

## **PRINCIPLES OF ORIGAMI**

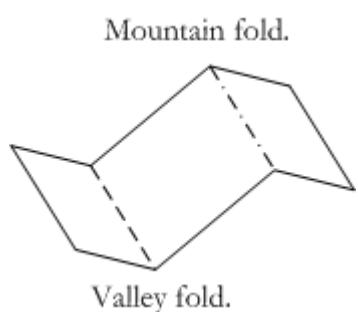
Origami, the ancient Japanese art of paper folding, is much more than a craft; it is a beautiful blend of creativity and mathematics, particularly geometry. By transforming a flat sheet of paper into intricate three-dimensional shapes, origami demonstrates geometric principles tangibly and engagingly. Let's dive into the fascinating world of origami and explore the geometry behind this elegant art form.

### **The Basics of Origami Geometry**

At its core, origami involves folding a square piece of paper into various shapes without cutting or gluing. These folds create creases that act as the edges of geometric figures. The starting point, a square, is a fundamental geometric shape, and through a series of folds, it can be transformed into complex structures such as animals, flowers, or even abstract forms. The primary operations in origami involve basic geometric transformations: reflections, rotations, and translations. When you fold a piece of paper, you are essentially reflecting parts of the paper across a crease line. This crease line, known as a fold line, becomes an axis of symmetry. The angles and lines created by these folds are the building blocks of origami's geometric nature.

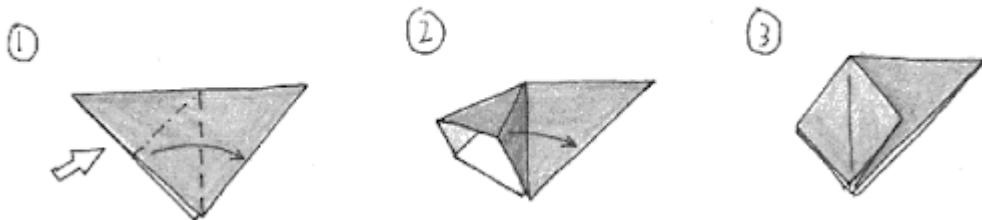
### **Types of Folds and Their Geometric Significance**

**Valley and Mountain Folds:** The simplest and most common folds in origami are the valley fold and the mountain fold. A valley fold creates a crease that bends the paper downwards, forming a V shape, while a mountain fold bends the paper upwards, forming an inverted V. These folds are akin to creating angles in geometry and are the basis for more complex folding techniques.



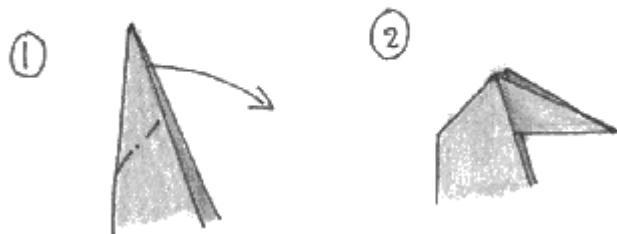
**Squash Fold:** This involves flattening a part of the paper to create new creases, often forming right angles or other specific angles. It's a perfect example of how folding can transform shapes and angles, making it a practical demonstration of geometric concepts.

### Squash fold



**Reverse Fold:** This fold changes the direction of a part of the paper by reversing a previous fold. It's like flipping an angle inside out and is crucial for creating detailed features in origami models.

### Reverse fold



## Origami and Mathematical Theorems

Origami is not just an art but also a subject of mathematical study. One of the fascinating areas is origami's ability to solve geometric problems and prove theorems. For example, the Huzita-Hatori axioms are a set of principles that describe the mathematics of paper folding. These axioms can solve problems like angle trisection, which is impossible with just a compass and straightedge.

Another significant theorem in origami is Maekawa's theorem, which states that at any vertex (a point where several creases meet) in a flat origami model, the difference between the number of mountain folds and valley folds is always two. This theorem highlights the intrinsic geometric balance in origami.

## Practical Applications of Origami Geometry

The principles of origami geometry have practical applications in various fields. Engineers and designers use origami concepts to create foldable structures and devices. For instance, the development of foldable solar panels and telescopes for space exploration relies on origami techniques. These designs require understanding how materials can be folded compactly and then expanded when needed, similar to unfolding an intricate origami model.

In medicine, origami has inspired innovations like stents that can be inserted into blood vessels in a compact form and then expanded to support the vessel walls. This application shows how the geometric principles of origami can have life-saving implications.

Origami is a captivating intersection of art and geometry, where simple folds create complex structures and reveal deep mathematical truths. From basic valley and mountain folds to advanced theorems and practical applications, the geometry of origami offers a rich field of exploration for both the mathematically curious and the creatively inclined. Whether you are folding a simple paper crane or studying the underlying geometric principles, origami provides a unique and hands-on way to appreciate the beauty of mathematics.