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Paper Pentasia: an aperiodic surface in modular origami.

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In the 1980s, R. Penrose introduced a pair of tiles, a “kite” and a “dart”, that (with an appropriate matching rule) tile the plane non-periodically. He also introduced a second nonperiodic tile set whose tiles are two different rhombs. J. H. Conway discovered a way, unpublished until the article under review appeared, of replacing the kite and dart by pairs of equilateral triangles in space; the edges of the triangle pairs are skew quadrilaterals, which project to the kite and dart. Replacing each tile of a Penrose tiling by an appropriately positioned triangle pair yields a complicated surface that Conway calls “Pentasia”. In this article, the authors present a modular-origami design whereby “Pentasia” can be built from folded paper. The authors also introduce a similar 3D triangle set that projects to a Penrose rhomb tiling, which they call “Rhombonia”. They show that, while “Rhombonia” tiles (like any other shape) can be folded, the elegant approach used for “Pentasia” does not work. The origami is very easy (comparable to the traditional crane in difficulty.) The mathematics might not be wholly understood at the middle grade level, but should be accessible to a university liberal-arts math class. Actual construction of these beautiful surfaces is encouraged!

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