Objective: In this lesson, you will describe the rotations and reflections that carry a given rectangle, parallelogram, trapezoid, or regular polygon onto itself.

Rotations

When a regular polygon is rotated about its center, the number of times it maps back onto itself in one complete rotation is equal to the number of sides, \( n \), of the polygon.

A rotation through an angle of \( \frac{360°}{n} \) about the center maps one vertex exactly onto the next vertex in the preimage.

How many different angles will each of the following regular polygons map onto itself?

Square - ________________  Pentagon - ________________  Hexagon - ________________

When you rotate a rectangle counterclockwise about its center, you'll observe that the rotated rectangle coincides with the preimage only at 180° and 360°.
In diagram A, a parallelogram rotates 180° counterclockwise about its center. In diagram B, a trapezoid rotates 360° counterclockwise about its center.

Example

A regular hexagon rotates counterclockwise about its center. It turns through angles greater than 0° and less than or equal to 360°. At how many different angles will the hexagon map onto itself?

________________________________________

Example

An $n$-sided polygon rotates 360° about its center, $P$. The image coincides with its preimage $n$ times during the rotation. What can you conclude about this polygon?

________________________________________
Reflections

There are six lines of reflection across which a regular hexagon can map back onto itself.

The number of lines of reflection is the same as the number of sides, \( n \), of the polygon.

Hexagon: ______ lines of reflection

Pentagon: _______ lines of reflection

rectangle: ________ lines of reflection

rhombus: ________ lines of reflection

trapezoid: ________ lines of reflection
Example

[Image of a GeoGebra activity on returning a polygon to its original position, showing different shapes and the number of lines of reflection needed to return them to their original position.]
Summary

This table summarizes the rotation and reflection properties of the polygons you studied in this lesson.

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Rotation About the Center</th>
<th>Lines of Reflection (Lines of Symmetry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>regular polygon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with (n) sides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rectangle (non-square)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>parallelogram (non-square)</td>
<td></td>
<td></td>
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<tr>
<td>trapezoid</td>
<td></td>
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</tbody>
</table>