Math Lesson: Rotational Symmetry

Grades 4-7

Materials:
- Basic shape templates cut from tagboard—triangle to octagon
- Pencils
- Rulers
- Thumbtacks
- White 8.5" x 11" paper
- Colored paper squares, approximately 8" x 8"
- Scissors
- Symmetry Self-assessment

Project Description:
Students will learn about lines of symmetry and rotational symmetry in designs.

Objectives:
Students will learn how to divide a shape along its line(s) of symmetry.
Students will understand that there is a relationship between lines of symmetry and number of sides.
Students will learn how to determine the orders of rotational symmetry for a shape.
Students will learn the relationship between shapes and their lines of symmetry and rotations.

EALRs:
1.3 (Math) Understand and apply concepts and procedures from geometric sense.
5.2 (Math) Relate mathematical concepts and procedures to other disciplines.
5.3 (Math) Relate mathematical concepts and procedures to real-life situations.

Procedure:
Two 50 minute periods
Introduce the concept of symmetry by asking a student volunteer to come to the front of the group. Ask the class to imagine the student being divided in half from top to bottom. What do the two sides have in common? Guide the examples and discussion to the conclusion that the sides are mirror images, or reflections of each other, and that is the definition of symmetry.

Lines of Symmetry Activity:
Use the square shape template, traced and cut from construction paper, as your visual aid for the next section. Ask the students to tell you how you can fold the shape to divide it so that it has symmetrical sides—this is its line of symmetry. Fold the shape to show where the
Some shapes may have more than one line of symmetry. Keep folding until you have found the four lines of symmetry for a square (horizontally, vertically, and across both diagonals).

Next, take a few minutes to have the students look around the room for shapes and objects that are symmetrical. Ask them to identify the line(s) of symmetry in each.

Start a chart on the board like this:

<table>
<thead>
<tr>
<th>Shape</th>
<th>Number of sides</th>
<th>Number of lines of symmetry</th>
<th>Order of rotational symmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Pentagon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexagon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heptagon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octagon</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Distribute the other five shapes to groups of students and have them determine the number of sides and lines of symmetry and complete the chart.

Discuss the pattern and relationship of the number of sides to the lines of symmetry.

**Rotational Symmetry Activity:**
Use the triangle template from the previous activity to explain the concept of rotational symmetry. Tack the triangle in its center (the point where all of the lines of symmetry meet) to a piece of white paper on a bulletin board or other surface. Trace the outline of the triangle onto the white paper. Then rotate the shape until it matches the traced outline again. Ask the class: *How many times will the triangle match the outline as you spin it completely around once?* (three times) You can then say that the triangle has three orders of rotational symmetry. Note: If a shape “matches” itself only once in a full rotation, it does not have rotational symmetry.
Explain that an object has rotational symmetry if there is a center point around which the object is turned a certain number of degrees if the object still looks the same (matches itself) a number of times while being rotated.

Have each group take their shape from the previous activity, tack it against a sheet of white paper against a surface, and then trace the shape. Rotate the shape to find how many orders of rotational symmetry it has. Add that number to the chart above.

Discuss the relationship among all of the numbers for each shape.

**Making Shapes with Rotational Symmetry Activity:**
Give each student a square of colored paper and scissors. Have the class count off by fives. All of the 1s will fold their paper in half once, the 2s twice, etc. Instruct the students to cut into their paper (but not all of the way along the seam!) to make a design.

When the students are finished cutting, have then open up their design and repeat the steps from the above activity to determine how many orders of rotational symmetry their design has. Each student should enter their findings on a chart like the one below:

<table>
<thead>
<tr>
<th>Number of folds</th>
<th>Order of rotational symmetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>One (there will be one entry per student under each number)</td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td></td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
</tr>
</tbody>
</table>

**Assessment:**
Once the chart is complete, discuss the results with the group, and use student examples to illustrate whether the numbers are correct. Students should complete a Symmetry Self-assessment worksheet.

**Extension:**
(Art) Design challenge: create symbols with a particular number of rotational symmetries.
Rorschach designs: fold a piece of paper in half, open it back up, and then put paint “blobs” on one side of the paper. Fold paper back over and press. Open up to see your symmetrical design. What do you see in the design? How many lines of symmetry does it have? Can you make a Rorschach Design with two lines of symmetry?