RAFT IDEAS

Topics: Identifying Geometric Shapes, Tessellations, Penrose Tiling

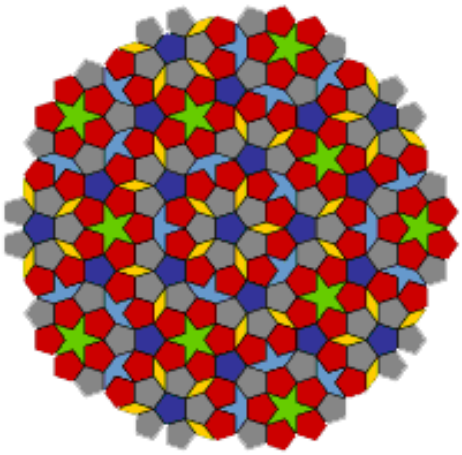
Materials List
- ✓ Cardstock, colored
- ✓ Penrose tile patterns, die cuts available at RAFT

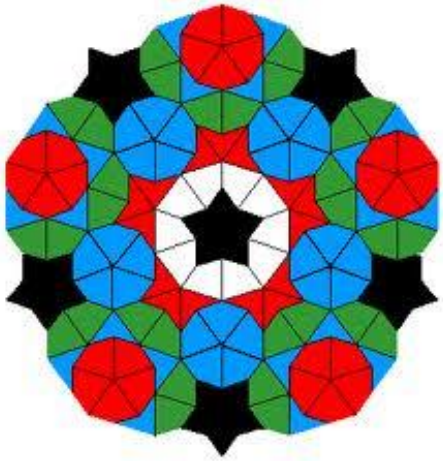
This activity can be used to teach:
Common Core Math Standards:
- Describe, Compare, Classify objects (Grade K, Measurement and Data, 1, 2, & 3)
- Describe, Compare, & Classify shapes (Grade K, Geometry, 1, 2, 3, & 4)
- Patterns (Grade 1, Measurement / Data, 4.1; Grade 4, Ops./ Algebraic Thinking, 5)
- Shapes / attributes (Grade 1, Geometry, 1-2; Grade 2, Geom.; Grade 3, Geom.; Grade 4 Geom.; Grade 5, Geom., 3-6; Grade 6, Geom.; Grade, 7, Geom.)
- Symmetry, rotation, reflection, congruence (Grade 8, Geom., 1-5)
- Problem Solving and Reasoning (Math Practices Grades K-12)

raft resource area for teaching
www.raft.net

What are Penrose Tiles?

Make beautiful mathematical designs with Penrose Tiles!





Create many interesting designs that tessellate by fitting together Penrose tile shapes!

Assembly

1. Cut out or die cut Penrose tile shapes from colorful cardstock

To Do and Notice

1. Arrange shapes on a flat surface so that shapes tessellate with each other – no gaps or overlaps.

The Math Behind the Activity

Penrose tiles are simple examples of aperiodic tilings of the plane because the patterns made by the tiles do not repeat in periodic intervals. When individual tiles fit together with no gaps or overlaps to fill a flat space like a ceiling, wall, or floor, the arrangement of pieces, or tiles, is called a tessellation, or a tiling. Mathematically, the tessellation would go on infinitely in all directions on the planar space. The most familiar tilings (e.g., with squares or triangles) are periodic: a perfect copy of the tiling can be obtained by translating all of the tiles by a fixed distance in a given direction. British physicist and mathematician Sir Roger Penrose of the University of Oxford came up with a special tiling that uses two shapes, a kite (a rhombi) and a dart (another type of rhombi, also known as a concave kite). There are seven ways to arrange darts and kites around a vertex in a Penrose tiling, and only two of them have perfect pentagonal symmetry!

Kite

Dart

There are other types of Penrose shapes that tessellate. For example, Penrose's tiling on the top left side of this page uses pentagons and three other shapes: a five-pointed "star" (a pentagram), a "boat" (roughly 3/5 of a star) and a "diamond" (a thin rhombus).

Taking it Further

- Glue shapes onto a larger piece of paper to create a poster.
- Measure angles and determine why a particular combination of Penrose tiles will tessellate and others will not.

Web Resources (Visit www.raft.net/raft-idea?isid=639 for more resources!)
- More about Penrose tiles -http://mathworld.wolfram.com/PenroseTiles.html & http://jointmathematicsmeetings.org/samplings/feature-column/fcarc-penrose

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