THE IDEA

* Take a piece of paper, fold it into any flat origami, and make one complete straight cut.
* Now unfold the pieces and see what you get!

THEOREM

Every pattern (plane graph) can be made by folding and making one complete straight cut. This includes single (possibly non-convex) polygons, multiple disjoint polygons, nested polygons, adjoining polygons, and even floating line segments and points.

RECOMMENDED FOLDING PROCEDURE

* Print the pattern as large as possible.
* Pre-crease all the creases (dashed and dot-dashed) by pinching the paper and making sure to follow along the printed lines.
* Reverse the valley (dashed) creases so that all creases have their proper orientation.
* Collapse all the creases simultaneously. This can take some practice, especially on the more complex examples, but with some effort you should be able to get it.

PATTERN NOTATIONS

* Bold lines are the desired cuts, so you should not fold along them.
* The thin outside rectangle located on some patterns is the intended boundary of the paper. You can cut the paper to those limits after printing if you wish.
* The dashed lines are “valley” folds and should be folded towards you.
* The dot-dashed lines are “mountain” folds and should be folded away from you.
* Some patterns may include a middle line of symmetry. Mountain fold along such a line before you do anything (including pre-creasing).

Background

Folding and cutting goes back to at least 1721, when a Japanese book,

Wakoku Chiyekurabe, (Mathematical Contests), by Kan Chu Sen was published.

Historically well-known Betsy Ross also used the fold and cut method to design the star for our American flag. In 1777, George Washington and a Congress committee asked Betsy to create a flag with thirteen six-pointed stars. She demonstrated how she could fold a sheet of paper and make one cut to form a five-pointed star. They accepted her suggestion, and thus the American Flag was born!

NYS MATH STANDARDS

* K.G.4 Manipulate two- and three-dimensional shapes to explore symmetry
* 1.G.4 Identify symmetry in two-dimensional shapes
* 2.G.6 Explore line symmetry
* 3.G.5 Identify and construct lines of symmetry
* 5.G.11 Identify and draw lines of symmetry of basic geometric shapes
* 8.G.7 Describe and identify transformations in the plane, using proper function notation (rotations, reflections, translations, and dilations)
* 8.G.12 Identify the properties preserved and not preserved under a reflection, rotation, translation, and dilation
* G.G.54 Define, investigate, justify, and apply

isometries in the plane (rotations, reflections, translations, glide reflections)

* G.G.55 Investigate, justify, and apply the properties that remain invariant under translations, rotations, reflections, and glide reflections
* G.G.57 Justify geometric relationships (perpendicularity, parallelism, congruence) using transformational techniques (translations, rotations, reflections)
* G.G.61 Investigate, justify, and apply the analytical representations for translations, rotations about the origin of 90º and 180º, reflections over the lines , , and , and dilations centered at the origin
* K.G.1 Describe characteristics and relationships of geometric objects
* 1.G.1 Match shapes and parts of shapes to justify congruency
* 1.G.2 Recognize, name, describe, create, sort, and compare two-dimensional and three-dimensional shapes
* 2.G.1 Experiment with slides, flips, and turns to compare two-dimensional shapes
* 2.G.2 Identify and appropriately name two-dimensional shapes: circle, square, rectangle, and triangle (both regular and irregular)
* 2.G.3 Compose (put together) and decompose (break apart) two-dimensional shapes
* 3.G.1 Define and use correct terminology when referring to shapes (circle, triangle, square, rectangle, rhombus, trapezoid, and hexagon)
* 3.G.2 Identify congruent and similar figures
* 3.G.3 Name, describe, compare, and sort three-dimensional shapes: cube, cylinder, sphere, prism, and cone
* 4.G.1 Identify and name polygons, recognizing that their names are related to the number of sides and angles (triangle, quadrilateral, pentagon, hexagon, and octagon)

COMMON CORE STATE MATHEMATICS STANDARDS

* K.G.2. Correctly name shapes regardless of their orientations or overall size.
* 4.G.3. Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.
* 8.G.1. Verify experimentally the properties of rotations, reflections, and translations:

a. Lines are taken to lines, and line segments to line segments of the same length.

b. Angles are taken to angles of the same measure.

c. Parallel lines are taken to parallel lines.

* 8.G.2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
* 8.G.3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
* G-CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
* G-CO.4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
* G-CO.5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.