

Tessellations that use only translations have tiles that all face in the same direction. Using rotations, you can make a tessellation with tiles facing in different directions. The designs in a rotation tessellation have rotation symmetry about points in the tiling.

## SKETCH AND INVESTIGATE

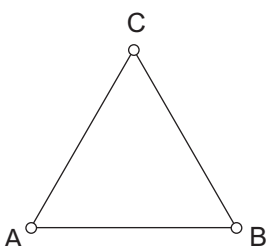
Use a custom tool (such as one in the sketch **Tessellations Using Rotation.gsp**) or construct the triangle from scratch.

Double-click the point to mark it as a center. Select the segments and points; then, in the Transform menu, choose **Rotate**.

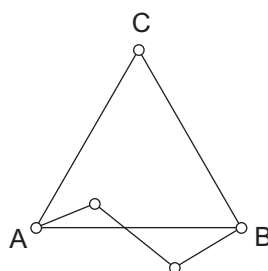
1. Construct equilateral triangle  $ABC$  as shown.

2. Construct two or three connected segments from  $A$  to  $B$ . We'll call this *irregular edge*  $AB$ .

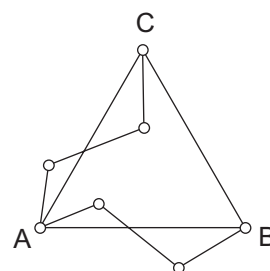
3. Mark point  $A$  as a center for rotation. Then rotate all the points and segments of irregular edge  $AB$  by  $60^\circ$ .



Step 1



Step 2



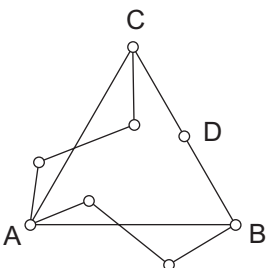
Step 3

4. Construct midpoint  $D$  of side  $CB$ .

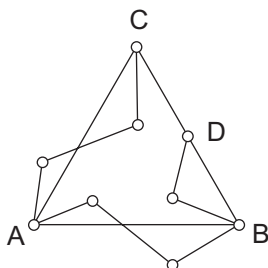
5. Construct two connected segments from  $B$  to  $D$ . We'll call this *irregular edge*  $BD$ .

6. Mark point  $D$  as a center for rotation. Then rotate the point and segments of irregular edge  $BD$  by  $180^\circ$ .

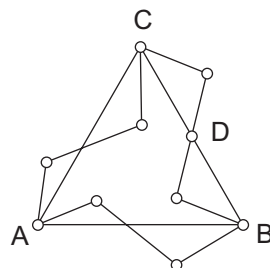
7. You have finished the edges of your tile. Drag points to see how they behave. When you're done, make sure none of the irregular edges intersect.



Step 4



Step 5

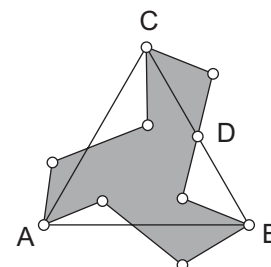


Step 6

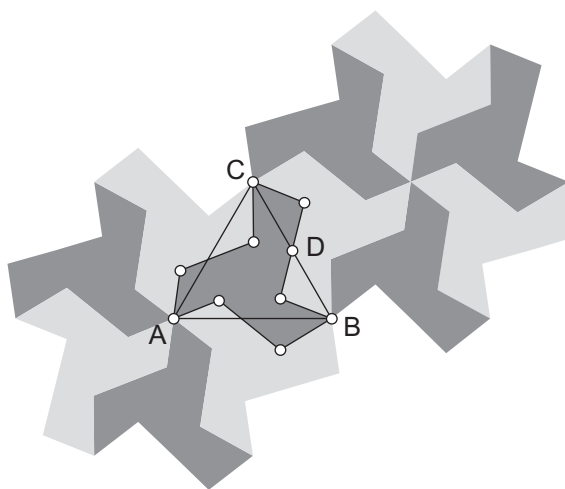
Select the vertices in consecutive order; then, in the Construct menu, choose **Polygon Interior**.

Change the color of your tiles using the Display menu.

8. Construct the polygon interior with vertices along the irregular edges.
9. To begin tessellating, mark point *A* as a center and rotate the tile interior six times by the appropriate number of degrees to surround point *A* with tiles. Change the color of alternate tiles.



10. Mark point *D* as a center and rotate the six tiles by  $180^\circ$ . Reverse their shading as necessary to keep a clear shading pattern.



- Q1** Look at the tiles surrounding point *A*. What kind of rotation symmetry would the completed tessellation have about this point?
- Q2** Look at the tiles surrounding point *D*. What kind of rotation symmetry would the completed tessellation have about this point?
- Q3** Look at the tiles surrounding points *B* and *C* so far. What angle of rotation will you have to use to fill in tiles around these points?
11. Use the appropriate rotations to fill in tiles around points *B* and *C*. If you choose an angle that doesn't work right, undo and try a different angle. Change your answer to Q3, if necessary.
12. Drag vertices of your original tile until you get a shape that you like or that is recognizable as some interesting form.