PBS Mathline®

The Middle School Math Project

Tiling the Plaza

(Geometry)

Objective

Using pattern blocks, students will create a tessellation and examine geometric patterns.

Overview of the Lesson

Students first explore making patterns with a variety of pattern blocks. They next engage in experiments of making tile designs using only one shape by rotating that shape around a point. Finally, they are faced with the situation of entering a contest for creating the best tile design for the new plaza using these geometric shapes. Students are placed into groups and are to use only the blocks with equal sides and equal angles (the triangle, the square and the hexagon) to create a patterned tile design. Each group makes a tile design using combinations of these regular polygons. The students view these designs and vote for the design which they like best.

Materials

Per Student

❶ A set of pattern blocks

❷ A clean sheet of paper

Procedure

Distribute a set of pattern blocks and a sheet of paper to each student. Allow time for them to freely explore creating patterns with these blocks. Students should use the sheet of paper as a mat. Once the patterns have been completed, encourage students to share their designs and comments about their designs with their classmates.

Students should remove all of the blocks from their mats to prepare for the next phase of this lesson. Have students place a dot (representation of a point) anywhere on their mat. They are then to select one of the shapes from their collection of pattern blocks. Tell them to place a vertex of this shape on this point and to trace it as many times as possible by rotating it around this point, with no overlapping. Circulate to be sure students understand the directions.

Once this has been completed, engage the students in a discussion concerning the number of degrees in the angles of these regular polygons. (See ***Mathematically Speaking . . .***)

Mathematically Speaking . . .

There are 360 degrees in a complete circle. By rotating a regular polygon around a point, the number of degrees in the angles of a particular shape can be determined by counting the number of times this shape was used to be completely rotated around this point. Divide this number into 360 degrees. The resulting answer is the number of degrees contained in the angle of this polygon. For example, a vertex of 6 equilateral triangles can be rotated around a point. Therefore, the number of degrees in each angle of this triangle is 60 degrees. If the acute angle of the rhombus is used, then it takes 6 rhombi, and the number of degrees will be 60. If the obtuse angle is used, then the number of degrees is 120 because only three rhombi can be used to rotate around the point.

Have students continue tracing their selected shape on their mat. They will soon see how the entire mat can be covered with the chosen pattern. Solicit responses as to what this type of patterning is called. Students may be aware that the designs being generated are called *tessellations*. If a shape or combination of shapes can completely cover the plane with no spaces and no overlaps, it is a tessellation. You could say, “a rectangle tessellates the plane.”

Present a hypothetical scenario of a special contest which is taking place in your locale which involves the tiling of a new plaza. For example you may say:

> “It was decided by your City Council that since the new plaza will be a public place for its citizens, the citizens should have an opportunity to design the tile pattern. Each entry should fit within the same sized square, so that it is fair for judging purposes. The task is to create a design that tessellates the square and submit it for consideration to the City Council.”

Divide the class into groups of four. Suggest to the class that each group will represent a company which is submitting an entry for consideration in the *Tiling the Plaza* contest. Using the pattern blocks, each company is to create a design using the tiles on the floor of the classroom If your classroom does not permit this, supply a square sheet of paper for each group to use. Entries can only include the shapes from the pattern blocks which have equal sides and angles (regular polygons).

After students create their patterns, they should circulate around the room to view the patterns of the other groups. Finally, allow each student to vote for the design that is aesthetically appealing to them.

Conclude the lesson by having students identify tessellations in their world. Also allow them to share some of their practical uses.

Extensions & Connections

Give students a square. Have them cut a small triangle out of one side of the square, and carefully tape it to the opposite side of the square. Trace this new shape, cut it out, and see if it will tessellate the plane. Let students try this procedure with other shapes. (It will work with quadrilaterals).

Resources

Escher, M.C. and J.C. Locher. *The World of M.C. Escher*. (1972) New York: Henry Abrams.

TesselMania! MECC. (1994) Minneapolis, Minnesota.