ORIGAMI MASTERS

BUGS

HOW THE BUG WARS CHANGED THE ART OF ORIGAMI

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INCLUDES INSTRUCTIONS FOR 12 AMAZING MODELS
The artist is a receptacle for emotions that come from all over the place: from the sky, from the earth, from a scrap of paper . . .

–Pablo Picasso
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THE BUG WARS

What can you make with a single piece of paper?

Scissors can’t be used, nor can glue. It’s just you, the piece of paper, and the shapes you make by folding it. So how far can you take it?

This was essentially the question posed by the informal competition between expert paper folders in the 1990s. That competition, which has come to be known as “The Bug Wars,” was an expression of the discovery process and an exploration of technique by the most experienced folders, once they found themselves liberated from the traditional underpinnings of the ancient art of origami. The discovery that it was possible to create a model with several legs—like an insect, for instance—quite simply transformed origami.

Until the middle of the 20th century, all origami models were derived from just a few standard base patterns.
It sounds like a crazy notion because these days, complex origami models—intricately folded paper interpretations of just about everything, from spine-studded sea urchins to a complete cuckoo clock—abound. Even though origami is an ancient art, it remained pretty much unchanged until the middle of the 20th century. Models were fairly simple, and all were derived from a few standard base patterns.

But that began to change when Japan's Akira Yoshizawa developed a system of diagrams and symbols that allowed for the encoding of origami instructions. Considered the father of modern origami and a prolific creator of new, original models, Yoshizawa wrote books in the 1940s and 1950s that showed how to fold each step. Suddenly, a craft that had been an oral tradition shared by a few could be documented... and shared by many.

Akira Yoshizawa, called by many the father of modern origami.
Yoshizawa's system of symbols was adopted and refined by Samuel Randlett in the US and Robert Harbin in the UK, and word of the art of paper folding began to spread. Some European countries also had traditional paper folding crafts and those were shared as well. It was this cross-fertilization process that brought fresh thinkers and ideas to the ancient art, building a new mindset that would eventually look past the traditional forms.

By the 1970s and 1980s, things reached critical mass. Origami societies had sprung up all over—in Japan, the US, the UK, and Spain, to name a few. While origami still focused on the classical models and techniques of Japan, new models were being created and shared by folders everywhere. The origami community is nothing if not generous with its knowledge. But the models were still fairly simple, around 30 or so steps at the most. And no one could figure out how to use the traditional origami bases to make the additional flaps that would allow them to take the art to the next level.

After initial breakthroughs and innovations made by John Montroll in the US and Jun Maekawa in Japan, another breakthrough was made: a technique called circle/river packing. Developed by American folder Robert J. Lang (an origami enthusiast with a scientific background) and Japanese folder Toshiyuki Meguro—each working independently—the work was published in the 1990s. This technique allowed a model creator to place any number of circles—which stood in for appendages—within a square of paper. It was a brilliant bit of engineering that resulted in the placement of folds in order to create multiple legs, wings, and other appendages right where they were needed. It also showed origami enthusiasts that they didn't need to be tied down by traditional techniques. Instead, those traditional techniques were now the first important steps toward a new level of art and craft.
Another technical innovation helped demonstrate that even the most complex of models could be tackled, designed, and communicated in a systematic way: it was the invention of TreeMaker, a computer program written by Robert J. Lang. It would eventually allow the computational modeling of a stick figure—a rough idea of what a model should look like—to generate a basic outline for the crease pattern needed to create the model. Origami artists began to use the same concepts in their own designs, not even needing the computer program; they could create incredibly complex figures using just pencil and paper to design a “crease pattern” as the folding plan for their work. Crease patterns became the standard way to communicate instructions for supercomplex models, because such models cannot always be broken down into step-by-step diagrams.

* a. Generic crease pattern; b. Crease pattern generated by TreeMaker; c. Base; d. Folded model
Such an innovation allows model creators to spend less time testing ideas out—a process that becomes quite burdensome with long, super-complex models—and more time working out a greater number of new ideas, as long as the creators are comfortable with the geometric method of design. It can shorten the development time greatly.

Expert folders in Japan were the first to stretch their new wings (as it were) by folding realistic insects. Each year at the annual meeting of the Japanese Origami Academic Society, artists such as Toshiyuki Meguro, Jun Maekawa, Seiji Nishikawa, and Fumiaki Kawahata would show off their latest and greatest feats of folding (all done without computational modeling), which would then set the bar for the following year’s models. First, there were insects with six legs, then came the addition of wings, horns, color changes indicating spots, and more. From there, the spirit of friendly competition made its way to America at the annual OrigamiUSA convention. Robert J. Lang, the only American to be involved in the informal Japanese competition, challenged friends Dan Robinson and Satoshi Kamiya to come up with a design for a *Eupatorus gracilicornis*, a ve-horned rhinoceros beetle. And on it went.

The models collected in this book aren’t from that 2004 design challenge. But that spirit of competitive collaboration does live on in the models presented here. They showcase the latest technical innovations from some of the top folders on this side of the Atlantic. They are, in essence, the culmination of more than 20 years of technical experimentation.

But they also mark the end of an era. Now that the technical barriers have been broken down, origami stands at a crossroads. Is it art, mathematics, science…or a bit of all three? Many creators of origami models have moved on. They’ve turned their focus on the search for beauty and art in simplicity instead of in the technically accomplished. Try googling “polygon packing” (a concept similar to circle/river packing) and you’ll find websites devoted to discussions on engineering. And industrial designers continue to tap into the origami community to find ways to use folding in new inventions. One good possibility: a new way to fold airbags.

So what’s next for origami? A good question. Its artists are already turning the paper over, folding again, and seeing what can be made this time.
We can allow satellites, planets, suns, universe, nay whole systems of universes, to be governed by laws, but the smallest insect, we wish to be created at once by special act.

—Charles Darwin
**TERMS & SYMBOLS**

- **Edge**
- **Existing crease**
- **Valley fold**
- **Mountain fold**
- **Fold in front**
- **Fold behind**
- **Fold and unfold**
- **Hidden lines**
- **Rotate**
- **Sink/squash/push**
- **View from here**
- **Turn over**
- **Open**
- **Repeat**
- **Magnify**
- **View of detail next**
- **Pleat**
- **Crimp**

- **Preliminary base**
- **Water-bomb base**
- **Blintz base**
- **Kite base/fold**
- **Petal fold**
Won Park is an origami artist who has been practicing the art of paper folding for more than 30 years. He specializes in folding paper currency from the United States and other countries. He is well known for his meticulous folding execution, his eye for detail, and a finely tuned sense of artistry. He currently lives in Honolulu, Hawaii.
FLAPPING DOLLAR BUTTERFLY

This is one of my latest designs, created in 2012. I wanted to create a model that would capture the flapping motion of a real butterfly. To make sure you get a clean flapping action, try ironing the model after it has been completely folded.

1. Fold in half. Unfold

2. Fold. Unfold.

3. Make a pinch mark close to the edge.

4. Make another pinch mark close to the edge. Turn over.

5. Fold as indicated. Unfold. Turn over.

6. Use the existing crease to fold in half. Align the creases. The model will not lie flat.

7. Bring edge to edge and fold an angle bisector.

Flapping Dollar Butterfly
Unfold everything. Create a new crease to allow the model to lie completely flat.

Pleat, using the creases created in step 5.

Fold between the points indicated from edge to edge. Unfold. Turn over.

Complete the collapse following a sequence similar to steps 7 through 9. Use existing creases. The model should then lie completely flat.

Repeat steps 6 to 10 on the other side.

Fold the angle bisectors. Unfold.

Fold the edge to the crease line as indicated. Turn over.

Begin the collapse by folding the rabbit ear and in half as indicated. This should create concave halves on each side.

Origami Masters: Bugs
17. Open the top layer to see inside the model.

18. Inside reverse using the creases created in step 14.

19. Valley fold using the creases created in steps 12 and 13. Repeat on the other side.

20. Close. The model should like completely flat.

21. Open.

22. Fold the corner inside as indicated, while allowing the wings to flip out. The model will not lie flat.

23. Swivel the top to make it flat. Spread squash the bottom symmetrically. Repeat on the back. The model will lie flat at this point.

24. Fold the angle bisectors, edge to edge. Repeat on the back.

25. Swivel fold by releasing paper trapped under the layer. Repeat on the back.
This is the completed Flapping Dollar Butterfly. To make the wings stiff enough to flap, iron them.

Valley fold the top layer of the pleat and squash. Repeat on the other wing, too.

Details for the wings next.

Hold the head while pulling on the tail to flap the wings.

Top view of folded model, wings open.
DOLLAR DRAGONFLY

This is one of my very first original models. I created it in high school. It uses the same base as my first butterfly design. My advice for making a model with clean folds: dampen the bill slightly and use clamps to set folds properly.

1. Fold in half. Unfold.

2. Fold. Unfold. Turn over.


4. Prepare creases for the collapse.

5. Complete collapse.


7. Inside reverse fold.
Fold as far as you can.
Repeat on the back.
Fold in half. Rotate.
Fold as far as you can.
Repeat on the back.
Swivel fold so that the horizontal edges are aligned. Repeat on the back.
Swivel the top layer while folding the flap back to the original position. Repeat on the back.
Fold as far as you can. Repeat on the back.
Swivel fold. Repeat on the back.
Swivel fold so that the horizontal edges are aligned. Repeat on the back.
Swivel fold so that the horizontal edges are aligned. Repeat on the back.
Valley fold. Repeat on the back.
Fold the wing up.
Repeat on the back.
Fold the head flaps between the crimp.
Crimp fold and move the wing forward.
Repeat on the back.
Fold the wings down.
Fold back the corners to shape the eyes.
Close the wing at slight angle. Repeat on the back.
Pleat to form the eyes and the mouthparts.
Open the wing and squash symmetrically. Repeat on the back.
Unfold in half.
Fold the wings down.
Fold back the corners to shape the eyes.
Dollar Dragonfly
Fold the edges under to narrow the abdomen.

Fold in half.

Sequence of crimps to shape the abdomen.

Open out the wings.

The completed dragonfly.

Editor’s note: Folding with paper currency brings special challenges due to its rectangular shape. In this case, the artist has taken advantage of the extra width to create the large, streamlined wings of a dragonfly. Note that two sets of wings are in evidence; most insects have two sets of wings. You can also see this in the artist’s flapping butterfly, a model that shares the same base.
Sebastian Arellano started folding origami models when he was 11 years old and started designing his own original models about three years later. He loves fantastic creatures, and in origami he found a unique tool that enabled him to give shape to the creatures as he imagined them.

Sebastian Arellano currently studies animation and the digital arts, including illustration and 3D modeling. He lives in Mexico.
BED BUG

This is one of my earliest designs, and the one that has gone through the most revisions. I usually fold it from 6- or 8-inch paper, but anything smaller than 12 inches is fine. While the sample shown here has been folded from tissue foil, it can also be folded from stiffer paper. When I first designed the model, I used to varnish it and attach it to a barrette for my sister to wear in her hair. It made a very interesting decoration!

1. Precrease: fold the diagonals and unfold.

2. Fold the corners to the center.

3. Collapse into a preliminary base.

4. Squash fold.

5. Precrease: fold the angle bisectors and unfold.

6. Petal fold.

7. Unwrap one layer.
Collapse along existing creases.

Reverse fold on both sides. Squash fold. Collapse along existing creases.

Valley fold over. Note that a 90° angle is formed.

Mirror steps 12 to 14 on the opposite side.

Valley fold up.

Repeat steps 3 to 10 on the remaining three flaps.

Valley fold one flap up.

Valley fold over. Note that a 90° angle is formed.

Valley fold up.

Unfold.

Mirror steps 12 to 14 on the opposite side.
17. Valley fold the flap down and open the sides.

18. Mountain fold.


20. Reverse fold.

21. Valley fold both sides.

22. Reverse fold.

23. Reverse fold.

24. Valley fold the tip to the center. Unfold.

25. Open sink.
Turn over. Fold the top layer back while incorporating a reverse fold.

Fold the front layer to the left; fold the back layer to the right.

Turn over. Rabbit-ear fold. Mountain fold behind. Valley fold up.

Open and spread fold. Stretch while unfolding the mountain fold made in step 30.

Valley fold up. Rabbit-ear fold.
Valley fold up.
Rabbit-ear fold.
Turn over.

Valley fold the top.
Mountain fold the bottom.

Valley fold.
Mountain fold the corners.

Valley fold the corners.
Mountain fold the corners.
Fold the tip to the center.
Unfold.
Create a sequence of five pleats.
Fold in half again. Unfold.
Fold in half. Unfold.
Create leg articulations.
Narrow the legs and adjust the orientation as indicated.
Mountain fold the tip.
Create leg articulations.

The completed bed bug.
View from underside.

Bed Bug
This particular praying mantis is a combination of two previous insect designs. Squares measuring 12 to 17.5 inches work well for this model. Use tissue foil or double tissue. If you use larger, thinner paper, take special care with the legs—the weight of the body may be too much for them unless they are folded and positioned just so! The plus side of using the larger paper is that you will be able to shape the head better, so it is a tradeoff.

1. Precrease: fold in half and unfold.

2. Fold the angle bisectors and unfold.

3. Make pinch marks at the edge as indicated.

4. Valley fold the edges in, creasing at the pinch marks. Unfold.

5. Valley fold through the intersection points shown from edge to edge. Unfold.

6. Fold the corners to the creases.

7. Fold the angle bisectors. Unfold.
Fold the edges to the center and unfold.

Fold the angle bisectors.
Unfold.

Fold crease mark to crease mark as shown and unfold.

Valley fold between the points indicated. Unfold.

Fold through the points indicated to the crease marks shown. Unfold.

Fold the angle bisectors.
Unfold.

Fold through the points indicated from edge to edge. Unfold.

Fold the angle bisectors.
Unfold.

Fold the angle bisectors.
Unfold.

Praying Mantis
17. Valley fold between the points indicated. Unfold.
18. Turn over.
19. Pleat fold.

20. Magnified view.
21. Valley fold as shown, from the midpoint at the bottom edge. Unfold.
22. Pinching the center, slide the paper up and flatten on existing creases.

23. Close up of result.
24. Larger view. Turn over.
25. Collapse as indicated.
Open the top layer and collapse as indicated.

Closer view.
Swivel both sides.

Open so that layers are symmetrical.

Swivel and fold top layer.

Turn over.

Magnified view.

Fold the angle bisector.
Unfold.

Fold the angle bisectors.
Unfold.

Make a sequence of inside reverse folds.
Larger view. Valley fold into thirds. Unfold.
Close up of result. Repeat steps 32 to 34 on the other flaps.

Fold in half. Unfold.

Crease pattern of the sink with all details.
Repeat steps 37 and 38 on the other side.
Sink on both sides.

Make a sequence of sinks.
Fold in half. Unfold.
Magnified view.

Mirror steps 45 to 47 on the other side.

Inside reverse fold.

Unfold.

Sink while lifting the corner.

Mirror steps 50 to 51 on the other side.

Sink.

Fold the angle bisectors. Unfold.

Swivel. Some new creases will be made.

Mirror steps 50 to 51 on the other side.

Sink the four flaps.

Close up of result.

Larger view. Swivel fold.
Sink the four corners indicated.
Valley fold as shown to narrow the flaps.
Rabbit-ear the corners and flatten.
Valley fold to the front, then mountain fold to the back to narrow.
Valley fold the flap down.
Sink both sides.
Turn over.
Mountain fold the corners.
Turn over.
Magnified view.
Rabbit-ear the forelegs to the sides.
Rabbit-ear the forelegs to the sides.
Mountain fold the corners.
Valley fold the corner down.
Valley fold the flaps.
Squash symmetrically.
Fold the flaps up.

Open spread the flaps to the sides.

Pleat fold.

Valley fold the flaps to the sides, opening the pleat.

Turn over.

Fold the tip down.

Pleat fold.

Sink the corners.

Open squash to make the eyes.
Shift the wings up, mountain folding as shown on both sides.

Shift the head flaps.

Crimp in half while crimping the neck. Rotate.

Narrow the legs and the antennae.

Rabbit-ear fold on front and back to create the grasping parts.

Crimp forelegs to create articulations.

Crimp fold as indicated to create more leg articulations.

The completed praying mantis.
Marc Kirschenbaum, a leading American origami artist, is known for his wide range of subject matter and for utilizing a variety of folding mediums—even toilet paper.

His works have been shown in many museums and shows around the world, including the American Museum of Natural History, the Smithsonian Institution, Mingei International Museum, and Hangar-7. Several of his works have been published in books and periodicals as well.

An active member of OrigamiUSA, a premiere international origami organization, he is currently on its Board of Directors. Marc Kirschenbaum also manages the production of many of OrigamiUSA’s publications.
I happen to like the paper of the unryu (mulberry bark) variety, but any fine paper with long, strong fibers should be equally effective. I used 10-inch sheets here. Thinner papers (20 gm/in or lighter) work well for the mosquito. I will bond two sheets of paper together with methyl cellulose for a two-toned effect.
Repeat steps 8 to 9 on the other three corners.

Valley fold while spread-squashing the top.

Valley fold and unfold.

Unfold the pleat.

Valley fold the top flaps outward.

Valley fold to the center.

Valley fold along the angle bisector.

Reverse fold in and out along the existing creases.

Repeat steps 11 to 14 on the remaining seven flaps.
17
Valley fold up as far as possible.

18
Valley fold over.

19
Valley fold up.

20
Unfold the pleat.

21
Mirror steps 18 to 20 on the other side.

22
Squash fold along existing creases.

23
Squash fold.

24
Pull out the inner layers.

25
Outside reverse fold.
Pull out two layers and swivel down to flatten.

Squash fold.

Wrap around two layers.

Swing two flaps over.

Mirror steps 26 to 28 on the other side.

Squash fold.

Petal fold under.

Swing one flap over.

Valley fold up, while swiveling the top layer over.
35
Valley fold down while swiveling over.

36
Swivel fold under along the angle bisector.

37
Valley fold the top edge up, swiveling the trapped paper out.

38
Closed sink along the existing crease.

39
Reverse fold the corner.

40
Valley fold over.

41
Mountain fold.

42
Mountain fold.

43
Mirror steps 33 to 42 on the other side.
Turn over.

Mountain fold.

Valley fold.

Valley fold up as far as possible.

Reverse fold the top set of flaps, distributing the layers evenly.

Wrap all of the layers around.

Valley fold the top layers outward.

Valley fold along the angle bisectors.

Wrap all of the layers around.
Reverse fold, distributing the layers evenly.

Swing the flaps upward.

Mountain fold along the angle bisectors.

Wrap all of the layers around.

Mountain fold along the angle bisectors.

Valley fold along the angle bisectors.

Wrap all of the layers around.

Repeat steps 55 to 59 on the other three flaps.

Valley fold the model in half.
Reverse fold in and out, allowing the resulting pleat to fall inside the body.

Slide the outer layers of the abdomen up.

Reverse fold in and out, allowing the resulting pleat to fall inside the body.

Reverse fold the tips of the wings and abdomen. Round out the body and wings. Position the legs as desired.

The completed mosquito.
I've experimented with various paper sizes and types for my insects. As with the mosquito, I like to use 10-inch paper of the unryu (mulberry bark) variety. For the ladybug, I tend to use thicker papers (about 40 gm/in) and I prefer papers that do not show fibers because the piece is busy enough with all the spots. I use a thick red paper bonded with methyl cellulose to a thinner black paper.

**LADYBUG**

1. Precrease: fold the diagonals. Unfold. Turn over.

2. Fold in half. Unfold.

3. Form a preliminary base.

4. Precrease: valley fold along angle bisectors. Repeat behind.

5. Precrease: valley fold and unfold.

6. Precrease: valley fold along the angle bisectors and unfold.

7. Valley fold through the intersection of the creases.
Valley fold up to align with crease below.

Valley fold down to the folded edge.

Unfold the pleat.

Sink down and then up again.

Valley fold down, spreading the sides.

Valley fold up again.

Reverse fold the sides.

Repeat steps 12 to 14 behind.

Valley fold the top up.
Unfold the pleat.

Valley fold over. Note that a $90^\circ$ angle is formed.

20

Mirror steps 17 to 19 on the other side.

21

Spread the sides apart, squashing the top flap down.

22

Mountain fold.

23

Rabbit-ear the top flap.

24

Squash the center flap.

25

Petal fold under.
Swing one flap over.
Valley fold the top flap over and over.
Turn over.
Swing the flap back.
Squash fold.
Wrap one layer around.
Repeat the precrease sequence of steps 17 to 20 on the indicated flap.
Valley fold up.
Mirror steps 28 to 31 on the opposite side.
Swing the flap back.
Mirror steps 28 to 31 on the opposite side.
Repeat the precrease sequence of steps 17 to 20 on the indicated flap.
Squash fold.
Squash fold. Pull out a single layer. Squash again.

Valley fold the side flap up, allowing a spread squash to form at the bottom.

Valley fold one flap up.

Pull the flap through to match the other side.

Valley fold over.

Swivel the side down.

Valley fold down.
Reverse fold the side flaps down.

Valley fold down. Unsink.

Valley fold back up.

Valley fold the tip down.

Reverse fold the flaps back up.

Valley fold up, allowing the sides to swivel outward.

Spread-squash by spreading apart the seam at the center.

Valley fold down while swiveling the sides in.

Reverse fold the side flaps back up.

Valley fold back up.

Valley fold down while swiveling the sides in.

Valley fold up, allowing the sides to swivel outward.

Valley fold the tip down.
Valley fold the two flaps down.

Valley fold the side flaps down.

Valley fold the two flaps down.

Swing two flaps down.

Open sink the sides (sinking triangularly).

Valley fold down as far as possible.

Unfold.

Swing one flap over.

Valley fold the top flaps to the center.

Turn over.

555453
58
61
57
60
56
59
52
Ladybug  61

Valley fold down as far as possible.
Squash fold. Unfold the pleat. Valley fold up. Form a squash at the right, allowing a squash to form at the left. Reverse fold the hidden flap. Valley fold up. Sink the flap (closed reverse fold). Swivel the white edge over to lie along the center. Swing the flap back down. Form a squash at the right, allowing a squash to form at the left.

Swing the flap back down. Sink the flap (closed reverse fold). Reverse fold the hidden flap.
Valley fold the thick flap up (it is partially hidden).

Swing the flap up. Unsink a single layer.

Precrease: fold and unfold.

Swing the small flaps down.

Swing the flap over.

Turn over.

Mirror steps 60 to 76 on the opposite side.
Valley fold to the top crease.

Mountain fold.

Valley fold.

Unfold the pleat.

Precrease: mountain fold at a 45° angle, starting from the crease made in step 80. Unfold.

Valley fold down along the existing crease.

Valley fold along the existing crease.

Slide out a single layer and flatten.

Wrap a single layer around.
Valley fold point A over to point B.

Pull out a single layer and flatten to match the back.

Valley fold point A over to point B.

Flip the top section over.

Precrease again: valley fold down and unfold.

Spread-squash the side while stretching forward. The next step shows where points A and B land.

Swing points A and B up as far as possible.

Swing the next flap up as far as possible.

Precrease the top flap: valley fold the corner and unfold.

Precrease again: valley fold down and unfold.

Valley fold down while incorporating a reverse fold on the top layer.
Valley fold up to reveal a colored square.

Swing the flap back down.

Valley fold up. See the next step for approximate positioning.

Swing one flap down.

Flip the colored squares behind.

Squash fold the two flaps to create squares the same size as the one made in step 98.

Mountain fold the corner to lie flush with the top edges.

Swing one flap up.
Valley fold the lower flap.

Mirror steps 80 to 111 on the other side.

Valley fold one flap up.

Mountain fold the top edge down.

Swivel the top flap through.

Valley fold both flaps down together.

Turn over.

Valley fold the side flaps outward.

Mirror steps 80 to 111 on the other side.

Valley fold up.

Ladybug 67

80–111
Rabbit-ear the flaps outward.

Valley fold the flaps up, allowing one layer to swivel over.

Valley fold the flaps in half, allowing the squashes to form.

Rabbit-ear the flaps outward.

Turn over.

Crimp the top layer of the front legs, allowing the sides of the model to curve downward.

Pleat the front legs to lock.

Swivel the lower layer of the legs underneath.

Rabbit-ear the front legs forward.
125

Reverse fold at the front to shape the head. Round the body and shape the legs as desired.

The completed ladybug.
Daniel Robinson is an industrial designer from Pennington, New Jersey. He has been doing origami for over 25 years. His work has been published and displayed in museums all over the world.

The inspiration for his designs comes from nature. He focuses on capturing the features of an insect or animal but also its essence, as well as on creating models that are enjoyable for other origami enthusiasts to fold.

Daniel Robinson believes that the product of origami is secondary to the process; it is in the transformation of a simple sheet of paper into something evocative and stimulating that conveys the real magic of origami.
This model of Linnaeus' leaf insect (Phyllium siccifolium) is folded from a 10-inch square of handmade origami paper, a blend of abaca and rag cotton fiber. I wanted to deliver a convincing change in texture from the stick-like legs to the leaf appendages as well as creating a distribution of layers that would give the folder the opportunity to shape the model in a realistic way.

Fun fact about leaf insects, cousins of walking sticks: they are sometimes fooled by their own camouflage and end up eating each other!

Start with the colored side up. Fold in half along the diagonals and unfold.

Fold behind along the diagonal. Rotate the model.

Fold the corners to the creases indicated, creasing only the indicated sections.

Fold the tip to the intersection, then unfold everything.

Pleat so the raw edges end up on the center crease.
Fold the corners to the creases indicated, creasing only the indicated sections.

Fold the paper in half.

Reverse fold both points.

Fold the angle bisectors and unfold, then unfold to step 10.

Reverse fold the points.

Fold the angle bisectors and unfold. Repeat behind.

Fold the angle bisectors and unfold. Repeat behind.

Crimp on existing creases.

Crimp on existing creases.
Petal fold and swing the excess paper to the right.
Focus on the center area. Fold on existing crease.
Crimp on existing creases.
Fold the flap down, creasing from corner to corner.

17
Crimp on existing creases.

18
Focus on the center area. Fold on existing crease.

19
Petal fold and swing the excess paper to the right.

20
Fold between the corners and unfold.

21
Fold the angle bisector and unfold. Repeat on the right.

22
Fold the flap down, creasing from corner to corner.

23
Inside reverse fold.

24
Pull out the paper (similar to an unsink).

25
Fold the angle bisector and unfold. Repeat on the right.

Leaf Insect 73
Swivel fold so that the raw edge lies along the center. This uses the crease from step 20.

Swivel fold this flap in half. Fold the angle bisectors and unfold. Repeat on the right.

Petal fold and swing the excess paper to the right.

Unsink the shaded section. Fold the angle bisector and unfold. Repeat on the right.

Turn the model over. Squash fold.

Petal fold and swing the excess paper to the right.

Fold the angle bisector and unfold. Repeat on the right.

Squash fold. Petal fold.
Triple reverse fold on creases from steps 13 to 14 and 25 to 26.

Open-sink on creases from steps 21, 32, and 35.

Fold the angle bisectors and unfold.

Petal fold.

Spread-squash.

View from above. Squash fold.

Inside reverse fold.

Unwrap and pull the flap open.

Leaf Insect
Mirror steps 45 to 46 on the opposite side.

Swivel \( \frac{2}{3} \) of the top layer of each flap toward the back.

Squash the center layer and bring the point down at.

Open sink along the angle bisectors.

Squash fold all three legs so there is an equal number of layers on each side.

It should look like this.

Turn the model over.

Swivel \( \frac{2}{3} \) of the top layer of each flap toward the back.

Turn the model over.
Fold the corners in so that each leg appears symmetrical when viewed from above. Then mirror steps 48 to 51 on the opposite side to make remaining legs. Make them symmetrical too.

The next steps focus on the head; the rest will not be drawn for simplicity.

Mirror steps 57 to 58 on the opposite side.
Reverse fold. Swivel fold to hide the white part of the paper.

Make a tiny petal fold.

Collapse along existing creases.

Fold the tip to the intersection.

Open sink. Pull open. Pull out paper.

Fold the tip to the intersection.

Collapse along existing creases.

Squash fold.

Make a tiny petal fold.

Swivel fold to hide the white part of the paper.

Reverse fold.
71
Swivel fold. Repeat behind.

72
Rabbit-ear to shape the mandibles.

73
Mirror steps 70 to 72 on the opposite side.

74
Tuck the corners underneath.

75
Full view here. Open up the abdomen and look at the model from behind.

76
Focus on the abdomen. Reverse fold.

77
Tuck the tip to the inside.

78
Fold the corners and unfold.

79
Bring the edge to the center, incorporating a reverse fold.
80. Swivel fold.

81. Mirror steps 79 to 80 on the opposite side.

82. Round out the tip of the leaf structure.

83. Pleat both sides.

84. Make three more pleats.

85. Rabbit-ear to round this tip. Close the abdomen flaps back up.

86. in the leg and shape foot (tarsus) with a small crimp.

87. Repeat step 86 on the other legs.

88. Round the leaf structure.
Pinch ridges into the leaf structure to form veins.

Round the thorax.

Pleat just above the head.

The completed leaf insect.
Jason Ku has been folding since the age of five. He began designing original models in high school.

In 2005, Ku was invited as a Yoshino Fund special guest to teach and exhibit at the Origami Tanteidan convention (the annual meeting of the Japanese Origami Academic Society) in Tokyo, Japan. Since then, he has received two degrees in mechanical engineering from MIT while acting as the president of MIT's origami club, OrigaMIT.

Currently, Ku volunteers as the managing editor for OrigamiUSA's online magazine, *The Fold*, and is a member of the OrigamiUSA board of directors.
When it comes to horned beetles, the common rhinoceros beetle is probably the most basic. That means that I could focus on producing a clean, 3D body with an even distribution of layers. Many different paper types and thicknesses can be used, but I’d avoid very thick paper. This model locks itself together during the folding process, so glues or special treatments aren’t needed. A 10-inch square will produce a 4-inch long model.

Start with the colored side up. Fold and unfold along the diagonals.

1.

Fold and unfold horizontally and vertically.

2.

Valley fold the corners to the center.

3.

Valley fold the edge to the center crease.

4.

Mountain fold in half.

5.

Closer view. Squash fold.

6.

Closer view. Petal fold.

7.
8. Pull out the paper.

9. Fold the flap to the left.

10. Fold the corner to the center crease and unfold.

11. Open sink.

12. Valley fold the flap back to the right.

13. Mirror steps 9 to 12 on the other side.

14. Turn over.

15. Valley fold down.

16. Valley fold up.
Valley fold the corner to the edge.
Open sink. Valley fold up.
Pleat.
Valley fold two layers over.
Petal fold.
Valley fold edge to edge.
Squash fold.

17 Valley fold up.
18 Open sink.
19 Valley fold the corner to the edge.

20 Valley fold edge to edge.
21 Valley fold two layers over.
22 Pleat.

23 Squash fold.
24 Petal fold.
25 Unfold while forming a squash fold.

Rhinoceros Beetle
Unwrap one layer of paper.

Petal fold.

Collapse along existing creases.

Closer view.

Squash fold.

Unsink flap.

Unsink flap.

Valley fold up.

Valley fold up.

Valley fold up.

Unsink flap.
Valley fold and unfold.
Valley fold over.
Valley fold and unfold.
Pull out some paper so the left edge is vertical.
Squash fold.
Swivel fold.
Reverse fold.
Reverse fold inside.
Reverse fold inside.
Swivel fold.
Pull out some paper so the left edge is vertical.
Valley fold over.

Mirror steps 30 to 44 on the right.

Valley fold and unfold.

Open sink.

Valley fold.

Valley fold and unfold from corner to corner.

Squash fold.

Rabbit-ear fold.

Mirror steps 48 to 51 on the right.
Reverse fold three times.

Valley fold and unfold the angle bisectors.

Closed sink.

Reverse fold on both sides.

Valley fold down.

Valley fold down.

555453

58

61

57

56

60

59

61

Rhinoceros Beetle
Valley fold from corner to corner and unfold.

Spread sink.

Reverse fold.

Valley fold over.

Mirror steps 53 to 65 on the right.

Valley fold the corners to the center.

Rabbit-ear fold.

Reverse fold on both sides.

Open and spread sink central flap inward.
Unsink the flap.
Valley fold and unfold the angle bisector.
Squash fold.
Valley fold over.
Valley fold in half.
Valley fold up.

Valley fold in half.
Squash fold.
Unsink the flap.

Valley fold up.
Valley fold over.
Valley fold and unfold the angle bisector.
Mirror steps 74 to 81 on the right.

Unfold. Valley fold and unfold the angle bisectors.

Pleat. Wrap layers from behind in front (closed unsink).

Open sink. Valley fold down.

Refold while pushing out the paper at the center.

Unfold.
Valley fold up. Valley fold down. Open layers. Model will not lie flat.
Fold back to the center.
Valley fold up.
Pleat.
Valley fold down.
Closed sink.
Mountain fold the corners.

89

90

91

92

93

94

95

96

97

Open layers. Model will not lie flat.
Valley fold down.
Valley fold up.
Closed sink.
Pleat.
Fold back to the center.
Mountain fold the corners.
Valley fold down.
Valley fold up.
Refold step 98 while incorporating an open sink.

Unfold.

Fold the side corners to the bottom.

Stretch head and the front two sets of leg flaps upward.

Reverse fold the legs.

Reverse fold the sides.

Valley fold the leg flaps out.

Turn over.

Valley fold the front leg flaps up.

Reverse fold the legs.

Valley fold the leg flaps out.
Crimp the thorax.
Mountain fold in half.
Crimp the thorax.

Closer view.

Mountain fold.

Valley fold up.

Squash fold.

Mountain fold.

Mountain fold the corners.

Valley fold up.
125
Squash fold.

126
Petal fold.

127
Valley fold.

128
Squash fold the tip.

129
Mirror steps 120 to 128 on the opposite side.

130
Crimp.

131
Pinch and curve the horn up.

132
Pinch and curve the horns down.

133
Enlarged view of completed head.
Crimp foreleg several times. See next step for close-up of finished crimps.

Valley fold inside. Reverse fold to form wing covers (elytra).

Repeat steps 136 to 137 to form leg articulations.

Mountain fold upper leg.

The folded rhinoceros beetle in front of the crease pattern.
Butterflies and moths are interesting subjects for an origami designer. You need to create several slender appendages as well as wide, flat wings. This particular moth—the male Chinese luna moth—is especially striking for its long, trailing hindwings and feathery antennae. This model is best folded from very strong, yet very thin paper. A 10-inch square will produce a 6-inch model. Applying glue or paper stiffener to the finished piece can help it keep its shape.

Start with the colored side up. Fold along the diagonals and unfold.

Fold in half horizontally and vertically. Unfold after each fold.

Folding the corners to the pinch marks, mark the edges as indicated.

Folding the corners to the center creases, mark the edges as indicated.

Folding the pinch mark to the pinch mark, mark the edge as indicated.

Valley fold the corner to the pinch mark and unfold.

Valley fold the edge to the crease mark and unfold.
Valley fold the edges to the crease marks and unfold.

Valley fold the edge to the new crease mark and unfold.

Valley fold the edges to the crease marks and unfold.

Valley fold the edges to the new crease marks and unfold.

Valley fold horizontally through the points of intersection.

Mountain fold behind.

Valley fold the diagonal between the points of intersection and unfold.

Valley fold the diagonal between the points of intersection and unfold.

Valley fold the diagonal between the points of intersection and unfold.
Crimp. Valley fold a parallel diagonal starting at the intersection point indicated. Rotate.

Valley fold the diagonal between the points of intersection and unfold.

Valley fold the top flap.

Valley fold the sides into the center.

Reverse fold.

Crimp.

Valley fold and unfold.

Squash fold asymmetrically. Model will not lie flat.

Valley fold the top flap.

27. Valley fold.

28. Valley fold while pulling out some trapped paper.

29. Valley fold.

30. Valley fold and unfold.

31. Fold and unfold into fourths.

32. Mirror steps 22 to 31 on the flap behind.

33. Valley fold.

34. Valley fold while pulling out some trapped paper.
Valley fold while raising center flap.
Open sink.
Valley fold.
Fold and unfold in fourths.
Unfold.
Valley fold and unfold.
Pleat.
Valley fold the flap up.
Valley fold and unfold.
Fold and unfold in fourths.
Valley fold.
Pleat.
Unfold.
Valley fold edge to crease mark indicated.

Valley fold edge to crease mark indicated.

Valley fold the diagonal connecting indicated intersection points.

Valley fold, aligning the folded edge with the crease mark indicated.

Valley fold edge to folded edge.

Unfold.

Reverse fold.

Crimp.

Valley fold through points of intersection.
53
Open unsink.

54
Open unsink.

55
Spread sink.

56
Spread sink.

57
Closer view.

58
Valley fold and unfold.

59
Petal fold.

60
Unfold.

61
Open sink.
Larger view.

Turn over.

Spread sink.

Spread sink.

Closed unsink.

Squash fold along existing creases.

Valley fold down.

Collapse into a waterbomb base by pressing in the sides.

Squash fold while lifting the bottom center edge.
Open sink in and out. Squash fold. Turn over.
Valley fold the sides to the center. Valley fold while pulling out some trapped paper. The left side will not lie flat.

Spread sink the top while squash folding. The model will not lie flat.

Valley fold the sides to the center.

Wrap layers behind. Valley fold. Valley fold while pulling out some trapped paper. The left side will not lie flat.
Mirror steps 74 to 81 on the flap behind.

Open sink in and out. Valley fold.

Valley fold.

The left side will not lie flat.

Spread sink. The model will not lie flat.

Valley fold down.
Closer view. Mirror steps 86 to 89 on the flap behind.

Valley fold.

Valley fold.

Fold and unfold in fourths.

Pleat.

Valley fold and unfold.

Valley fold.

Valley fold down.

Luna Moth

86–89

91

90

92

93

94

95

96

97

Valley fold.

Pleat.

Valley fold.

Valley fold down.

Valley fold and unfold.

Fold and unfold in fourths.
98 Unfold.

99 Crimp.

100 Petal fold.

101 Valley fold down.

102 Open sink.

103 Spread sink while lifting the center flap.

104 Closed unsink.

105 Valley fold up.

106 Spread sink.
Crimp. Open sink, except for the top corner, which will be closed.

Valley fold.

Valley fold and unfold.

Mirror steps 92 to 114 on the flap behind.

Valley fold.

Open sink in and out.

Open sink.

109

110

111

112

113

114

115

Luna Moth
Valley fold while squash folding interior flap.

Valley fold down.

Valley fold and unfold.

Open sink.

Valley fold up.

Turn over.

Valley fold.

Closed unsink.

Valley fold and unfold the corners.
Valley fold and unfold in fourths.
Valley fold and unfold the corners.
Reverse fold.
Pleat while pushing out paper trapped inside.
Squash fold.
Valley fold and unfold.
Open sink in and out on both corners.
Valley fold and unfold.
Pleat while pushing out paper trapped inside.
Valley fold up.
Closer view.
Squash fold.
Squash fold.
Open sink.
Valley fold.

In progress.

Open paper and swivel fold.
Pleat while pushing interior layer in.

In progress.

Valley fold down.

In progress.

Valley fold.

Pleat while collapsing paper inside.

In progress.

Open paper and swivel fold.
Reverse fold. Reverse fold. Reverse fold.

Hybrid sink (top is closed, bottom is open).

Repeat steps 132 to 149 on the other side of the same flap.

Valley fold and unfold. Hybrid sink (top is closed, bottom is open).

Larger view. Valley fold up.

Repeat steps 132 to 149 on the other side of the same flap.
Turn over. Mirror steps 132 to 152 on the other side. Valley fold.

Fold sides down while turning the long flap to give it dimension.

Swivel fold inside. Model will not lie flat.

Mountain fold the center portion of the long flap.

Mirror steps 155 to 158 on the other side.

Closer view.
Valley fold down while folding the sides inside.

Swivel fold inside.

Valley fold down.

Swivel fold inside.

Squash fold inside.

Squash fold inside.

Squash fold inside.

Mirror steps 163 to 166 on the other side.

Turn over.

Petal fold on both sides.
Valley fold the corners.

Rabbit-ear fold.

Pleat.

Valley fold up.

Valley fold up.

Swivel bottom two flaps to the right while folding the top flap down. This will free some paper on the left.

Spread sink. The model will not lie flat.

Closed unsink.

Valley fold down.
Kite fold in thirds.

Kite fold.

Squash fold.

Valley fold over.

Reverse fold on both sides.

Valley fold up.

Squash fold.

Valley fold down.

Mirror steps 172 to 192 on the other side.

172–192
Valley fold a leg down.

Mountain fold the model in half. Rotate.

Open antennae and spread. Model will not lie flat.

Repeat steps 199 to 200 five more times to shape remaining legs.

Valley fold to make the leg jointed.

Folded luna moth set against the crease pattern for this model.
Shuki Kato first learned about origami from John Montroll’s classic book, *Origami for the Enthusiast*, at around age 6. Shortly afterward, he began designing his own original models. In 2000 he became a member of OrigamiUSA and in college he started giving lectures about origami design as well as teaching classes on simple origami models and folding techniques.

An avid golfer, he also enjoys studying about animals (primarily dinosaurs and insects) and is a fan of fantasy novels and Japanese manga and anime. Shuki Kato currently resides in Kalispell, Montana, and is working on a comprehensive origami book of his own.

Photographs, crease patterns, and descriptions of much of his work can be found at his Flickr account:

www. ickr.com/photos/origami-artist-galen/
I first designed a version of this model in 2008 and revised it in 2012. I like to use tracing paper to fold this model. I recommend starting out with a 25-inch square, which results in a finished piece of about 6¾ inches. It takes me 7 hours to fold this particular model.

Whenever I fold with tracing paper, I use a wet finish. At the last point where the model still lies flat, I spray the model with water, flatten and dry it somewhat, and then complete the final steps. This process works best if you work on one section at a time. If you apply too much water or spray the whole model at once, then the paper will likely sag and wrinkle.

1. Start with the colored side up. Fold in half vertically and unfold.
2. Fold and unfold, creasing only where shown.
3. Fold and unfold, creasing only where shown.
4. Fold and unfold horizontally and vertically through the intersection of the creases.
5. Fold and unfold horizontally and vertically to the creases indicated. This will divide the square into three equal rows of three squares.
6. Fold the diagonal creases and unfold.
7. Fold and unfold the outer boxes in the center row. Do not crease through the center box.
Fold and unfold through the crease intersections.

Add four creases, creasing only where they intersect the diagonals.

Fold the corners to the center crease, pinch, and unfold.

Fold edges to creases shown and unfold.

Fold creases to creases and unfold.

Fold creases to creases as shown and unfold.

Fold the top edge to the crease indicated, crease the sides only, and unfold.

Fold the bottom edge to the crease indicated and unfold.

Fold and unfold the side edges to the creases as shown.
17

Fold edges to creases shown and unfold.

18

You should now have an incomplete 15 x 15 grid.

19

Make additional horizontal and vertical creases shown, folding creases to creases, and unfold.

20

Fold the diagonals between the points indicated and unfold. Turn over.

21

Fold the 18 angle bisectors shown and unfold.
Fold the 16 angle bisectors shown and unfold. Turn over.

Divide rows shown in half horizontally, folding edge to crease or crease to crease, only where indicated.

Divide more areas in half vertically and diagonally, creasing between points indicated. Turn over.

Continue dividing more rows in half horizontally, creasing between points indicated.
Continue dividing, adding vertical and diagonal creases between the points indicated.

Focus on this area.

Push the sides in to form a triangle in the center as you pleat down.

Crease as shown, forming a number of small diamonds. Turn over.

Pleat along existing creases.

Pleat to the center along existing creases.

Close up. Open sink the corners.

Wrap one layer in front on both sides.
Unsink the sides.
Pull out the center region as you pleat down.
Fold the two hidden edges down.

In progress.
Pleat to the center on existing creases.
Pleat downward as you collapse the center on existing creases.

Closed sink the edge.
Bring one layer to the front (closed sink).
Slightly larger view.

Pleat to the center on existing creases.
Sink the edge in and out on existing creases.

The gray region shows the result of the previous step. Open sink the top edge.

Mirror steps 43 to 44 on the opposite side.

Turn the model over.

Sink the hidden edge upward.

Fold the edge down.

Repeat steps 47 to 48 on the other three hidden edges.

Pleat to the center, then return to full view.
Collapse on existing creases. The solid lines (mostly diagonals) indicate alternating valley and mountain folds. Note: this is not for the faint of heart!

is diagram shows the folds that are obscured by four sets of pleats.

In progress. This shows only the most complicated part of the collapse, but it will help orient you.

It should look like this. Note the position of each flap.
56

Spread the layers at the top apart.

57

Box-pleat the top edge inside.

58

Turn over from top to bottom.

59

Fold the extra flap down.

60

Pleat upward. You will have to readjust the diagonal folds inside to accomplish this.

61

Side view of the previous step.

62

Position this way. Return to view shown in step 60.

63

Pleat upward in the same manner as before.

64

Pleat upward in the same manner one more time.
1. Fold the thick abdomen down.
2. Fold one layer over, squash folding the corner. The model will not lie flat.
3. Partial view, close up. Pull out some loose paper (unsink).
4. Fold the edge over as indicated.
5. Wrap behind.
6. Swivel this bit of paper inside.
7. Fold to the center as you squash fold the top corner.
8. Swivel the edge.
9. Close back up.
Pleat in two places.

Fold the abdomen back up.

Mirror steps 66 to 73 on the opposite side.

Swivel the small corners behind.

Position like this. Rotate 180° and return to full view.

Fold the sides behind on existing creases.

Unfold the last three pleats.

Mountain fold the small hidden corners.

Reform the pleats, wrapping them all the way around the sides.

Titan Beetle

133
Pleat the final pair of legs. Pleat the next pair of legs straight out.

Fold the first pair of legs out to the sides.

Fold and unfold.

Fold over along the raw edge.

Fold the top layer inside.

Closer view.

Fold to the crease line.

Fold one flap down.

Fold and unfold.

Fold the top layer inside.

Fold over along the raw edge.
Rabbit-ear the small corner.

Noting the reference, fold the small flap back up.

Fold in half, squash folding the lower corner.

Bring two layers to the front.

Swivel the flap to the left.

It should look like this.

Return to full view.

Mirror steps 87 to 97 on the opposite side.

Squeeze the tiny flap in half.

Focus on the hind leg.
Fold the layer back.
Fold the corner over and over.
Lift the top layer.
Turn the model over.
Wrap the layers behind.
Mirror steps 101 to 104 on the other hind leg.
Squash fold the eyes.
Position this way. Return to full view.
Focus on the head.

101 102 103

104 105 106

107 108 109
Unsink one layer upward. Fold the top edge down while pulling some paper out at the corners. Fold the small corners to the sides.

Pull out some more loose paper. Reverse fold the tiny corners and fold the top edge inside. Fold the eyes back toward the center.

Fold the bottom edges behind and pull out a bit of paper to shape the eyes. Position this way. Return to full view. Focus on a hind leg.

Spread sink the tip. Fold the small flap to the right. Push a hidden edge inside as you pleat one layer to the left.
122
Push a hidden edge in as you squash the small flap.

123
Fold the small flap to the right.

124
Push a hidden edge in and pleat to the right.

125
Fold the small flap back to the right.

126
Make a tiny pleat.

127
Fold the entire leg in half.

128
Fold and unfold.

129
Reverse fold the top edge.

130
Reverse fold.

131
Reverse fold.

132
Narrow the end of the leg and spread out the claws.

133
Crimp upward.
Crimp all the legs. Repeat steps 119 to 134 on the remaining legs. It should look like this. Return to full view.

Mountain fold the antennae out to the sides. Pleat the antennae, curve the mandibles, and crimp the mouthparts.

Sink two hidden edges upward.

Shape the wing covers (elytra).

Crimp the antennae.

Narrow the antennae.

Crimp the antennae.

Pleat the antennae, curve the mandibles, and crimp the mouthparts.
Narrow the antennae further and give the ends a bit of curve.

Continue shaping the model to taste.
FLYING HERCULES BEETLE

This is a recent (2012) revision of a model I first created in 2005. I folded the model you see here with O-gami, but basically I would advise using the thinnest paper available. Tracing paper is 41 gsm, so try anything thinner than 50 gsm. To get a finished model with a 6½-inch wingspan, I started with a 17-inch square. Leave yourself at least 5 to 7 hours to fold this model.

1. Start with the colored side up. Fold in half diagonally and unfold.

2. Fold in half vertically, making a pinch at the top.

3. Fold the corner to the crease, pinch the left edge and unfold.

4. Fold the top corner to the bottom edge, creasing lightly through the pinch made in step 3, and unfold.

5. Fold the bottom corner to the crease intersection, pinch, and unfold.

6. Fold to the pinch mark and unfold.

7. Fold and unfold. This will create a rectangle.
Fold the last fourth in half, creasing as indicated.

Fold the diagonal creases.

Divide the rectangle into fourths. Note that the creases from steps 2 to 5 are no longer shown.

Fold, aligning points as indicated, and unfold.

The points indicated should line up as shown.

Close up view shows the approximate reference is at the / mark.

Fold back down.

Valley fold. Check the next step for references.

Fold the edge down; note that the reference is not exact and lies slightly above where you would expect it to be.
Fold between the points indicated and unfold.

Fold along the angle bisector and unfold.

Fold and unfold.

Fold the 16 angle bisectors shown and unfold.

Reverse fold the corners along the top edge. From this point to step 36 you won’t need to crease firmly unless there is an already existing crease.

Turn the paper over.

Fold the 16 angle bisectors shown and unfold.

The model should look like this. Mirror steps 11 to 19 on the opposite side.

Fold in half diagonally.

Rotate counterclockwise 45°.

Fold the 30 angle bisectors shown and unfold.

Flying Hercules Beetle 143
26 Pleat to the left. Repeat behind.

27 Petal fold, swinging the excess paper to the left. The model will not lie flat.

28 Squash the layer to the right.

29 Squash the top edge and petal fold.

30 Rabbit-ear fold as shown.

31 Fold two flaps down.

32 Fold one flap back up.

33 Note that the creases should line up (due to the bizarre reference in step 15). The crease on the left would be higher if you folded the edge too far down.

34 Fold the flap back down.
Repeat steps 27 to 34 behind.

Fold the layer behind to the right.

Open up along the center. The next steps will focus on this area only.

Invert the pocket and swing the excess paper to the right.

Fold and unfold, noting the references.

Fold and unfold. This should divide the area into equal thirds.

Fold the middle flap to the left.

Mirror steps 39 to 40 on the opposite side.

Collapse as shown. It is similar to a petal fold.
Fold corner to corner and unfold.

Fold the flap into fourths and unfold.

Divide further.

Petal fold, creasing the mountain folds lightly.

Divide further.

Make two outside crimps on existing creases.

Squash fold.

Petal fold, creasing the mountain folds lightly.

Fold and unfold.

Swivel the top layer slightly.
Bring the triangle to the front (closed sink it from behind).

Mirror steps 51 to 53 on the opposite side.

Wrap to the inside and flatten.

Turn the model over.

Swivel the top layers to the right while pleating a hidden layer.

It should look like this.

Return to full view.

Fold the corner and tuck it inside.

Petal fold, swinging the excess paper to the left.

Invert the pocket (unsink).
Bring the trapped edge to the front (unsink).

Fold one layer to the left.

Fold and unfold, using the creases behind as guides.

Fold and unfold.

Divide into fourths.

Fold one layer to the left.

Fold one layer to the left.

Fold the flap down.

Fold and unfold, using the creases behind as guides.

Fold and unfold, using the creases behind as guides.

Divide into fourths.
Fold all the layers to the right.

Repeat steps 67 and 68 on the next three layers.

Fold one layer to the left.

Squash fold the large flap.

Fold up as far as possible.

73

Fold all the layers to the right.

Repeat steps 60 to 73 on this side.

Squash fold the large flap.

Fold the corner and tuck it inside.

Squash fold the flaps down.

Flying Hercules Beetle

149
1. Bring one layer to the front.
2. Swivel the edges out.
3. Fold the flap down just past the straight edge.
4. Fold inner edge to the center.
5. It should look like this. Fold the edge back inside.
6. Fold to the center. If the crease doesn’t touch the point indicated, it isn’t that important.
7. Petal fold the edge up at an angle. Check the next step for references.
8. Bring the edge out from behind.
9. It should look like this. Fold the edge back inside.
Fold the wide flap to the left.

Open sink in and out on existing creases.

Open sink in and out on existing creases.

Fold the wide flap over.

Bring one layer to the front at the top and reverse fold the edge shown.

Fold over and fan out the top pleat.

Pleat as shown.
Fold the wing down.
Reverse fold the corner.
Gently pull the top layer to separate it from the layer below.
Wrap the tiny edge behind at the top and reverse fold the lower flap.
Spread sink two more corners.
Fold the sunken edges to the right.
Fold the wing back up.
Fold one flap up.
Wrap the tiny edge behind at the top and reverse fold the lower flap.
Fold one edge over, spread sinking two corners.
Spread sink two more corners.
Pull the wing down. It will not flatten completely.

Fold one flap down. Fold the edge back.

Fold the flap down. It should look like this.

Turn over.

Bring one edge up a bit from behind.

Mirror steps 83 to 113 on the opposite side.

Bring one edge to the front and flatten.

Fold one layer to the right.

It should look like this. Turn over.
Spread sink two corners.

Fold one layer to the right.

The wings are not shown.
Open-sink in and out on existing creases.

Fold the layer back to the left.

Open-sink in and out on existing creases.

Mirror steps 116 to 119 on the opposite site.

Fold the thick flap down.

Fold and unfold.
125

Squeeze the sides in and extend some paper downward as far as possible. The model will not lie flat.

126

Side view. Begin to collapse as shown.

127

Collapse as shown.

128

Fold the thick flap back down.

129

Spread sink four corners at the top.

130

Focus on this flap.

131

Spread sink two corners.

132

Fold and unfold.

133

Adjust the leading edge as shown.
Unsink one layer.
Reverse fold to the center.
Repeat on the right.
Fold the thick flap back up.
Narrow the flaps with reverse folds.
Open sink both sides.
Reverse fold the hidden flaps slightly beyond the halfway points.
Fold to the center and unfold.
Spread sink four corners.
Reverse fold the hidden flaps slightly beyond the halfway points.
Narrow the flaps with reverse folds.
Crimp the first pair of flaps to the sides, distributing the layers evenly.

Valley fold the lowest assembly of flaps to the top.

It should look like this.

Return to full view.

Crimp the rest pair of flaps to the sides, distributing the layers evenly.

Narrow the legs. Only the middle pair has all the layers folded in half at once.

Valley fold the next pair of flaps to the sides.

Valley fold the top pair of flaps down.

Fold one flap down.

Fold back down.

Valley fold the next pair of flaps to the sides.

Valley fold the top pair of flaps down.

Fold one flap down.

Fold back down.

Narrow the legs. Only the middle pair has all the layers folded in half at once.
Focus on the abdomen. Squeeze the flap in half, pulling it slightly toward you.

Valley fold the top pair of legs and reverse fold the bottom pair.

Fold up and flatten.

Shape the long horn as shown.

Pleat the edges out as indicated.

It should look like this.

Fold down and bring the sides in, keeping this area 3D.

Shape the long horn as shown.

Turn the model over.

Fold the tip and unfold.

Fold up and flatten.
161: Squash fold the wing cases to the sides.
162: Only one side is shown. Wrap the lower edge behind.
163: Mountain fold the edge behind, corner to corner.

164: Mountain fold the corner behind.
165: Make a small pleat.
166: Unfold to step 164.

167: Collapse on existing creases.
168: Reverse fold inside to lock.
169: Shape the wing case further.
Pleat the abdomen in two places.
The wing cases are not shown here. Bring the rear edge to the front.

It should look like this. Mirror steps 163 to 170 on the opposite side.

Round the edges of the abdomen and wings.

It should look like this. Focus on the body and legs.

Rabbit-ear fold all the legs.

Crimp each leg.

Shape the legs into a natural-looking pose and round the model.

It should look like this. Now focus on the side of the head and the main horn.
Rabbit-ear fold the antennae and bend the tips forward.

Shape the horns.

It will look like this. Switch to top view.

Side view is shown against the crease pattern.

Top view of completed model.
Born and raised in Atlanta, Georgia, Robert J. Lang worked as a physicist and engineer before becoming an origami artist full time.

Dr. Lang is one of the pioneers of the cross-disciplinary marriage of origami with mathematics. He is consulted on applications of origami to issues in engineering while being noted for origami designs of great detail and realism. His work has been shown worldwide, from the Museum of Modern Art in New York to the Nippon Museum of Origami in Japan.

Dr. Lang lectures widely on origami and its connection to the world of science and teaches workshops on both artistic techniques and applications of folding in industrial design. A Fellow of the Optical Society of America, a member of the IEEE Photonics Society, and a past Editor-in-Chief of the IEEE Journal of Quantum Electronics, he was recently selected as one of the inaugural Fellows of the American Mathematical Society.

He is the author or coauthor of 14 books and numerous articles on origami. He currently resides in Alamo, California.
For best results, I recommend folding this from a sheet of sized paper (as thin as you can find), ideally 40 cm or larger (the photographed piece was from a 40 cm (16 inches) square). You should start with dry paper and fold it dry up to the point that it starts to become 3D. At that point, I recommend using a small paintbrush and a dish of water to selectively dampen legs, wings, body segments, etc., for shaping, taking breaks to let one part dry before moving on to the next.

Bring the bottom right corner to the crease line, creating a pinch mark by the edge.

Fold the bottom corner to the pinch mark.

Fold raw edge to folded edge. Unfold.

Unfold.

Fold the edge to the crease. Unfold.

Fold the folded edge to the crease. Unfold.
Unfold.
Fold edge to edge. Unfold.
Fold to the intersection points shown. Unfold.
Crease as indicated. Note: unnecessary pinch marks are not shown for clarity.

Fold corner to corner, creating a small pinch only where indicated (on the third and fourth creases).

Fold edges to the creases. Unfold.
Fold edges to the creases. Unfold.

Turn over.
Crease as indicated.

Crease as indicated.

Crease as indicated.

Turn over.
Crease the diagonals as indicated.

Next, details of the creases needed for the corner. Note: steps 23 to 27 should be repeated on the right corner and side.

Crease as indicated. Note: the numbers represent the 1/56th divisions for reference.

Mountain crease as indicated.
Fold crease to crease (creases created in the previous step). Turn over.

Continue creasing as indicated on the left side. Additional diagonal creases need to be created. The vertical and horizontal creases need to be reinforced or extended. All creases indicated will be needed for the base or for later steps, including the ones marked in a fainter color. Unnecessary creases are not shown for clarity.

After creasing the right side, follow the creases indicated for the initial collapse. This is a one indivisible big honkin’ collapse and it needs to be done all at once.
Collapse the top of the base using the creases shown. Some of the necessary creases are not visible in this drawing; the next drawing shows all of the creases needed on unfolded paper.
Re ne the collapse. Some of the necessary creases are not visible in this drawing; the next drawing shows all of the creases needed on unfolded paper. Crease as indicated in the highlighted region. Note that the region near the corner is part of a double layer. Turn over.

There are two pairs of layers together in zigzag. Reverse fold one of each pair so it zigzags twice as much with half the width, using the creases indicated in the highlighted region. Turn over.
Refine the collapse. The next drawing shows all of the creases needed on the unfolded paper. Crease as indicated in the highlighted region.

Open the layers to work on the inside of the flap.

Asymmetrically spread sink three corners, then close them up.

Repeat the spread sinks on the other side.
This is the complete collapsed base. Turn over.
Open out the two pleats and stretch.
Refold with the creases indicated.

Bring layers to the front.
Sink four edges.
Fully Elias-stretch the pleats.

Stretch the top apart.
Refold the creases indicated.
It will look like this. Open out to see the interior.
Refold at on the creases indicated.

You can't actually open this part fully flat.

Like so. Reverse fold the flaps that got the three spread sinks and divide the layers at the spread sinks.

Fold through thick layers.

Precrease the pleats indicated. The legs will become perpendicular. View from the side next.

Fold the thick corners underneath.

Schematic view from the side.

Make 3D using the creases indicated. This will separate the segments.

Note: wings omitted for clarity. Detailed view next.
Make a distinct gap between segments by reverse folding the corners.

Like this. From here forward, the body-shaping folds should be soft and not all extend fully to the corners to keep the body rounded and natural.

Schematic view from the side with 3D segments.

Details of the head.

Crimp antennae to the side.
Fold tip under.

Fold entire assembly down at right angle. Crimp at base of antennae.

Side view of abdomen.

Curve and crimp.

Detailed view of a typical leg next.

It will look like this.

Schematic view from the side. Fold legs at.

Next, view from bottom.

Pinch legs, then fold out to the sides.

Reverse fold the toes (tarsae).

Crimp.

Finished leg. Continue shaping legs and position to match the photo.
Folded yellow jacket set against the crease pattern for the model.

View from the underside
As you look through these pages, you will notice that some (although not all) of the instructions show an illustration of the folded model in front of a diagram of the crease pattern for that particular model. These days, it is a common practice to display a small picture of the crease pattern—also called the CP—with the step-by-step instructions for super-complex models. Only models that are extremely challenging will have a CP, and it is sometimes used in place of step-by-step instructions for these super-complex projects. In fact, that is happening more and more.

Before step-by-step instructions were used, the unfolded paper model was the main visual way to document the folding process for a particular model. These days, we reproduce the patterns made by the folds in diagrams called crease patterns that resemble a maze of line-work because of their complexity. They are beautiful to look at in their own right, and so we are pleased to include them.

It does, however, take skill to be able to read and understand a CP. To the inexperienced viewer, it is simply the trail left behind by the creases. To an experienced folder, however, it communicates the basic outline of the model creator’s folding process in one picture, rather than a long sequence of several pictures. For those who are proficient enough to read and work off of crease patterns, we offer them, unimpeded by illustrations of the finished models.
RHINOCEROS
BEETLE
LUNA MOTH X-IMPOS
TITAN
BEETLEUR

The Crease Patterns
179
FLYING HERCULES BEETLE
YELLOW JACKET
ABOUT THE EDITOR

Sherry Gerstein is an editor and writer who has edited many origami books. She has been folding since she was 7 years old. She crafts and sells her own line of origami jewelry at etsy.com/shop/papergirlinct and aspires to create origami models of her own.
The saying “every picture tells a story” is especially true of origami diagrams; they tell the story of the transformation of a piece of paper into a work of art.

It is the challenge of the origami diagrammer to employ the tools of the trade—symbols such as solid lines, dashed lines, arrows and more—to tell the story in a clear and sequential fashion. The clearest diagrams work in such a way that the casual observer isn’t even aware of the work involved. For instance, a line of a certain weight translates into “edge”; a finer line translates into “existing crease” and a dotted line translates into “hidden edge.” These are concepts—the language of technical illustration, as it were—that are very nearly self-explanatory. At least, they are quickly grasped by the reader.

While this book collects models created by several different people, all the models have one thing in common: their stories were all told by the same illustrator/diagrammer, Marcio Noguchi.

Born in Brazil to Japanese parents, illustrator Marcio Noguchi first learned about origami as a child. But he didn’t become a serious enthusiast until the mid-2000s, after he moved to the US.

Since that time, Marcio Noguchi has illustrated and diagrammed a number of models for other creators. Some have appeared in books; others have been collected and distributed at the conventions of national origami societies in the US, the UK, and Japan. Says Noguchi, “Each diagram is a story. Each step indicates the before and the after, as well as the present action. It can tell about something as simple as a single fold or as complex as a big, one-step collapse. The best diagrams are so good that we feel we are reading, even if we don’t understand the language the actual text is written in.”

He is a supporting member of the Japan Origami Academic Society and a member of the OrigamiUSA Executive Board of Directors. He lives in Westchester County, New York.

In this tribute to the so-called “Bug Wars” of the 1980s and 1990s—the informal competition between top-tier folders of super-complex origami models—seven different artists present a menagerie of 12 insect models.

Including offerings from some of the most exciting names in modern origami—Won Park, Dan Robinson, Jason Ku, and Robert J. Lang, as well as fresh new talents—the book features step-by-step instructions for creating complex works of art from a single piece of paper, geared for the advanced folder. Crease patterns for the most complicated models are also included.