# Mathematics and Art

Interactive GeoGebra Worksheet on Plane Tessellation - Square Basis

Goal: To enable Maths educators to construct and explore plane tessellation patterns with three-fold symmetry dynamically and interactively with GeoGebra.
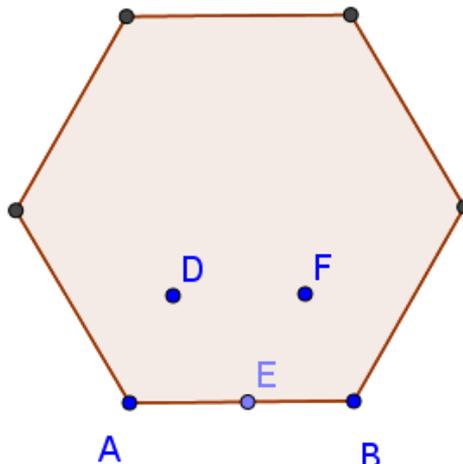
Relevant Maths Keywords and Concepts:

Tessellation, Tiling, Square, Symmetry, Regular Polygon, Hexagon, Vertices, Line Segment, Edge Rotation, Translation, Vector, Midpoint.
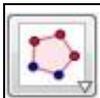
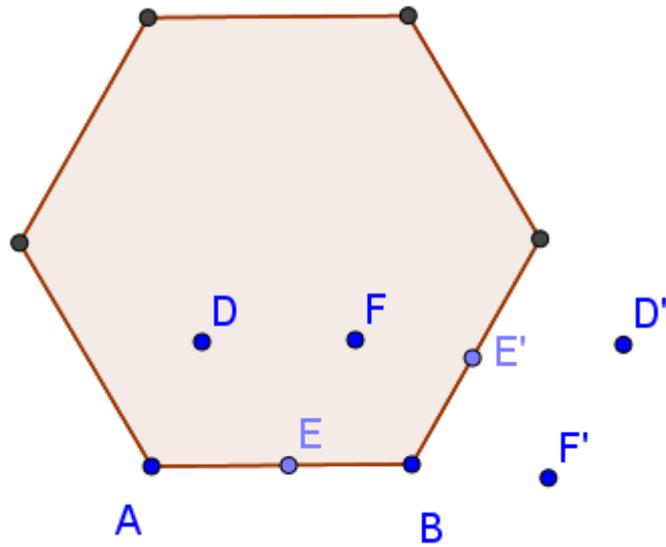|	
	1. Use the **Regular Polygon** tool to construct a regular hexagon.
	2. Use the **Point** tool to construct points *D* and *F* in the interior of the hexagon and point *E* on line segment *AB* as indicated.

3. Use the **Rotate Object around Point by Angle** tool to rotate points *D, E* and *F* 120° clockwise around point *B* to form *D', E' and F' as indicated*.
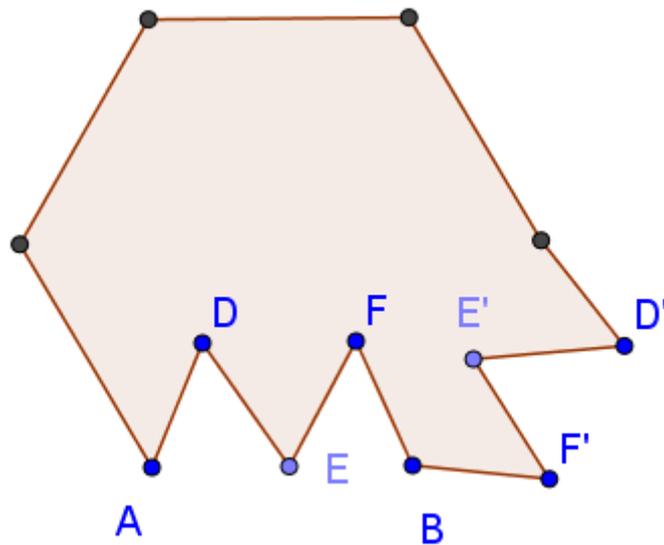
D   F
D'
E'
E
F'
A   B

4. Right-click in the interior of the hexagon and deselect **Show Object** to hide the hexagon.
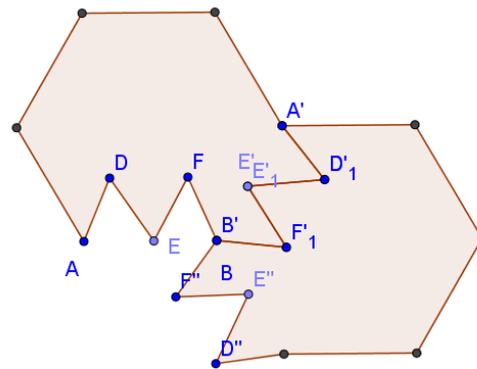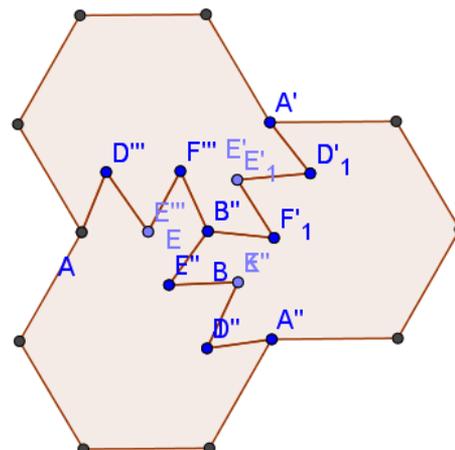
D   F
D'
E'
E
F'
A   B
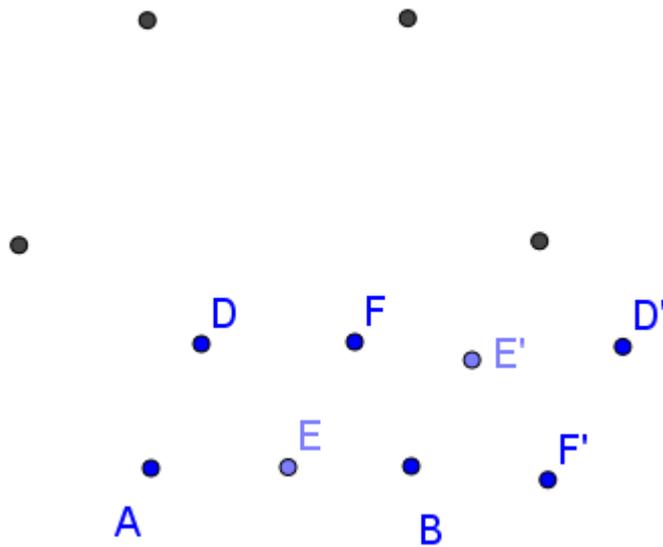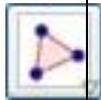
5. Use the **Polygon** tool to construct polygon as indicated.

6. Use the **Rotate Object around Point by Angle** tool to rotate the polygon 1200° clockwise around point *B*.

Continue to rotate the new images around point *B* until you fill the space around vertex *B*.

7. Color each of the six polygons a different color. Right-click a polygon, go to **Object Properties** and click the **Color** tab. Select a color and click **Close**. Repeat for the remaining two polygons. Click the **Style** tab to increase the color filling if desired.
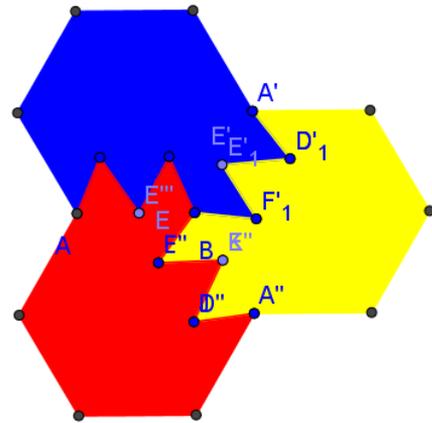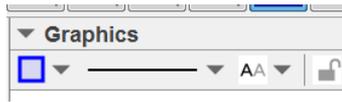
8. Turn off labels for all points except *A, B, D, E, F*. Right-click a point and go to **Object Properties**. Use Ctrl-click to select all points except for *A, B, D, E, F*. Uncheck **Show Label** and **Show Object**.
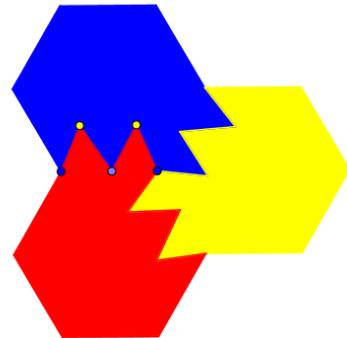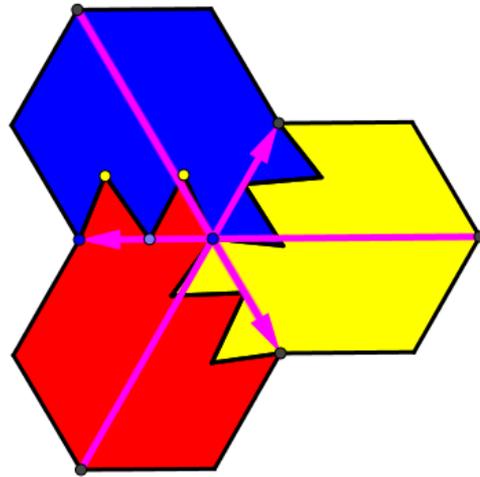
9. Select all segments in Algebra View by selecting Segment as indicated below left. Now choose Black as color for all segments and increase the segment width to show more prominently.
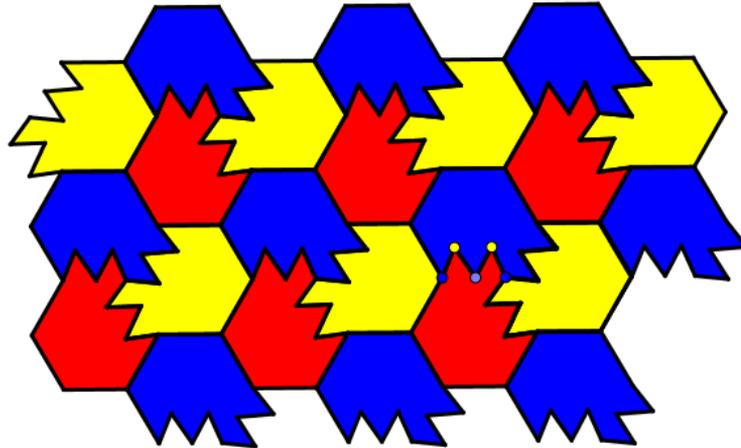
Segment
- a = 0.8
- a' = 0.8
- a'' = 0.8
- a''' = 0.8
- b = 0.58
- b' = 0.58
- b'' = 0.58
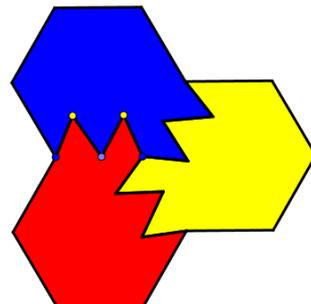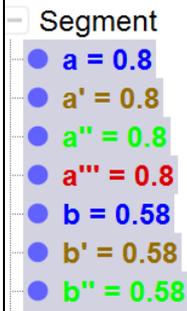
10. Use the **Vector between Two Points** tool to construct vectors **u**, v and **w** as indicated.

11. Use the **Translate Object by Vector** tool to translate each of the three colored polygons as illustrated. Choose the tool indicated in the column on the left, select each one of the colored polygons (as illustrated) and then one of the vectors **u, v** or **w. Repeat until** the pattern below is created**.** This may take some time as each translation has to be effected separately. Once done, hide the vectors.
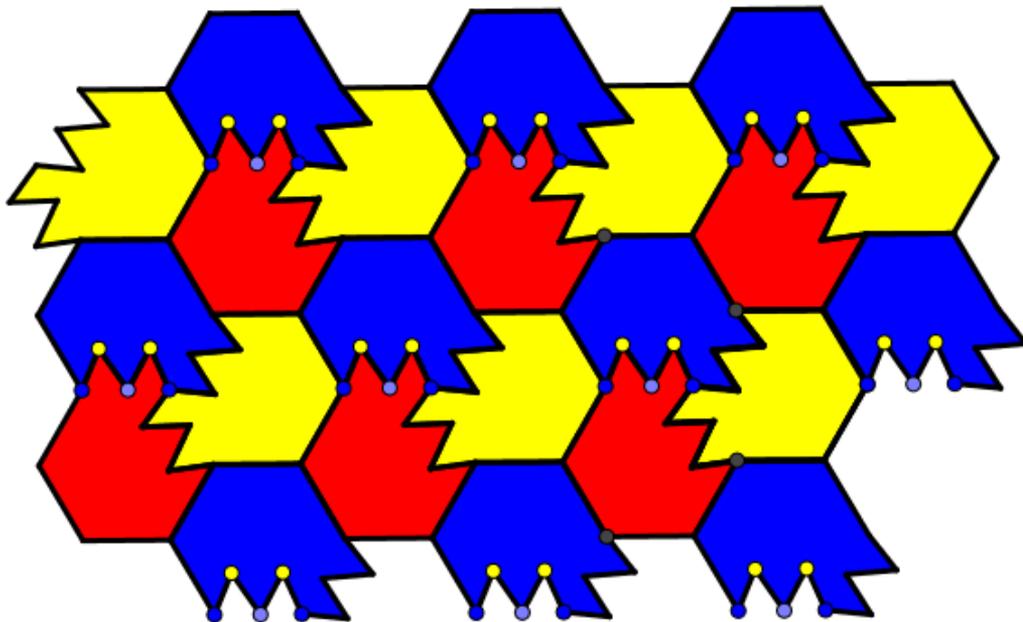
12. Hide all points except points *A, B, D, E* and *F*. Drag these points to change the shape of the tessellation pattern.

Explore Artistic Features!!!!!