EKATERINA LUKASHEVA

# *Floral Origami*

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The origami models in this book were created by Ekaterina Pavlović (Lukasheva) in the following years:

2009: Gloriosa;
2010: Belladonna, Carambola, Carcass, Easy Curls, Ice Queen, Igel, Imperialis, Lucia, Lyrica, Marquise, Mattiola, Mimosa, Rosette (former: Clematis);
2013: Fabiana (Belladonna var.), Psyche, Roxane;
2014: Anise, Astra, Curly, Matricaria, Polianta;
2017: Almond, Leaf, Maple Leaf, Palm Leaf.

Leaf model is very easy and seems to have been created by multiple people.

Thanks to all the people who helped me make, test fold,
proof-read and illustrate this book. Namely:

Adams family
Tatyana Bushueva
Uniya Filonova
Ekaterina Kim
Natalya Romanenko
Xander Perrot
Rui Roda
Tanya Turova
Jean Wallace
Patsy Wang-Iverson
and all the other people who inspired, encouraged and asked me to write a new book.

## Photo credits

Tatyana Bushueva: picture on page 40;
Ekaterina Kim: portrait on the back cover.
Natalya Romanenko: pictures on page 56, page 76.
Tanya Turova: pictures on page 42, page 52, page 63, page 81.

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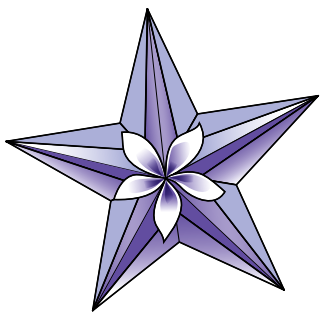

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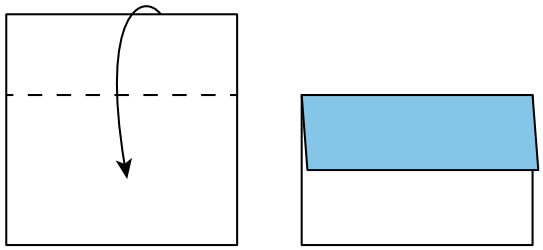
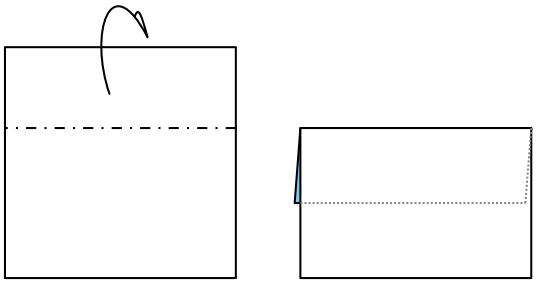
# ORIGAMI SYMBOLS

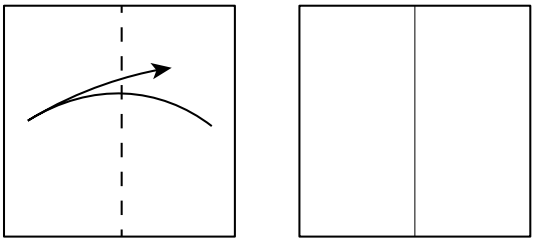


valley fold

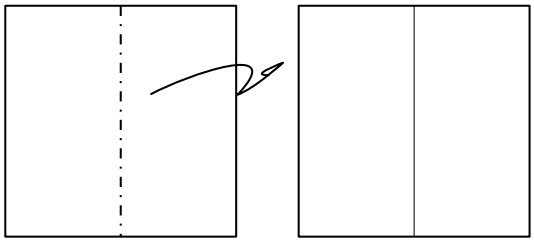


mountain fold

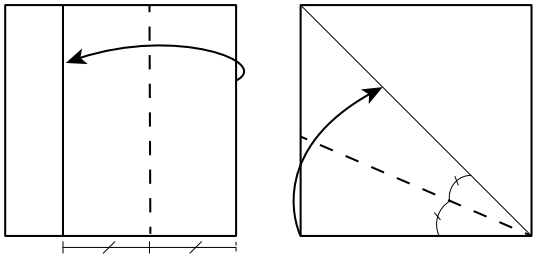
back (hidden) layer



valley fold and unfold



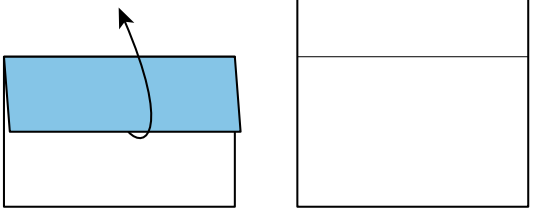
mountain fold and unfold



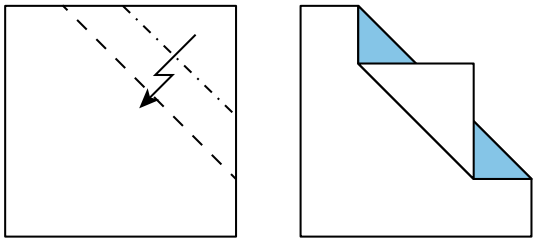
equal lengths



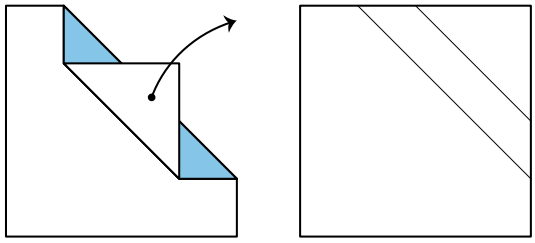
equal angles



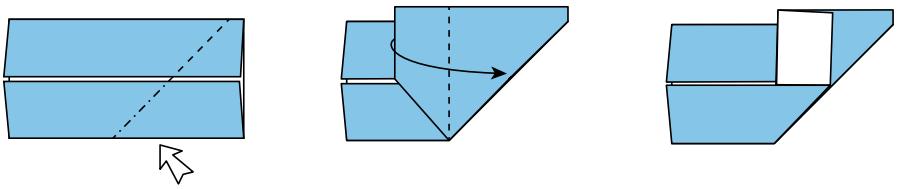
unfold



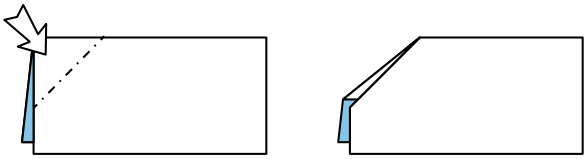
pleat fold



unfold/pull paper



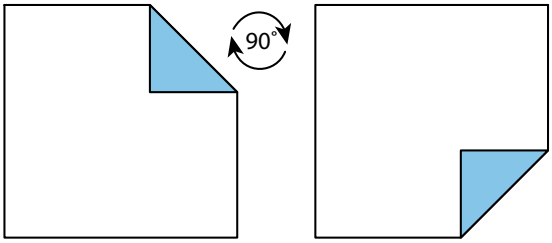
inside reverse fold: open, squash and then fold the remaining part flat



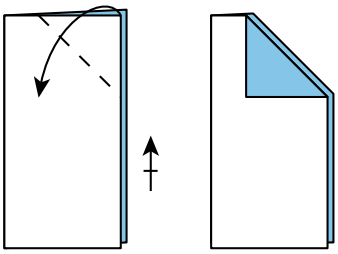
inside reverse fold

enlarged view ahead

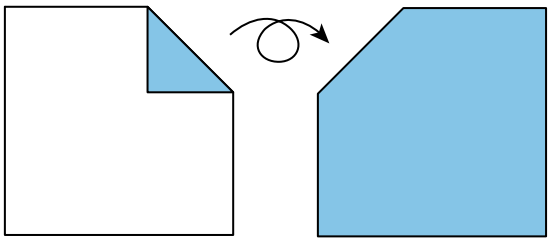
curl



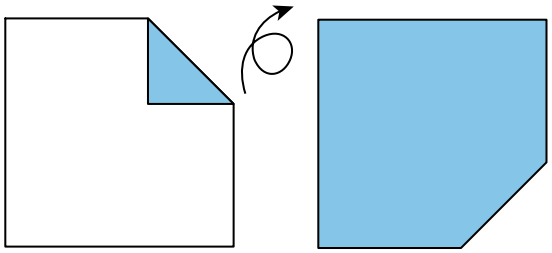

rotate 90° (or any other angle if specified)



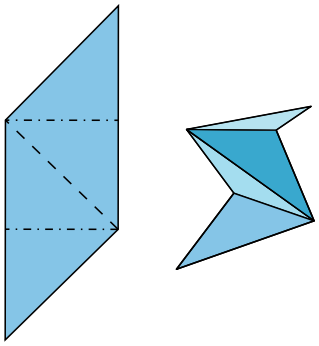
repeat on the other side



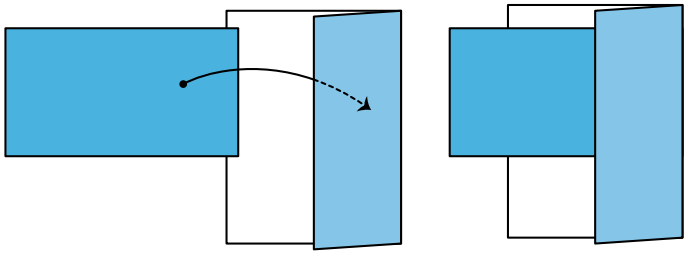
turn paper over



turn paper over

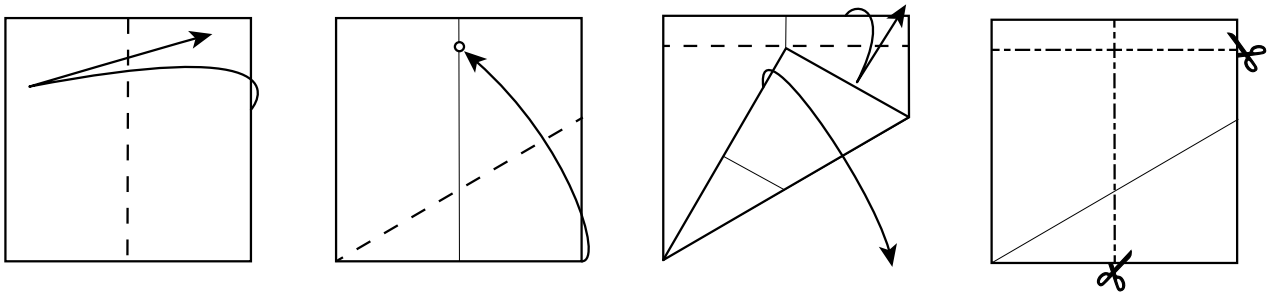


semi-fold (pre-crease)



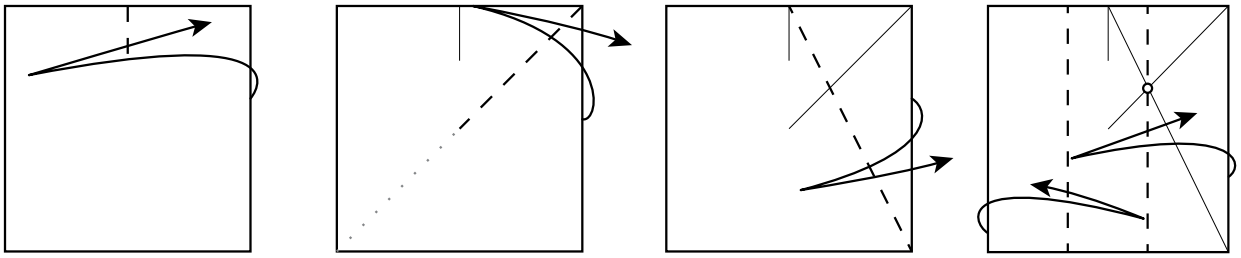
put inside

# HOW TO CUT A 1:√3 RECTANGLE



1 2 3 4

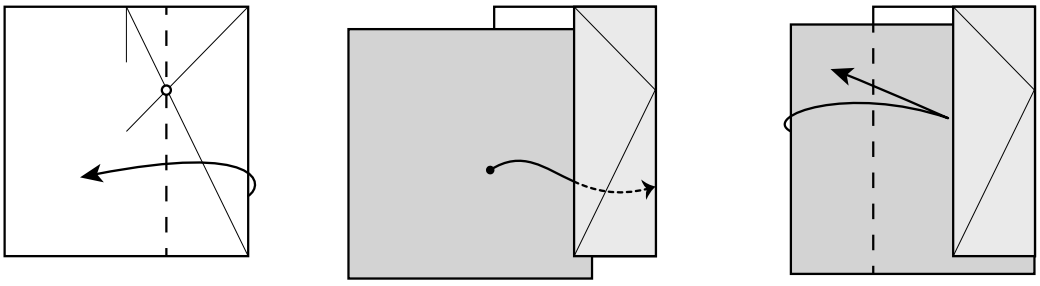
# DIVISION INTO THIRDS



1 2 3 4 make the crease parallel to the side through the intersection, then make the second crease

# USING A TEMPLATE

Use the following method to divide a square into thirds in order to save time and avoid unnecessary creases. Divide the first square into thirds by using the above method and use it as a template for the other units.



1 to make the template follow steps 1-4 of the above method

2 insert the other square of the same size to the end of the fold on the template

3 make the crease on the new square to the paper border; the new crease will be exactly 1/3 of the square

# ABOUT THE AUTHOR

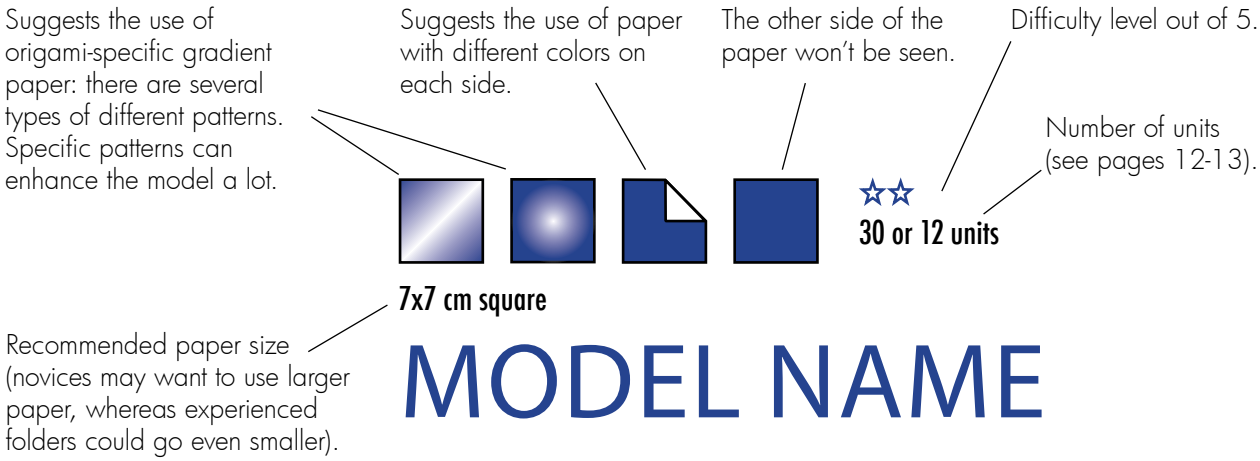
My name is Ekaterina Lukasheva, but my friends call me Kate. I became acquainted with modular origami as a teenager; it quickly became my passion and has been ever since. As I grew up, I continually developed my modular origami skills, and at some point I started creating my own designs. It is very interesting, since I compose the puzzles that I can then assemble into beautiful spheres. When I create a new origami model, I try to either make it look different from the existing models or make its modular locks different.

This book is my fourth published book. Kusudama Origami came out in 2014, followed by Modern Kusudama Origami in 2015 and Modular Origami Kaleidoscope in 2016. You can find more information about my other books on page 84. Besides, I also publish my diagrams in various origami journals and convention books throughout the world. You can find numerous kusudama pictures as well as a few free diagrams and videos on my website: www.kusudama.me and some advanced origami tricks in my blog www.blog.kusudama.me.

I was born in 1986 in Moscow, Russia, but moved to USA in 2015. Since early childhood I was fond of architecture and design art books and catalogs, as well as "entertaining math" books. I tried several hobbies throughout my life such as construction sets, drawing, painting, photography, modeling and... origami. I am fascinated by the latter at the moment. For me it is the ultimate manifestation of mathematics, art and design. I gain inspiration from various 3-dimensional objects like flowers, cacti, architecture objects and stellated polyhedrons. I recently started doing more single sheet tessellation-style curved-fold origami.

Although I hold a M.Sc. in applied math and computer science and a PhD in differential equations, I do not think a background in mathematics is necessary to make and enjoy beautiful origami. ;)

# BOOK SYMBOLS



# PAPER

There are plenty of types of origami paper. I will only mention the most common types of paper for modular origami:

- You can use note paper or sticky notes for folding, you can apply some corn starch directly on the adhesive, making it less sticky and more ideal for folding.
- Duo-colored paper has different colored sides and sometimes also has a pattern on one of the sides. This paper may not be specifically marketed for origami, although specially marked origami paper usually serves better for origami.
- Patterned paper: the paper that has contrast patterns on one or both of the sides. My personal opinion is that this paper is good only for very easy models, because it can make complicated models look chaotic.
- Harmony paper: paper with gradient coloring with smooth blending of the colors. This paper can make modular origami truly spectacular. This paper is usually sold specifically for origami in 5, 7.5 or 15 cm packs.

# MODULAR ORIGAMI

Origami is the art of paper folding. Traditional origami uses a single, uncut sheet of paper, whereas modular origami uses multiple sheets joined together to create a single form. This method offers great flexibility, while keeping the single unit relatively simple. So if you dislike 100+ step origami diagrams, but still want the resulting piece to look intricate, modular origami is for you.

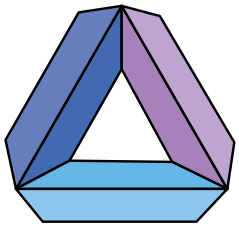
The figures created through modular origami are usually highly symmetric, because they are made from multiple equivalent units, or modules. The origami modules usually have special locks to allow unit-to-unit connection without using any adhesive. This feature of modular origami brings it closer to construction sets: you are just making the pieces of the construction set yourself prior to the assembly process.

There are several names for modular origami throughout the world. In the West it is referred to as modular origami, but in Eastern Europe and South America, the Japanese word "kusudama" is commonly used for ball-like modular origami figures. In Japan, the word "kusudama" originally meant "medicine ball", possibly referring to a ball made from flowers and used for incense.

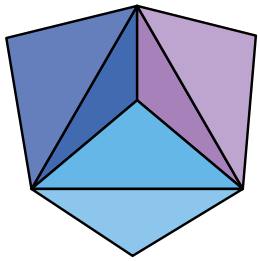
# MODULAR ASSEMBLY

The units presented in this book can be assembled in various ways. The assembly methods for modular origami spheres are based on the structure of Platonic[1] and Archimedean[2] solids. Each unit corresponds to an edge of the solid. The detailed assembly of these solids is outlined below.

There are two types of units in this book: 'edge' units and 'solid' units. The former act and look like real edges of the solids when you assemble the modules. But indeed the 'solid' units act in the same way: the only difference is that the final shape becomes  solid, and the holes between the units turn into pyramids.

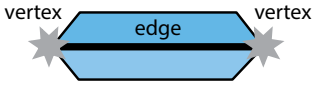


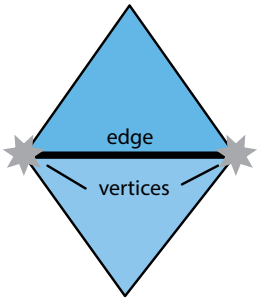
edge units



solid units

It means that the same assembly methods can be used for both 'types' of units. The following image illustrates the correspondence between units and the underlying solids.



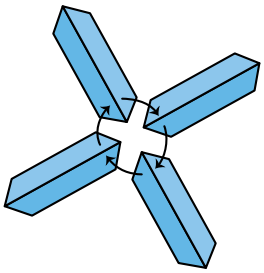

The methods below will illustrate the assembly methods for the edge units. But the same assembly schemes apply to the solid units as well. The assembly schemes are given symbolically, each arrow represents the unit's particular connection method.

1 A Platonic solid is a regular convex polyhedron composed of identical regular polygons meeting at identical vertices.

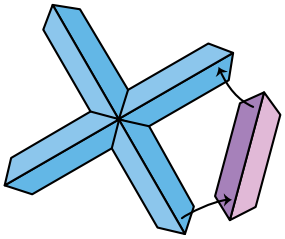
2 An Archimedean solid is a highly symmetric, semi-regular convex polyhedron composed of two or more types of regular polygons meeting at identical vertices. They are distinct from the Platonic solids, which are composed of only one type of polygon meeting at identical vertices.

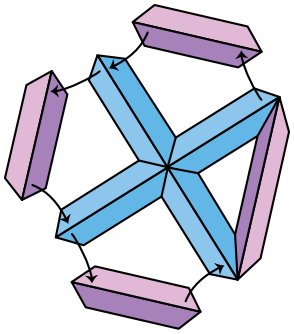
# OCTAHEDRON

**A regular octahedron is a Platonic solid composed of 8 equilateral triangles, 4 of which meet at each vertex. Since an octahedron is formed with 12 edges, you will need 12 units to complete a modular octahedron figure.**

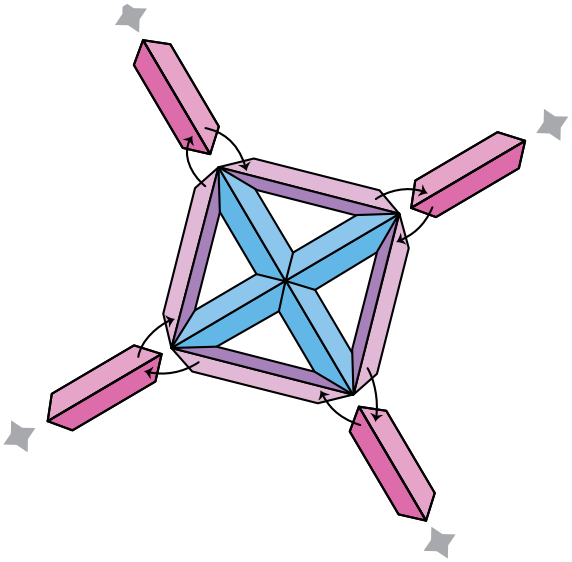


connect 4 units so that they meet at a single point



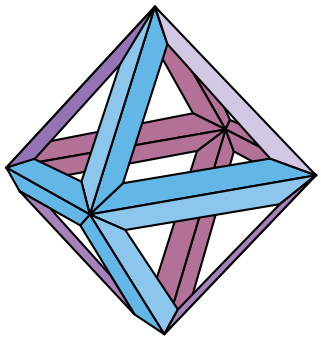


continue adding the units so that every 3 units form a triangular hole (triangular pyramid in case of solid units)

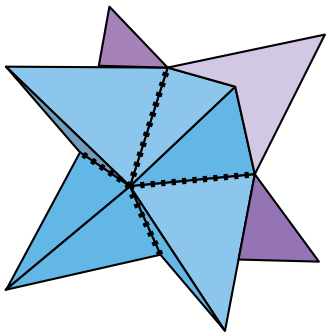


add 4 more units so that 4 units meet at a single point each time

connect the sides marked with the stars in the illustration to a single point behind, completing the octahedron



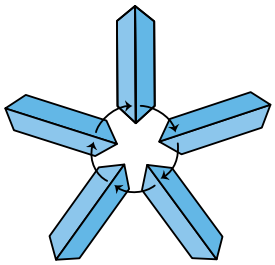
complete octahedron



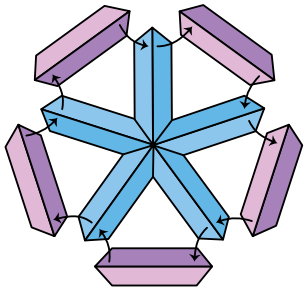
the solid version of the octahedron: the dotted lines show the underlying octahedron

# ICOSAHEDRON

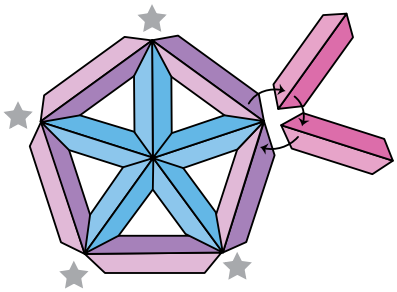
**An icosahedron is a polyhedron composed of 20 triangular faces, with 5 of those meeting at each vertex. Since an icosahedron is formed with 30 edges, you will need 30 units to complete a modular icosahedron figure.**



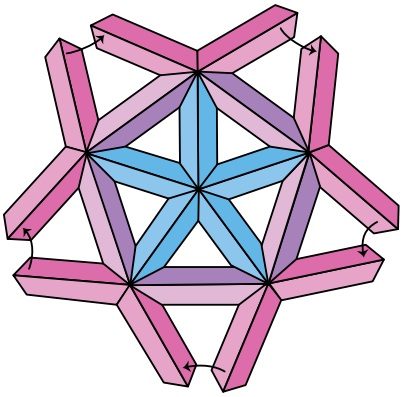
connect 5 units so that they meet at a single point



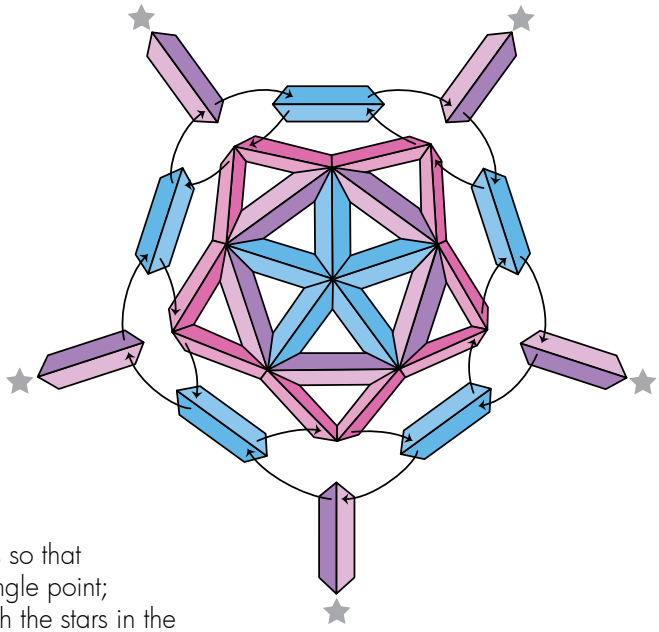
add 5 more units to form 5 triangles



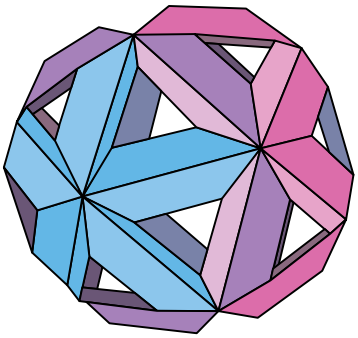
connect 2 additional units to every unfinished vertex, so that 5 units meet at a single vertex each time



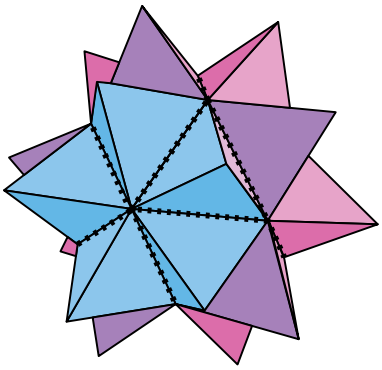
connect the loose sides of the units so that they form 5 triangles



add units to the non-finished vertices so that 5 units meet at a single point; the units marked with the stars in the picture should meet at a single point



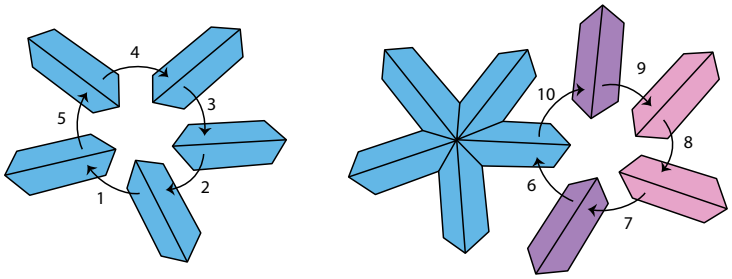
the complete icosahedron (left) and the solid version of the icosahedron (right)



the size of the holes, as well as the sharpness of the spikes, may vary from unit to unit

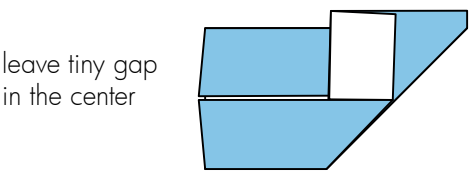
# ASSEMBLY HINT

Some of the models in this book share a similar connection system which can look unstable at first glance. However, if you join the pieces as shown below, they will connect more firmly, and the assembly process will be less cumbersome. The diagram below illustrates the modified assembly sequence for the icosahedron (30 units), but the same idea may be applied to any sphere you assemble. The concept behind this method is to try and finish the vertices of the polyhedron first. Thus, when you assemble an icosahedron, finish the vertices where five edges are connected. Since a "star" of five units is enclosed it becomes stable (steps 1-5 in the picture). Instead of closing the adjacent triangles, you should then assemble the next "star" (steps 6-10). Continue to assemble the model by finishing the vertices, proceeding in this fashion until the model is finished. As you go, keep in mind that the holes between the units should be triangular.




# TIPS AND TRICKS

- Try to choose papers of the same type and weight for a single model. If you mix papers with different properties in a single model it may not only look inconsistent but may also lack symmetry.
- Try folding a test unit from a larger piece of paper before starting the entire modular. It may give you a hint as to what paper size would be most comfortable for you, as well as how the color or pattern of the paper will appear when folded into a particular module.
- Be as accurate as possible when making every single unit. The more precise you are, the better the final model will look. Some modular locks only function when your folding is very precise.
- Rotate the paper to make your folds comfortable. Diagrams are drawn to be clear and straightforward but this may not be the most comfortable way for folding. Try rotating the paper so that you fold 'from you'. This is especially true about bigger, longer folds.
- Many units in this book have a central valley fold. When you fold such a unit, leave the tiniest gap between the upper layer of paper and the central line. This way there won't be overlapping layers of paper in a final unit.



- If you are not sure how to perform a particular step, refer to the next step in the diagram, as the illustration should give you a hint of the resulting shape.
- Shaping, rounding or curling the petals is a very powerful technique and it can drastically change your model's appearance. Use your nails or pincers for shaping.
- Some units have connectors that can serve both as a flap and as a pocket. For such units always assign which part of the unit is a flap and which one is a pocket. Keep this assignment through the whole model to preserve the symmetry and to balance paper thickness.
- For right-handed people inserting is usually easier with a right hand, since it is more skilled in manipulation. If you are left-handed you might find changing flap-pocket assignment very comfortable.
- Pro-tip: sometimes fold lines can spoil the final appearance of the model. At the same time the diagram may be drawn in the most understandable way. So if you see some undesirable lines on your final model, don't hesitate to alter your folding sequence to avoid these lines. You can use templates or pencil to minimize the reference lines appearance in your model.


The models in the book do not generally require glue for assembly, but if you are a novice to modular origami, you may need some. If you want your kusudama to have a better chance of staying together when being handled by guests, children or gently batted by animals, add a bit of glue during assembly or to a completed model. Stick glue is better during assembly, while PVA glue (white liquid glue) can be used to fasten more permanently the complete model. Add a drop of PVA glue to the point where units meet to fasten the point. This glue becomes nearly invisible when dry, but be sure to test it on a scrap of your selected paper before adding it to the kusudama.

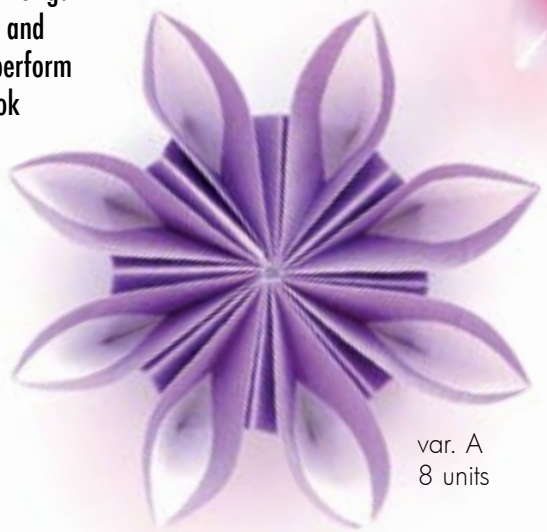
☆
Flower 5-8 units

6 x 6 cm square

# ROSETTE

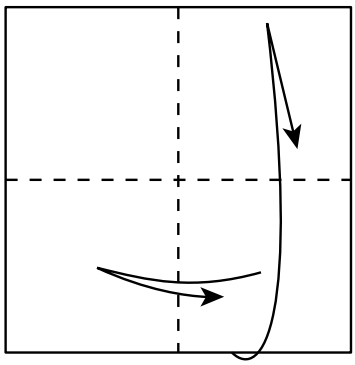
This is the easy beginner model to try even if you have never folded modular origami objects. There is a base diagram and several enhancements you can perform to make the resulting flowers look even nicer. Follow steps 1-7 for the base model or add steps A1-A3 or B1-B3 for additional enhancements.

var. B
6 units

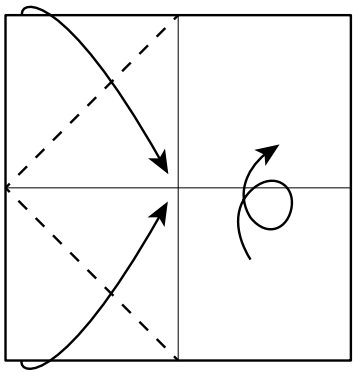


var. A
8 units

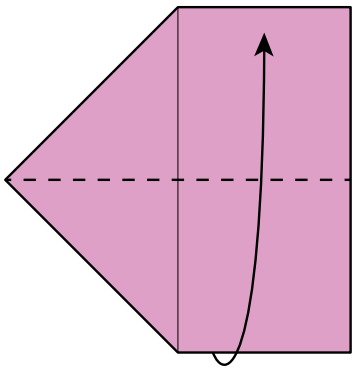
5 units



1



2 fold two corners to the central point



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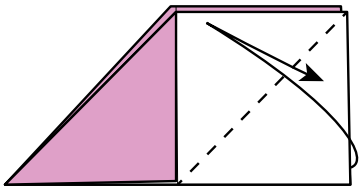
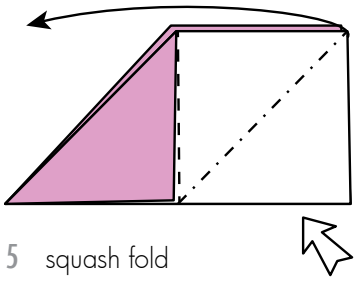
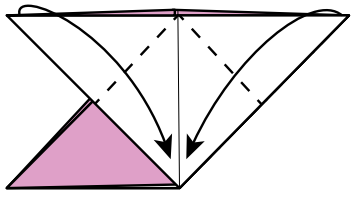


4



5 squash fold



6 fold both corners to the central line

☆
Flower 5-8 units

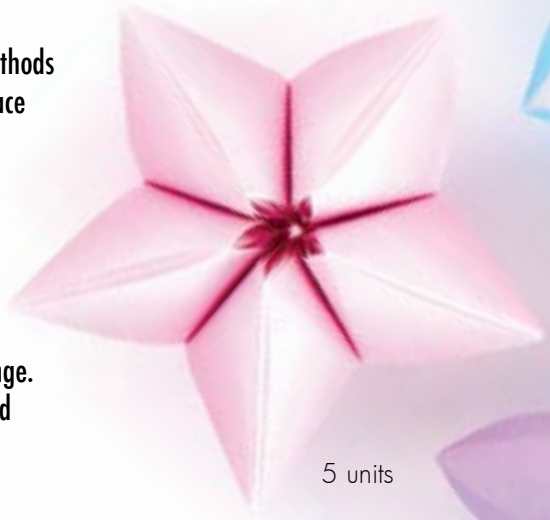
6 x 6 cm square

# CARAMBOLA

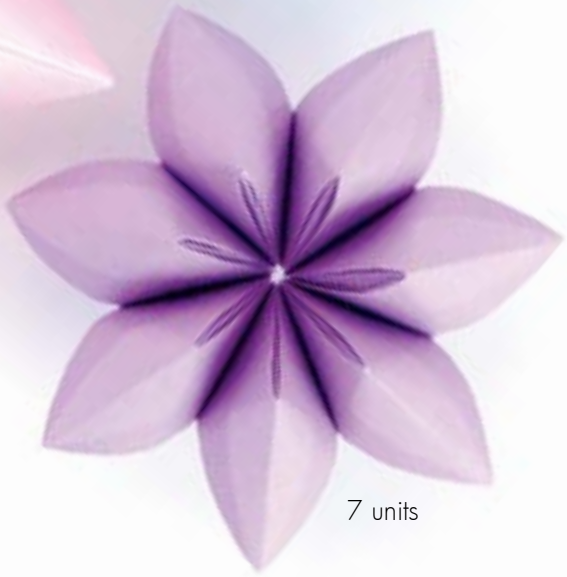
This easy flower allows the same enhancements as the previous model. Use variation A or B methods from the previous page and place them between steps 5 and 6 of Carambola to produce a visible color change.

You can also experiment with the side of the paper where you apply the color change. See the pictures of the front and of the back of the flowers.

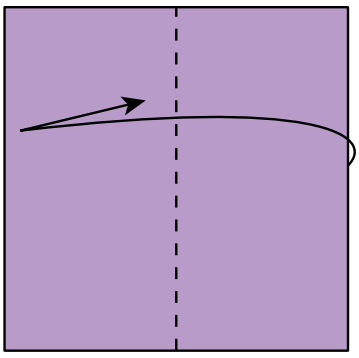
var. A
5 units



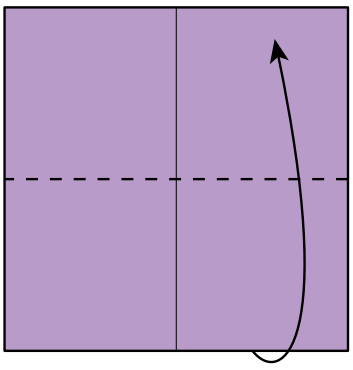
5 units



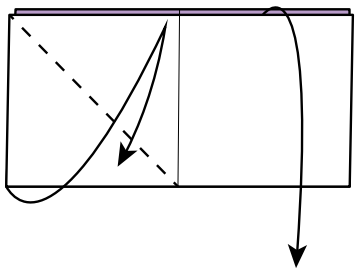
7 units



1



2



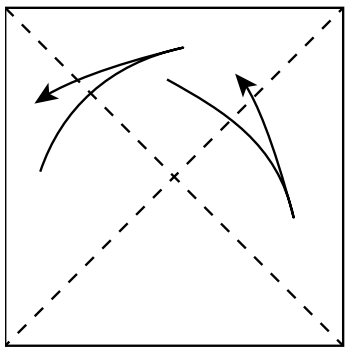
3

☆☆
Flower 5-10 units

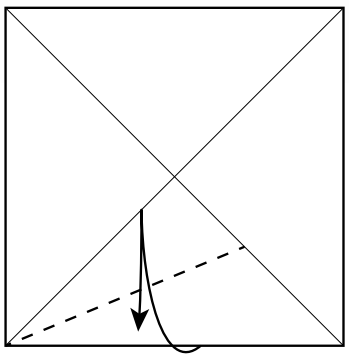
6 x 6 cm square

# GLORIOSA

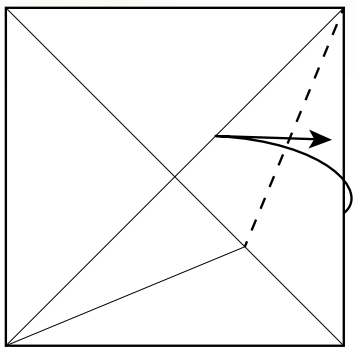
You can watch me teaching
this flower on YouTube:
https://youtu.be/2TRzUYtXocw

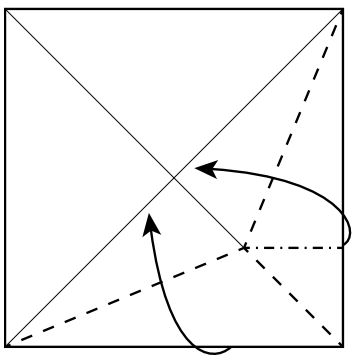
1



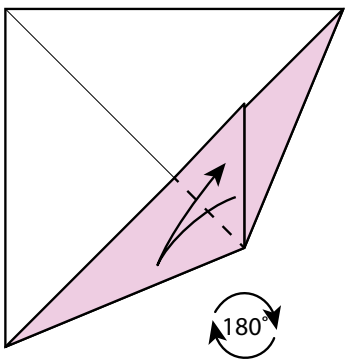
2 fold only in lower quarter and unfold



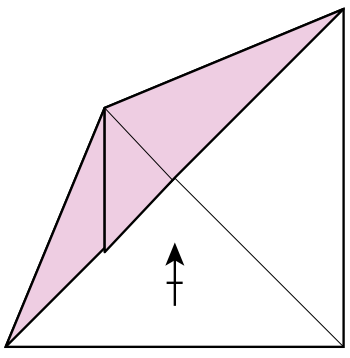
3



4 fold simultaneously (rabbit ear fold)




5 fold the tip in both directions



6 repeat steps 2-5 on the other side

# GLORIOSA FLOWER BALL

This is an advanced project, since it requires folding 150 units in total, but the result is truly spectacular.

To accomplish this gorgeous ball you need:

- 12 Gloriosa flowers with 10 petals each. Use 5cm papers for the flowers.
- Carcass model from page 34 with 30 units made from 7cm papers.

The recommended proportion between flower size and Carcass size works well, but you also can vary it a bit to get bigger or smaller flowers or to use the paper you have.

Attach flowers to Carcass one by one. First put the flower onto the Carcass so that there are 2 flaps in each hole of the Carcass. This way the petals are symmetrically distributed. Then move the flower down, closer to the center of the ball. Repeat with all the flowers.

Usually Gloriosa flowers are elastic and act like clothespins and they do not need any additional material to hold them on the Carcass.

30 units of Carcass
120 units of Gloriosa

☆☆
Flower 4-6 units

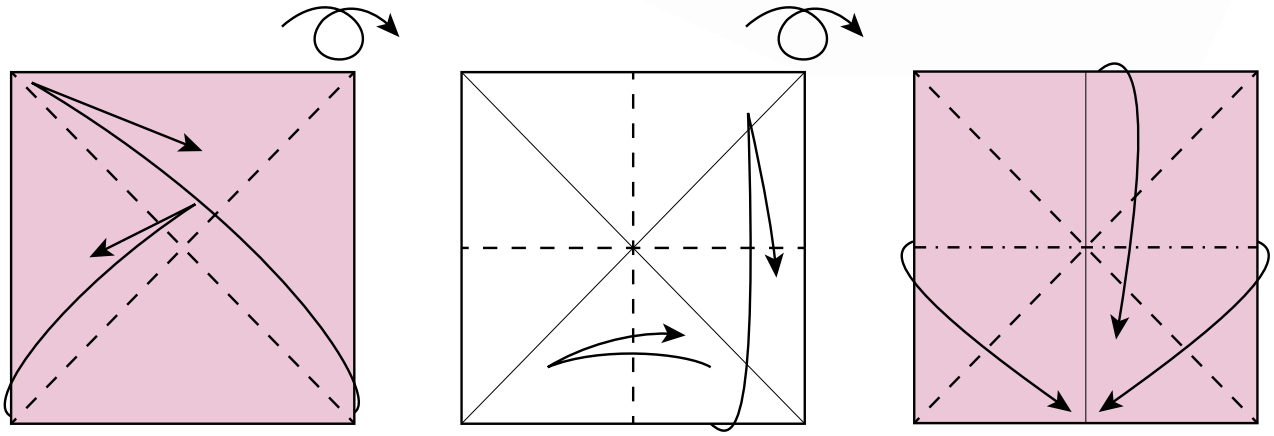
7 x 7 cm square

# MATRICARIA

4 units

5 units

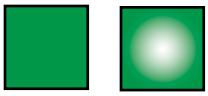
5 units



1

2

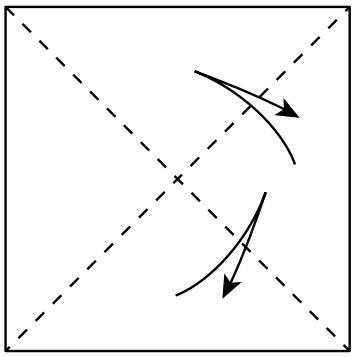
3 form the water bomb base



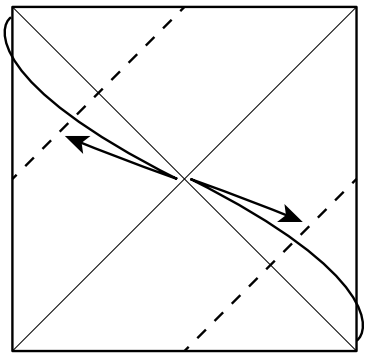
☆
Single sheet model

12 x 12 cm square

# LEAF



1



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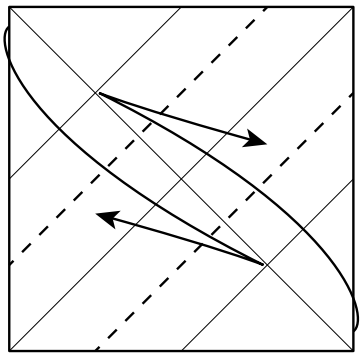
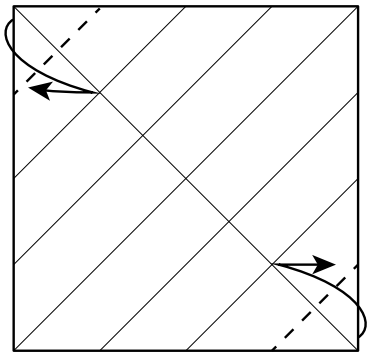
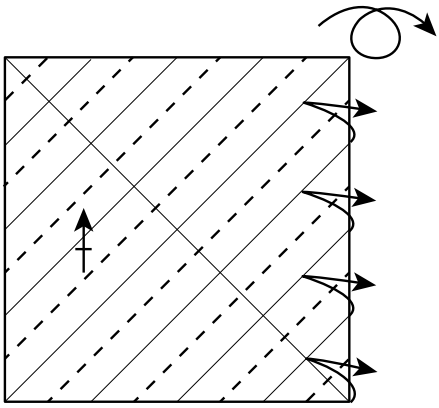


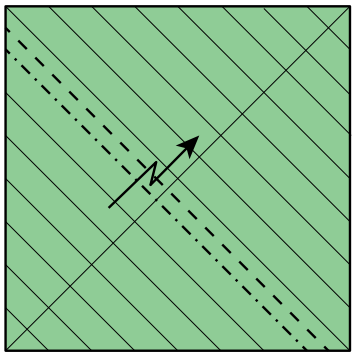
3



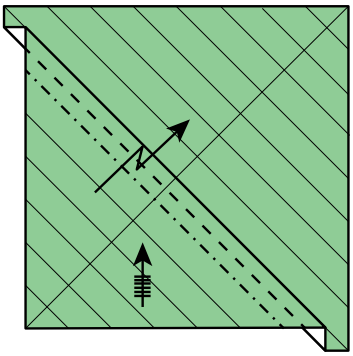
4



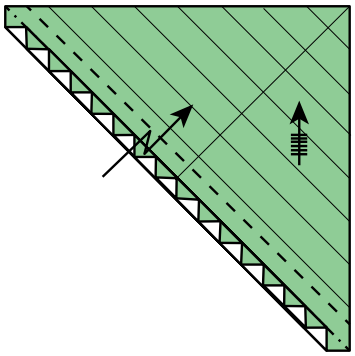
5



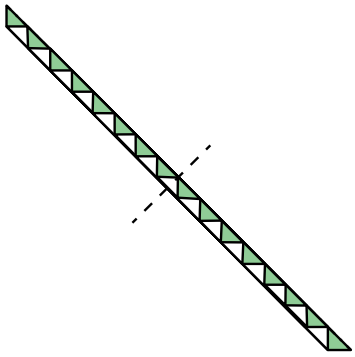
6 pleat fold



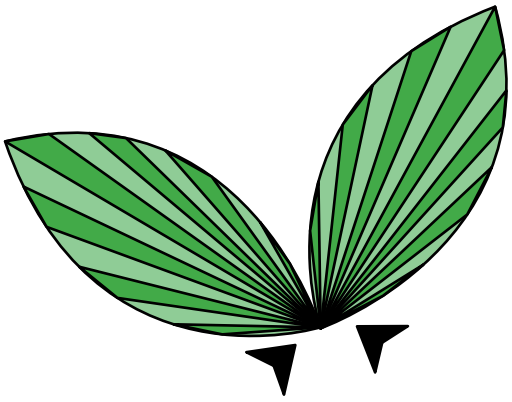
7 continue pleating



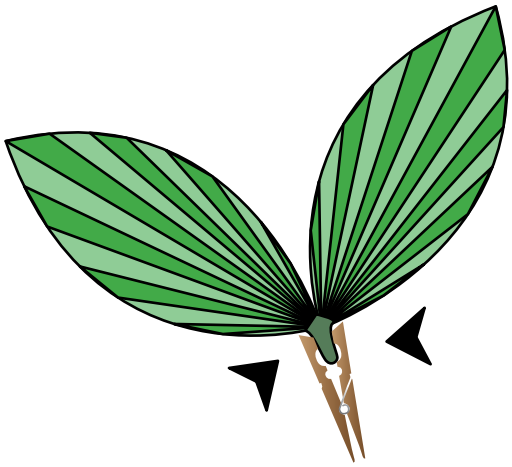
8 pleat fold
and continue pleating



9 fold in half and rotate



push with your fingers from the sides
to form a small flat area



apply a clothespin to the area, gently add
some water with a small brush only to the area,
let dry with the clothespin on,
then remove the clothespin

☆☆
3-5 units

8 x 8 cm square

# MAPLE LEAF

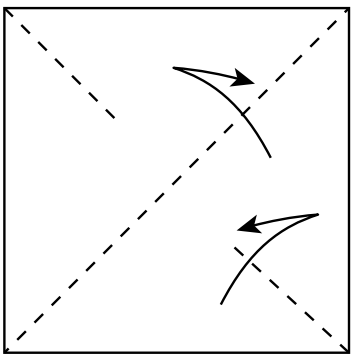
The units of this model are truly versatile, so you can connect units of different size together for a more realistic look.

3 big units
2 small units

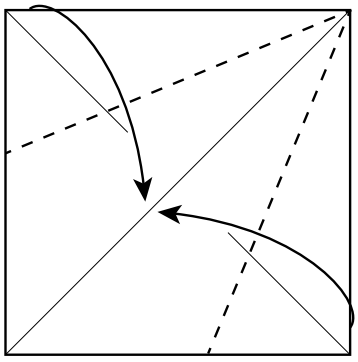
1 big unit
2 small units

3 units

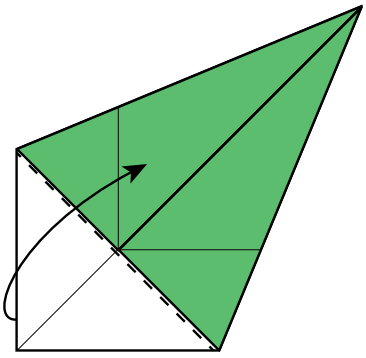
1 big unit
2 small units



1



2



3 fold using the border of the paper as a reference

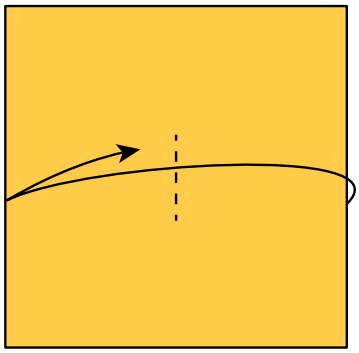
☆☆☆

30 or 12 units

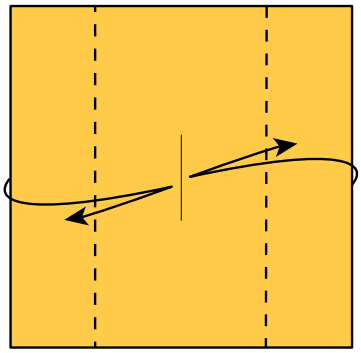
7 x 7 cm square

# BELLADONNA

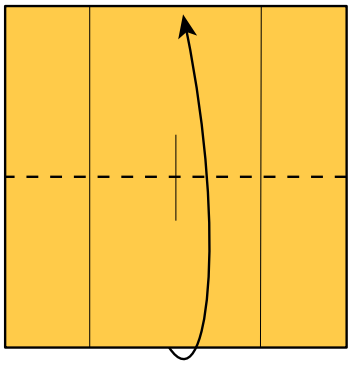
30 units



1 pinch in the center



2



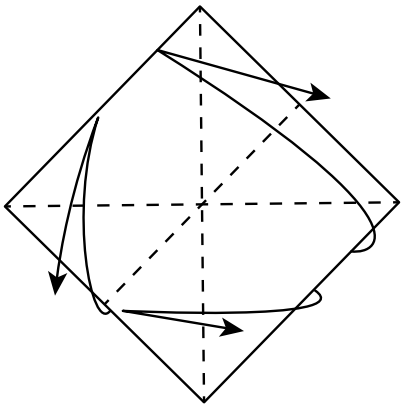
3

☆☆☆
30 or 12 units

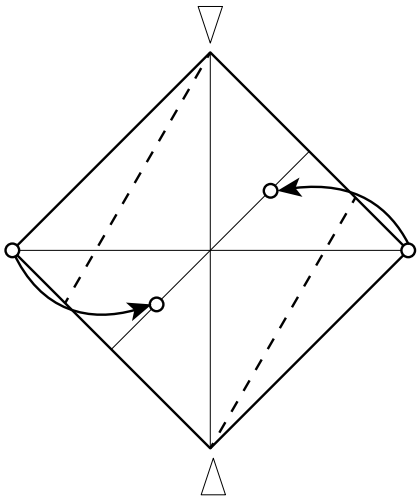
7 x 7 cm square

# IGEL

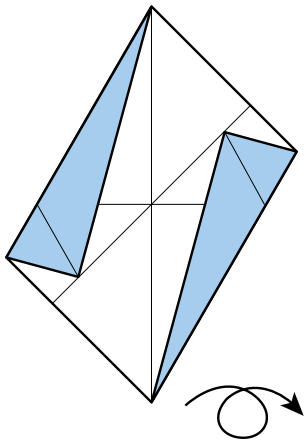
30 units



1



2 align the marked corners to the central line



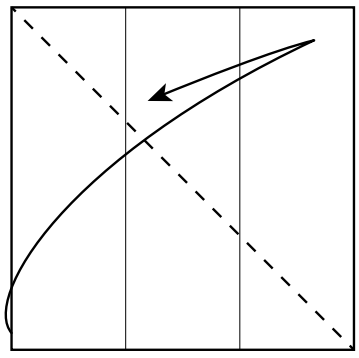
3

☆☆☆
30 units

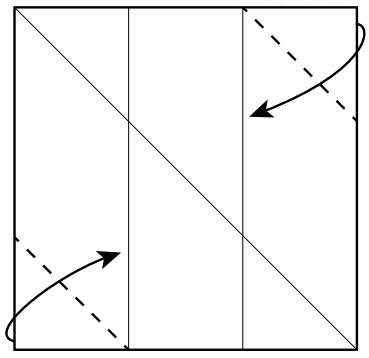
7 x 7 cm square

# IMPERIALIS

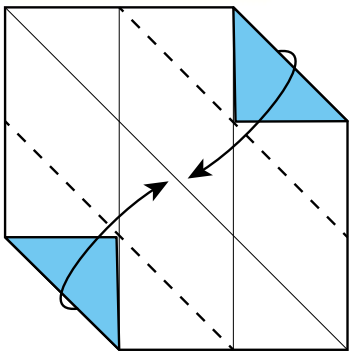
30 units



1 divide the square into thirds,
see Division into thirds on page 8



2

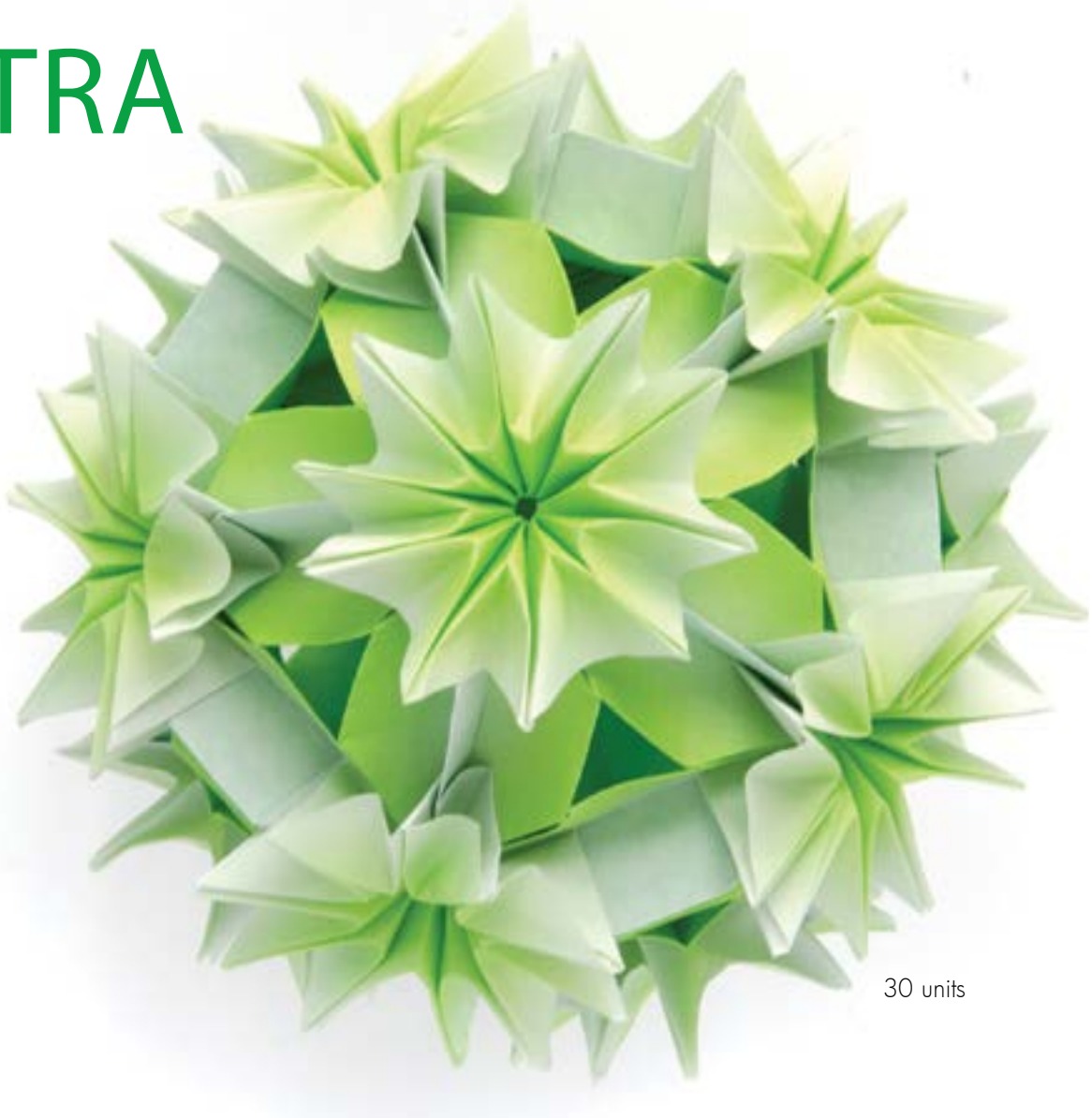


3 align sides to the central line

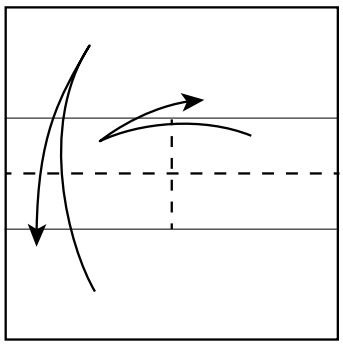
☆☆☆☆
30 units

8 x 8 cm square

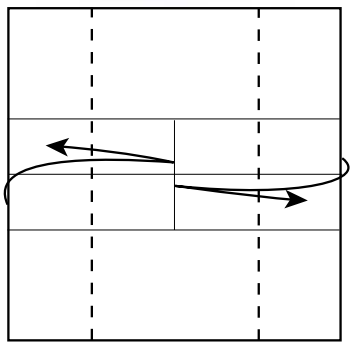
# ASTRA



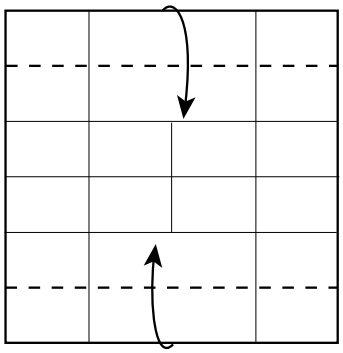
30 units



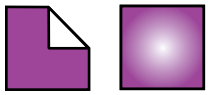
1 divide the square into thirds,
see Division into thirds on page 8



2



3



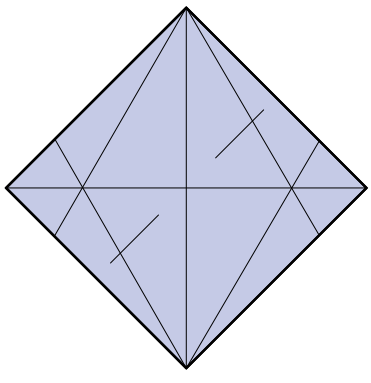
☆☆☆☆

30 units

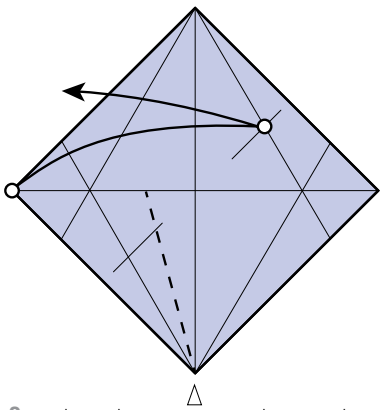
9 x 9 cm square

# MARQUISE

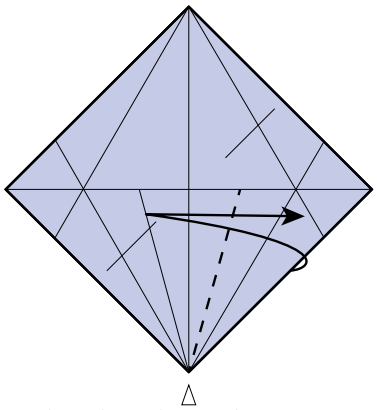
30 units



1 perform steps 1-5 of Lucia unit on page 76



2 align the corner to the pinch: fold only to the central line



3 align the edge to the existing line: fold only till the central line

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