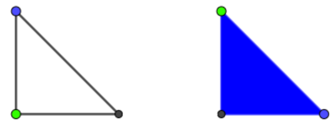
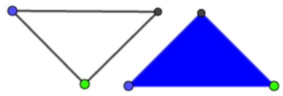
Making a Tangram in GeoGebra

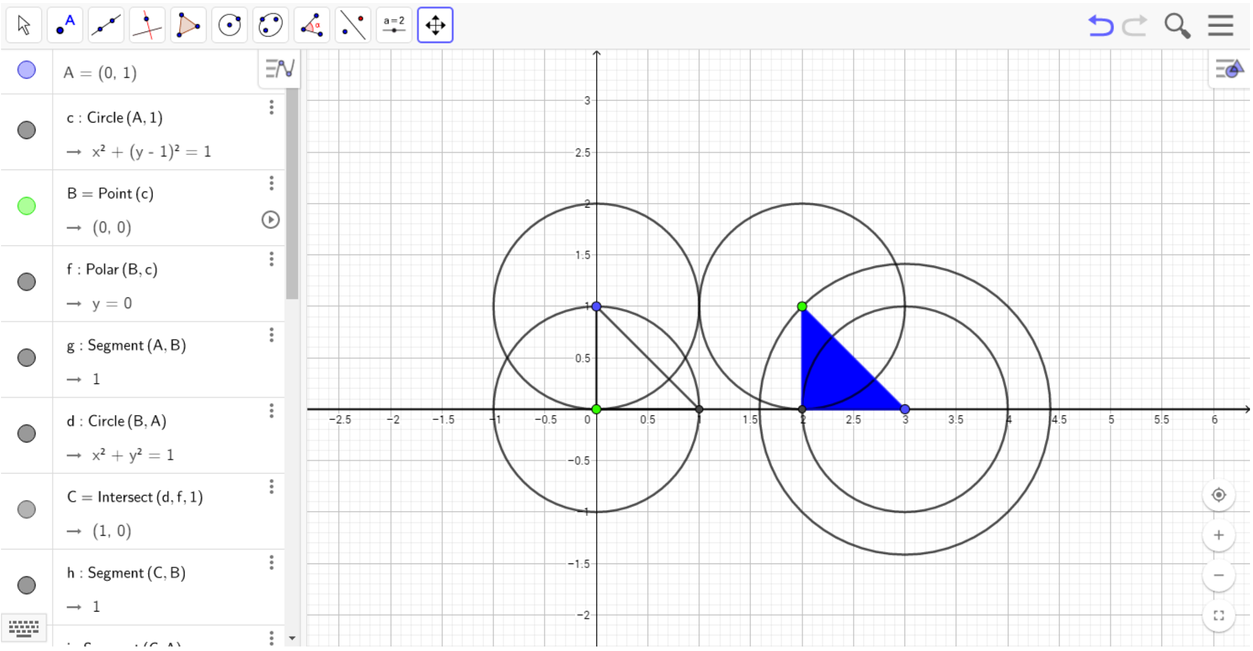
For the basics of GeoGebra, you will find many videos online such as the nice YouTube **introduction to GeoGebra 4.2** by Andrew Martin. **GeoGebra** has tens of millions of users, so it is not surprising that it has been updated over the years (see the **download options**). The version shown here is **GeoGebra Classic 6**.



In this tutorial, we will outline how to make 'dynamic' triangles such as the pair to the left, in such a way that their position and orientation can be easily changed (as seen to the right). This is all that is necessary to make a tangram app like **this one**.

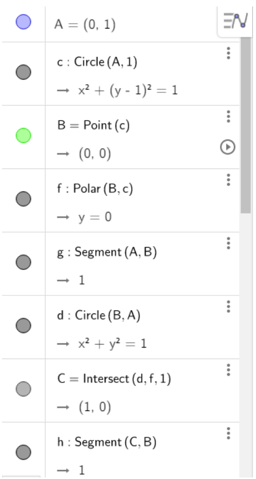


The finished product (with all the technical details) might look like this:

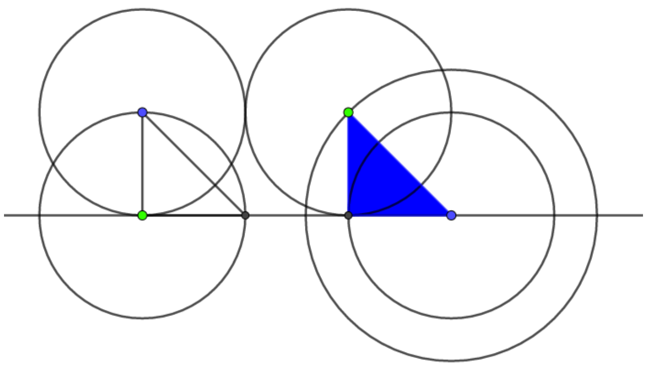


On the top, you see the **toolbar**:

There are 11 icons, each with a dropdown menu. We will mention just a few of these (named icon1 to icon11). Check out a video on YouTube for a more thorough tutorial.



To the left of the screen shown above is the **algebra view**, while to the right is the **graphics view**. The axes and grid can be shown (as above) or hidden (as on the right) in the graphics view.
Five circles and one horizontal line were used to construct the two triangles – these are easily hidden (with right-click and Show Object).



Let’s start with the algebra window and graphics window displayed. For convenience of construction show both the axes and the grid in the graphics window. It’s a good idea (as recommended in Martin’s YouTube) to choose **No New Objects** in the **Labelling** menu in **Options** (accessed from the three horizontal lines symbol, top right). There are just 16 steps to construct the triangles:

1. Choose icon2 and click on any point, e.g. (0,1) on the grid.	1. This point is shown as A = (0,1) in the algebra window. [If the axes are shown then A will be constrained to the vertical axis; so it’s best to hide the axes temporarily before creating A.]
2. Choose icon6.2 (the second dropdown option for icon 6 – Circle with Centre and Radius) to draw a circle with centre A and radius 1.	2. This will ensure that each of the equal sides in our isosceles triangle have length 1.
3. Choose icon2.1 and click on the circle. The resulting point, B = Point(c) in the algebra window, is constrained to the circle.	3. It’s best initially not to choose the origin (0,0) for B, but to choose another point on the circle (and later move it to the origin as desired).
4. Choose icon4.6 and click on B and then the circle. This will give a tangent to the circle at B, ensuring that the triangle will be right-angled.	4. A **polar line** is more general than a tangent, but the details are unimportant here.
5. Choose icon3.2 and click on A and B to create one of the sides of the triangle	5. Steps 4 & 5 can be interchanged without affecting the result.
6. Choose icon6.1 to draw a circle with centre B and radius BA (= 1).	6. This icon draws a Circle with Centre through Point
7. Choose icon2.4, the intersect tool, to create C where the second circle intersects the tangent to the first.	7. We now have all three vertices of the (isosceles right-angled) triangle.
8. Join BC (using icon3.2), as in step 5.	8. The second equal side of the isosceles triangle is drawn.
9. Join CA.	9. Now the first triangle is complete.
10. Choose another point, D, to start the second triangle.	10. This point, D, is shown as (3,0), but best to place it initially off the horizontal axis – see note 1.
11. Using icon6.2 draw a circle with centre D and radius square root of 2.	11. Type sqrt(2) in the dialogue box. This is the length of the hypotenuse of the triangle (having the other two sides of length 1).
12. Place a point, E, on this circle, as in step 3.	12. This is shown at (2,1), but it can be anywhere on the circle.
13. Draw a circle with centre E and radius 1.	13. The third vertex will lie on this circle.
14. Draw a circle with centre D and radius 1.	14. It will also lie on this circle. 13 & 14 are interchangeable.
15. Using icon2.4, choose one of the points of intersection, F, of the two circles.	15. Which you choose matters … think why …
16. Use icon5.1 to draw the triangle, DEF. Be sure to complete the triangle, clicking on D, E, F & D.	

Finally you can change the format of the objects to suit your preferences. To achieve the result shown:

- right-click on the triangle, DEF, and choose Settings, then the Colour tab; choose blue and set the Opacity to 100
- colour vertices A & D blue, and vertices B & E green
- hide the circles and the tangent line (see bottom of previous page)

The blue vertices can be positioned anywhere on the plane. The green vertices are constrained to move on circles, so that their distance from the respective blue vertex is fixed.

Think about the order in which these triangles were made and the ‘design’ of the blue tangram tile. You are now ready to make further tangram tiles choosing your own shapes and constraints. Once you have made your tangram collection, you can design lessons around it.