Name(s)	Project Number
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Project Title

The Glorious Unfolding: Similarities between Flexagons, Mobius Loops, and Klein Bottles

Abstract

Objectives/Goals

Study how shape and dimensionality determines the number of sides on a shape and investigate the similarities and differences between flexagons, Mobius loops, and Klein bottles.

Methods/Materials

Create paper models of loops with various number of half twists, create various types of flexagons, and crate a Klein bottle. Determine number of sides. Cut models in half and observe results. Create transition diagrams for flexagons.

Results

Through my experiments, I found that Mobius loops with an odd number of half twists are one sided, while those with an even number have two sides. Hexaflexagons with an odd number of faces are one-sided but hexaflexagons with an even number of faces and all tetraflexagons have two sides. Mobius loops cut into half split into two interlocking loops, except for Mobius loops with one, five and fifteen half twists, which became one longer loop. Trihexaflexagons cut in half resemblance to a Mobius loop with five half twists. I was unable to find a Mobius loop that resembled the hexahexaflexagon when it was cut in half.

When a Mobius loop was cut unevenly, double-sided loops would produce two interlocking loops of equal length. One-sided Mobius loops also produced two interlocking loops but with one of the loops double the length of the other.

Maps were created for the hexaflexagons, showing how to transition from one face to another in the fastest way possible using a Tuckerman Traverse diagram.

Conclusions/Discussion

All one-sided shapes have an odd number of twists. Because Klein bottles are one sided, they can only be made from loops with an odd number of twists. Every hexaflexagon with an odd number of faces has only one side, which means that an odd-faced hexaflexagon is a flat, one-sided shape with multiple faces.

Summary Statement

Are there similarities in flexagons, Mobius loops and Klein bottles?

Help Received

None other than from listed reference materials.