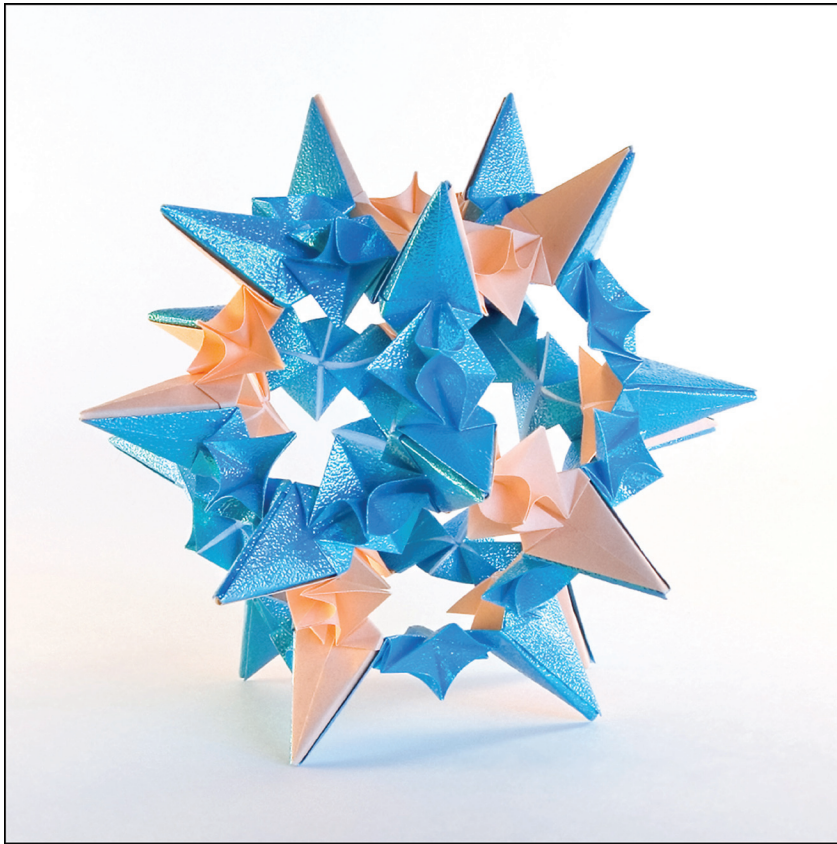


ORIGAMI INSPIRATIONS



MEENAKSHI MUKERJI

Origami Inspirations



Great Stellated Dodecahedron-like assembly of the Whipped Cream Star (top) and Truncated Rhombic Triacontahedron (bottom). See pages 69 and 82, respectively.

Origami Inspirations

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To Ratul, Rohit, Rohan, Riddhijit, and Rukmini

Contents

Preface	ix
Acknowledgments.....	x
Photo Credits.....	xi
1 ♦ Introduction	1
Origami Tips, Tools and Paper.....	2
Origami Symbols and Bases	5
Platonic, Archimedean, and Kepler-Poinsot Solids.....	8
Even Color Distribution.....	10
2 ♦ Simple Cubes (Created April 2000)	13
Folding a Square into Thirds	13
Plain Cube.....	14
Plain Cube 2.....	15
Ray Cube	16
Thatch Cube.....	18
Whirl Cube	19
Pattern Variations	20
3 ♦ Four-Sink Base Models (Created January–September 2009)	27
Four-Sink Base	28
Butterfly Cube.....	31
Flower Cube.....	33
Flower Cube 2.....	35
Flower Cube 3.....	36
Flower Cube 4.....	37
4 ♦ Folding with Pentagons (Created October 2006)	41
Making a Pentagon and Its Mathematics.....	42
Traditional and Five-Point Lilies	45
Flower Dodecahedron.....	48
Flower Dodecahedron 2.....	51
Flower Dodecahedron 3.....	53
Flower Dodecahedron 4.....	55
Flower Dodecahedron 5.....	58
Oleander.....	60

5 ♦ Miscellaneous (Created November 2001 and February 2009)	63
Windmill Base Cube.....	64
Windmill Base Cube 2.....	68
Whipped Cream Star.....	69
Star with Spirals.....	73
Whipped Cream Polyhedra.....	75
Waves.....	78
6 ♦ A Collection of Models by Guests	81
<i>Daniel Kwan</i>	
Truncated Rhombic Tricontahedron.....	82
Four Interlocked Triangular Prisms	84
<i>Carlos Cabrino (Leroy)</i>	
Chrysanthemum Leroy	88
Chrysanthemum Leroy Variation.....	92
Carnation Leroy	94
<i>Tanya Vysochina</i>	
Camellia.....	97
Dahlia	100
Lily of the Nile	103
Crystal	104
<i>Aldo Marcell</i>	
Adaptable Dodecahedron	107
Adaptable Dodecahedron 2	111
Appendix	113
Bibliography and Suggested Reading	113
Suggested Websites	115
About the Guest Contributors.....	116
About The Author	118

Preface

I was certain that I was done after writing my first two books *Marvelous Modular Origami* (2006, A K Peters, Ltd.) and *Ornamental Origami: Exploring 3D Geometric Designs* (2008, A K Peters Ltd.), nearly back to back. But it seemed the more I toyed around with paper, the more this intrigued my imagination, and new modular designs kept emerging. With so many new ideas and such kind readers' encouragement, I easily have enough new creations for yet another book—and here it is.

The first chapter contains origami basics and other material that simply must be included in any modular origami book to be complete. This might be the first book a new folder picks up, as his or her interest just piqued, and certainly all the tools to tackle the projects must be present. If you are already familiar with these basics, please feel free to skip ahead. I have provided polyhedron charts and color distribution charts for referencing during the assembly phase. Folding tips, types of paper, and other material important to folding origami, particularly modular origami, have been included.

The general structure of the book starts with simple models, gradually progressing into more complex ones, although there may be a few exceptions. We begin with simple cubes and then move on to more complicated and interesting models such as the four-sink windmill base models and the decorative dodecahedra folded from pentagons, just to mention a few. The mathematics of these models, of about high school level, is discussed whenever appropriate for those who might enjoy these things, such as myself.

Thanks to the amazing Internet making the entire world available, I am able to interact with like-minded modular origami designers worldwide. Their beautiful creations just further my belief that origami is a language spoken across the globe. In the last chapter, creations of guest artists Aldo Marcell of Nicaragua, Carlos Cabrino (Leroy) of Brazil, Daniel Kwan of the USA, and Tanya Vysochina of Ukraine are included. I have enjoyed and followed their work for some time

and I am happy to debut their prolific creations in my book. It was quite a difficult task to decide which of their many fine models to include. I am fortunate they share my philosophy that great origami is to be shared, not kept away in a closet. It is my privilege to introduce them to a new horizon of fellow origami enthusiasts. If you have not come across their work already, you are in for a treat.

The diagrams in this book follow standard origami symbols. Each creator has his or her own diagramming style. The styles of guest contributors have been preserved instead of changing them simply for the sake of being uniform across the book. Sometimes a different viewpoint on folding can quite change the experience of creating a piece. This is a big bonus in presenting a more global selection of models. The origami diagramming language is very powerful. Although there are written descriptions provided with the diagrams most of the time, their need is virtually nonexistent except for certain special circumstances. To keep the diagrams simple, I have refrained from showing layers except when absolutely necessary.

This book covers a range of folding levels from simple to high intermediate models. There is an emphasis toward the latter, which should appeal to audiences with or without a mathematical background, age 12 years and older. While some of the mathematics has been discussed, it is not a requirement to understand the mathematics in order to fold the models. It is just a bonus if you enjoy it, but no knowledge of math is required to produce these stunning objects. You will enjoy the book no matter what your folding level might be, particularly if you are a modular origami lover. Sometimes the units or modules separately may seem quite uninteresting, but I assure you that the assembled finished model is always like a pleasant surprise waiting to be cherished at the end. In modular origami the sum of the whole is almost always more than the sum of the individual parts. And that is what keeps me going and I hope it does the same for you.

Cupertino, California
January 2010

Acknowledgments

It is a pleasurable, although overwhelming task to thank the many people who were so generous with their time and ideas in helping me complete this book. I am certain I will inadvertently miss a few and my apologies in advance for this. I'll begin by thanking those who directly contributed to this book whether by folding models, submitting designs or photographs, or by proofreading and providing valuable feedback. First, a great BIG thanks to guest origami artists Aldo Marcell (Nicaragua), Leroy (Brazil), Daniel Kwan (NJ), and Tanya Vysochina (Ukraine) for their generous design contributions and spectacular photographs. Thanks to Mark Morden (WA) for sharing his novel locking method which I used in Chapter 3. Thanks to Priti Hansia (CA), Tripti Singhal (CA), Halina Narloch (Poland), and Rosalinda Sanchez (AZ), not only for testing my diagrams, but also for making some of my models and providing stunning photographs for the book. Thanks to Rachel Katz (NY) and Jean Jaiswal (OR) for proofreading, diagram testing, and giving me wonderful suggestions. Thanks to Sebastian Janas (Poland), Joy Dutta (CA), and Kedar Amladi (CA) for their stellar photography. Kedar deserves an extra special mention

for patiently doing several photo shoots of many of my models. Thanks to Koustubh Oka (CA) for folding a model for the book and generously allowing me to borrow from his reference library. Thanks to Shuzo Fujimoto San and J. C. Nolan for granting me permission to publish photos of models based on their models. Thanks to my editor Charlotte Henderson and my entire publishing team at A K Peters, Ltd. for doing a phenomenal job with the finished book.

Next I'd like to thank those who are indirectly involved with this book by supporting me in many different ways. Thanks to Gaurita and Pradip Amladi, parents of Kedar, and Vinita and Indra Singhal, parents of Tripti, for facilitating their children's contributions to the book. So many people have given me encouragement from so many different parts of the world, it is a bit humbling. I wish to thank the fans of my website, <http://www.origamee.net>, for their continued support and encouragement (see page 120 for some of the comments left on my guest book). A final note of thanks goes to everyone in my family as well as my friends over here in the US, in India, and around the world for providing me with so much inspiration.

Photo Credits

◆ *Photos by Kedar Amladi*

Cover, page 74: Star with Spirals and close up

Page 26: Flower Cube and Flower Cube 4 Variation

Page 39: Hydrangea Cube and Andrea's Rose Cube

Page 40: Flower Dodecahedra 1 and 2

Page 62: Whipped Cream Star and Windmill Base Cubes

Page 67: Windmill Base Cubes

Back cover, page 72: Whipped Cream Star

Page 80: Three Interlocked Triangular Prisms and Camellia

◆ *Folding and photos by Carlos Cabrino (Leroy)*

Page 93: Chrysanthemum Variation

Page 96: Carnation

◆ *Folding by Priti Hansia and photos by Joy Dutta*

Page 12: Plain Cubes

Page 25: Ray Cube Variation S3, Whirl Cube Variation S3, and Thatch Cube Variation S2

Page 36: Flower Cube 3

◆ *Folding and photos by Daniel Kwan*

Page 83: Truncated Rhombic Triacontahedron

Page 87: Four Interlocked Triangular Prisms

◆ *Folding and photos by Aldo Marcell*

Page 110: Adaptable Dodecahedron,

Page 112: Adaptable Dodecahedron 2

◆ *Photo by Ratul Mukerji*

Page 118: Author photograph

◆ *Folding by Halina Narloch and photos by Sebastian Janas*

Page 52: Flower Dodecahedron and Flower Dodecahedron 2

Page 54: Flower Dodecahedron 3

Page 56: Flower Dodecahedron 4

Page 61: Oleander

◆ *Folding by Koustubh Oka*

Page 34: Flower Cube with Flower Finish A

◆ *Folding and photos by Rosalinda Sanchez*

Page ii: Whipped Cream Star and Truncated Rhombic Triacontahedron

◆ *Folding by Tripti Singhal and photo by Indra Singhal*

Page 73: Star with Spirals

◆ *Folding and photos by Tanya Vysochina*

Page 81: Lily of the Nile

Page 99: Camellia and Variation

Page 101: Dahlia

Page 102: Dahlia Variation

Page 106: Crystal Variation A

All other models are folded and photographed by the author.

1 Introduction

The word origami is based on two Japanese words: *oru* (to fold) and *kami* (paper). Although this ancient art of paper folding started in Japan and China, origami is now a household word around the world. Most people have probably folded at least a paper boat or an airplane in their lifetime. Origami has evolved immensely in the present times and is much more than a handful of traditional models. Modular origami, origami sculptures, and origami tessellations are but some of the newer forms of the art. The method of designing models has also evolved. While some models are designed the old fashioned way using mostly imagination and by trial and error, others are designed with complex mathematical algorithms using the computer.

Modular origami, as the name implies, involves assembling several, usually identical, modules or units to form one finished model. Generally speaking, glue is not required, but for some models it is recommended for increased longevity, while for some others glue might be essential simply to hold the units together. The models presented in this book do not require glue to stay together, but if you intend to handle the models frequently or to ship them, a bit of glue is a fine idea for only those models that have relatively weaker locks.

While an understanding of mathematics is useful in designing these models, it is not crucial for merely following instructions to construct them. I think that even though mathematics may not be one's strong point, one can still construct these models, and perhaps the process might impart a deeper appreciation for the mathematical principles involved. Like any multi-stepped task it requires patience, diligence, and a bit of practice. It is always a pleasure to see the finished model at the end; the outcome is often greatly different than the individual parts would have initially suggested. Aesthetics and mathematics brilliantly come together in these wonderful modular origami structures to satisfy our many senses.

Modular origami can be fit relatively easily into one's busy schedule if one can be a bit organized. Unlike many other art forms, long uninterrupted stretches of time are not required. This makes it a perfect artistic endeavor given the hectic, fast-paced life we all lead. Upon mastering one unit, which usually does not take long, several more can be folded anywhere anytime, including the short breaks between other chores. When the units are all folded, the final assembly can also be done slowly over time. Modular origami is great for folding during the inevitable waits at airports, doctors' offices, or even on long flights. Just remember to carry your paper, diagrams, and maybe a box for the finished three-dimensional units.

Assembly of the units that comprise a model may at first seem very puzzling to the novice, or may even seem downright impossible. But understanding certain aspects can considerably simplify the process. First, one must determine whether a unit is a face unit, an edge unit, or a vertex unit, that is, whether a unit identifies with a face, an edge, or a vertex, respectively, of a polyhedron. Face units are the easiest to identify. For example, the four-sink windmill base models presented in Chapter 3 are face units. There are only a few known vertex units, e.g., David Mitchell's Electra [Mit00] and Ravi Apte's Universal Vertex Module [Tan02]. Most modular units tend to be edge units. For edge units there is a second step involved—one must identify which part of the unit, which is far from looking like an edge, actually maps to the edge of a polyhedron. Although it may appear perplexing at first, on closer look one may find that it is not an impossible task. Once the identifications are made and the folder can see through the maze of superficial designs and perceive the unit as a face, an edge, or a vertex, assembly becomes simple. It is then just a matter of following the structure of the underlying polyhedron to assemble the units.