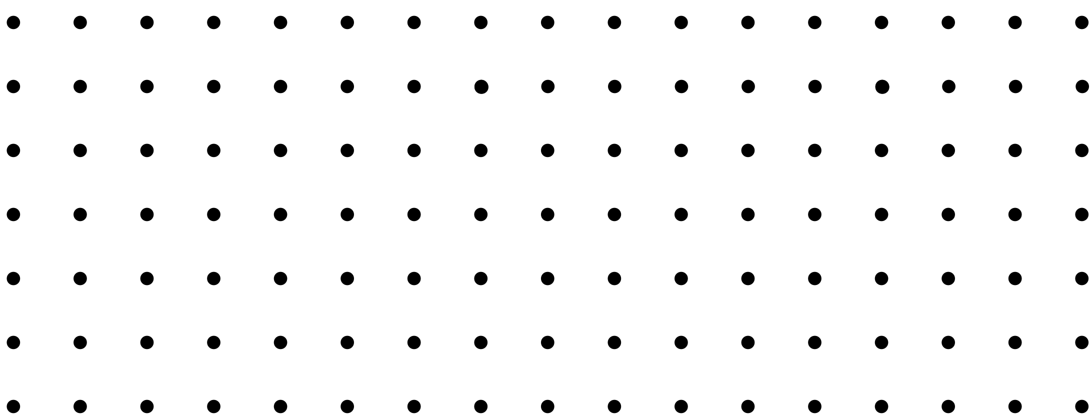


Area of A =

Area of B =

Area of C =

3. Draw a figure of your own the dotty paper below and ask your group to calculate the area of it? Use the area of the square and the triangle from above.



Let's Play an Area Game

This is an area game for two players – Player X and Player Y

1. Player X draws a line from one dot to another.
2. Player Y draws a line in the same way.
3. Each one can only draw one line at a time.
4. The line can be separate from your partner's one or it can be connected to it.
5. The one who draws the last line that will form a square, writes his/her name in the square.
6. If a player sees that more than one square can be completed because of his/her last line, that player completes all the squares that he or she can notice.
7. The winner is the one with the most squares.
8. Each player calculates the area of the squares completed by him/her.