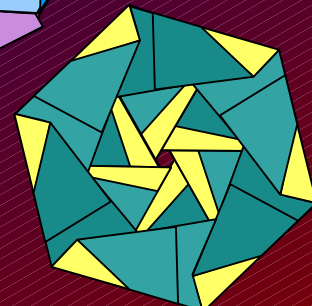
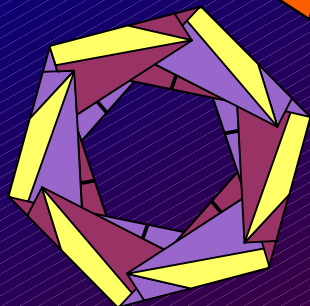
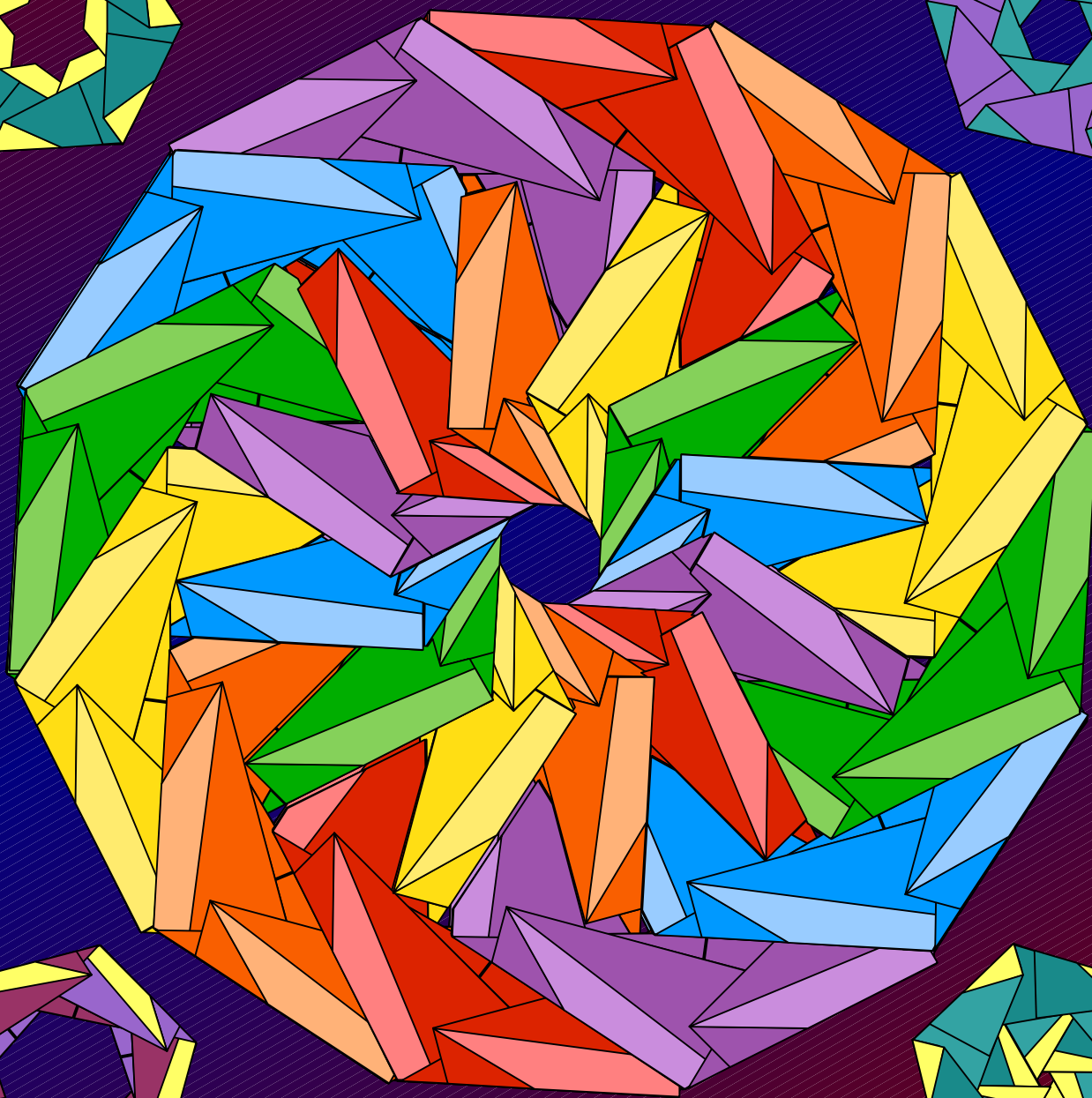
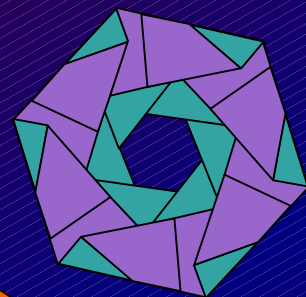
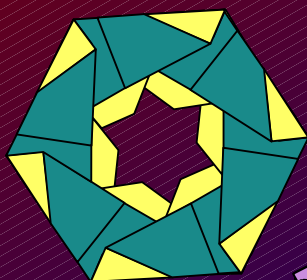


# Ring of Rings

12 Doubly-Linked Hexagons  
and their Origami Kin

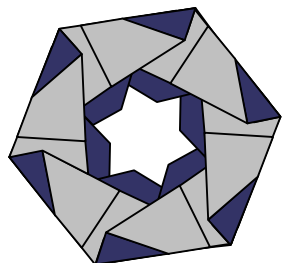


Wensdy Whitehead

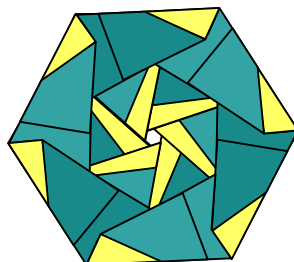
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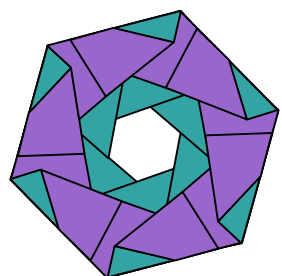
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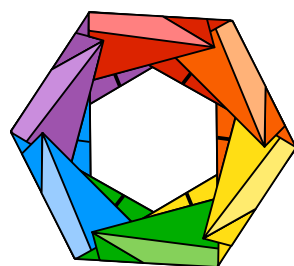
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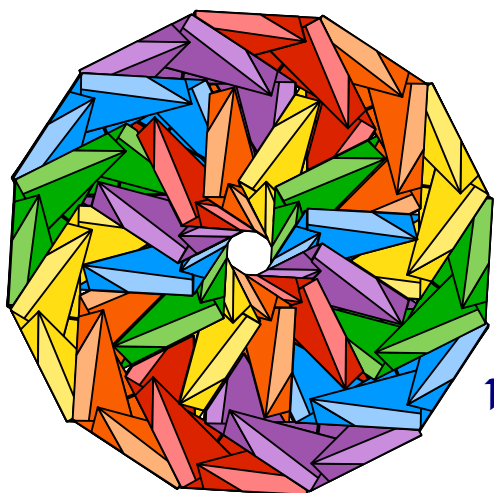
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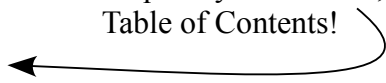
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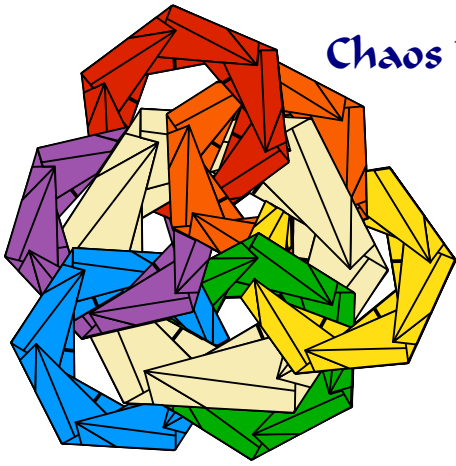
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Ring of Rings Planning Pages  
...???

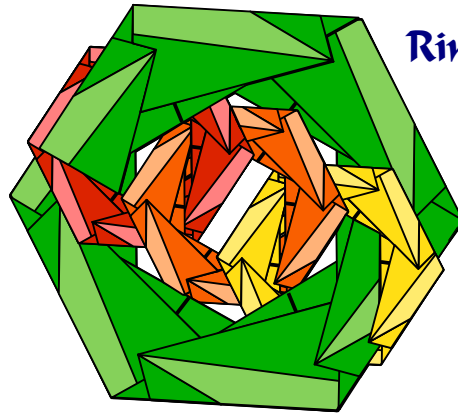
Use this link on most pages  
to quickly return here, the  
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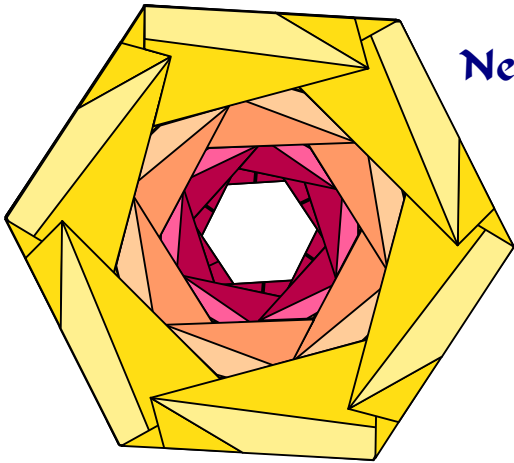




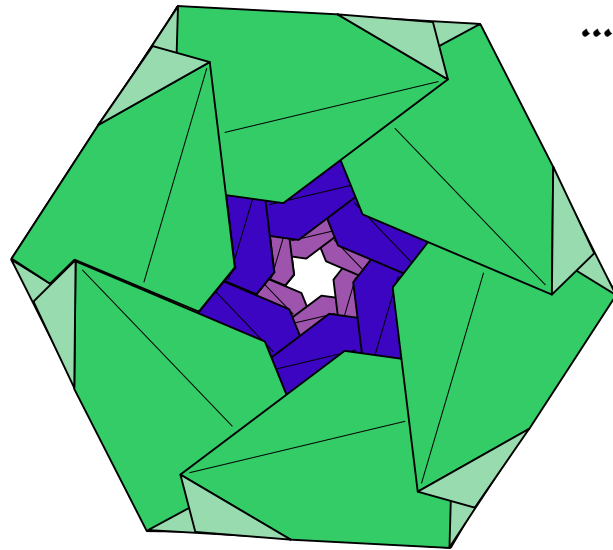
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...???



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...???


Extreme Nestagons  
...???


# Symbols


 Crease line – mark left by a crease that has been unfolded.


 Folded or raw edge.


 Paper seen from the edge.


 Valley fold. Fold the paper toward you along this line.


 Mountain fold. Fold the paper away from you along this line.


 X-ray line. A fold on an inner layer or layers of paper but not on the top layer. Also a hidden edge.

 Fold arrow. Part of the paper moves in this direction to complete the fold.

 Fold and unfold arrow. Make this crease, but return the paper to the way it was before the crease.

 Unfold arrow. Part of the paper moves in this direction to undo one or more folds.

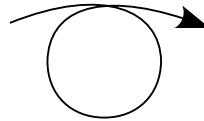
 Fold and tuck into the pocket.

 Push here.

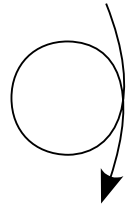
 Open here.



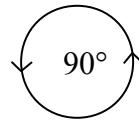
Inflate here. Do this gently with fingers if the opening is large enough. Otherwise blow into the model. Do not spit. A long, thin, blunt tool may help.



Turn the model over from side to side.



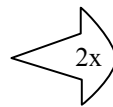
Turn the model over from top to bottom.



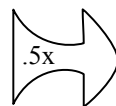
Rotate the model. The arrows indicate the direction. An optional angle measurement indicates how far to rotate. If there's no angle indicated, just look at the next diagram!



New view from this side of the model.



The diagrams get larger. Your paper does not. The precise enlargement factor is optional.



The diagrams get smaller. Your paper does not. The precise enlargement factor is optional.



Landmark for this fold. The small mark allows the intersection, corner, edge, etc. to show through. These show up in pairs – fold here to there.



Detail work which is shown magnified.

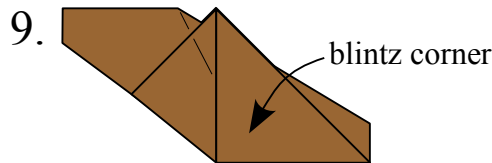


Repeat this fold on another layer behind this one. The number of lines across the arrow indicate the number of repetitions.

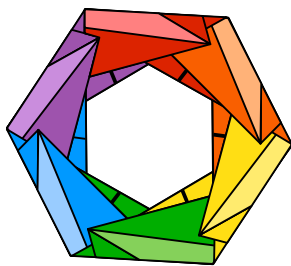


# Foreword

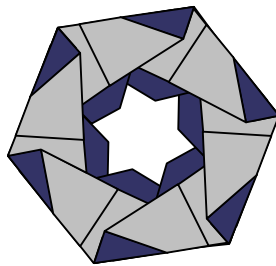
The units for the various hexagons are all closely related, taking advantage of a blintz corner that is non-structural and can be folded in numerous, decorative ways producing different color arrangements and different shapes and sizes for the gap in the center – or even affect the outer shape a bit. The variations shown are all diagrammed independently, so you can start with any of them. You will find their steps and assembly very similar; the first eight steps are the same. Step 9 starts work on that important blintz corner. The other blintz corner created with the roof fold in the second step could be folded to the back as a mountain fold for a bit more color variation and could even get a little more complicated but is much more limited than the one on the right hand side. Explore further variations on your own; there remains much to discover.



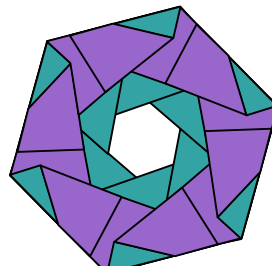
Changing the central hole makes more interesting hexagons, which generally cannot link doubly the way the Hexagonal Ring can. It is a tight fit with the largest central gap sported by the Hexagonal Ring. Other linkages are also possible and some variations with gaps only slightly smaller may link singly (passing through just the one ring to either side rather than the nearest two on each side).



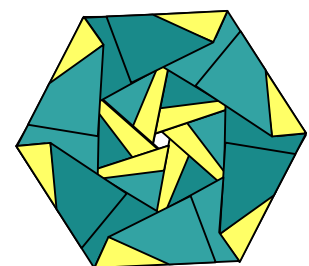
Hexagonal Ring



Starry Space



Triple Hex



Hex Vortex

All the versions have the same paper recommendation. They all work better with thicker paper such as memo cube, copy paper, scrapbooking paper or junk mail. This holds true even for small modules: 1" copy paper works fine, though it may be a bit smaller than most folders care to use. The paper recommendation is only that -- a recommendation for trying an unfamiliar model.

The [Ring of Rings](#) with seventy-two units provides a plethora of ways to arrange colors into patterns and even pictures. [Recipes](#) for some are provided. Explore more on you own, if you dare. [Colorable blanks](#) are provided after the recipes to help you test your own designs.

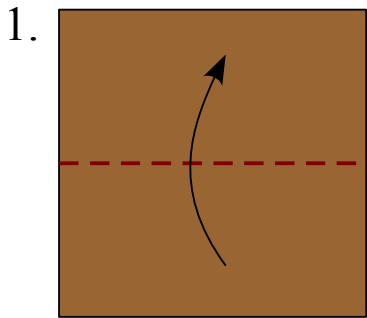
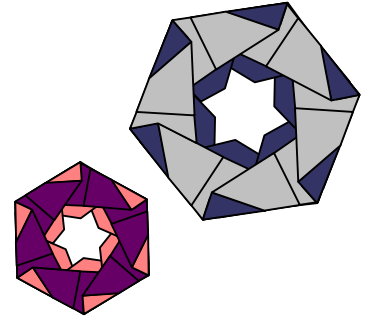
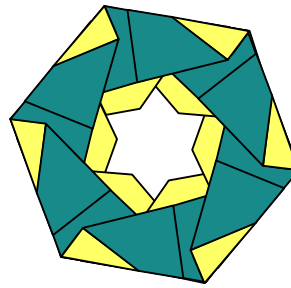
The fun doesn't stop there, Hexagonal Rings of different sizes can also [link up](#) or even [nest](#). Fortunately, these projects require fewer units than the Ring of Rings, coming in at 24, 42 and  $6n$  (where  $n$  is the number of nested hexagons).

# Starry Space

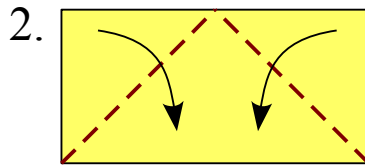
By Wensdy Whitehead



Recommended Paper: Six (6) thick 1.5-3" (40-75mm) squares.

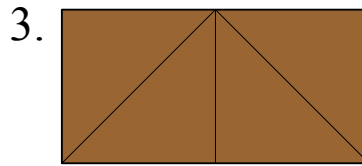


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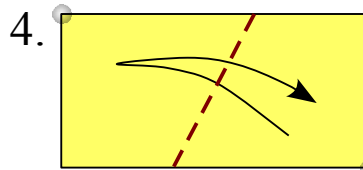


2.

Fold only the top layer.

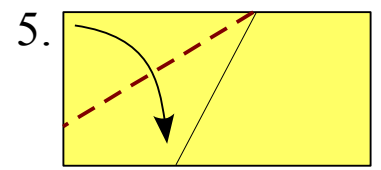


3.



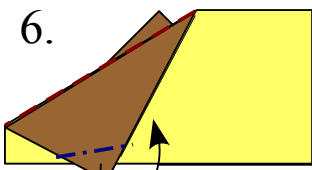
4.

Fold corner to corner and unfold.



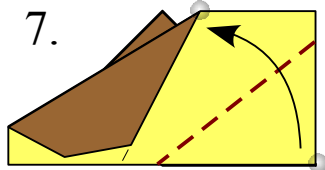
5.

Bisect the angle.



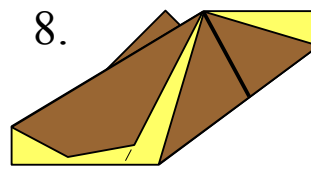
6.

RAT mountain fold to hide corner.

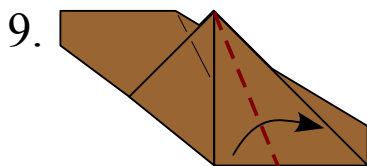


7.

Fold square corner to obtuse (blunt) corner.

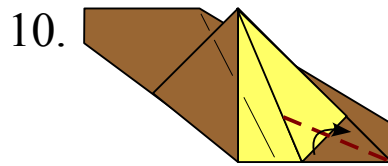


8.



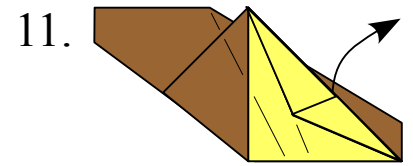
9.

Bisect the angle. (Fold only the top layer.)



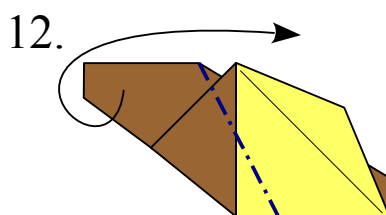
10.

Bisect the angle. TRADE OFF: This valley fold trades a folded edge on the front to remove an odd little bit of color change on the back.



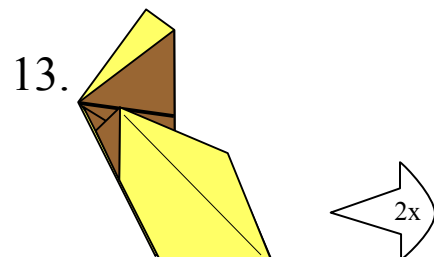
11.

Unfold one crease.



12.

Mountain fold the existing crease to complete the unit.

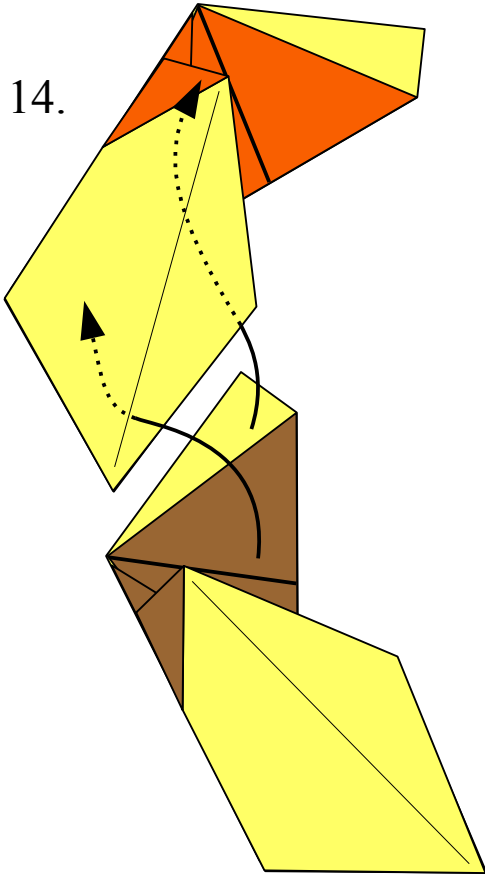


13.

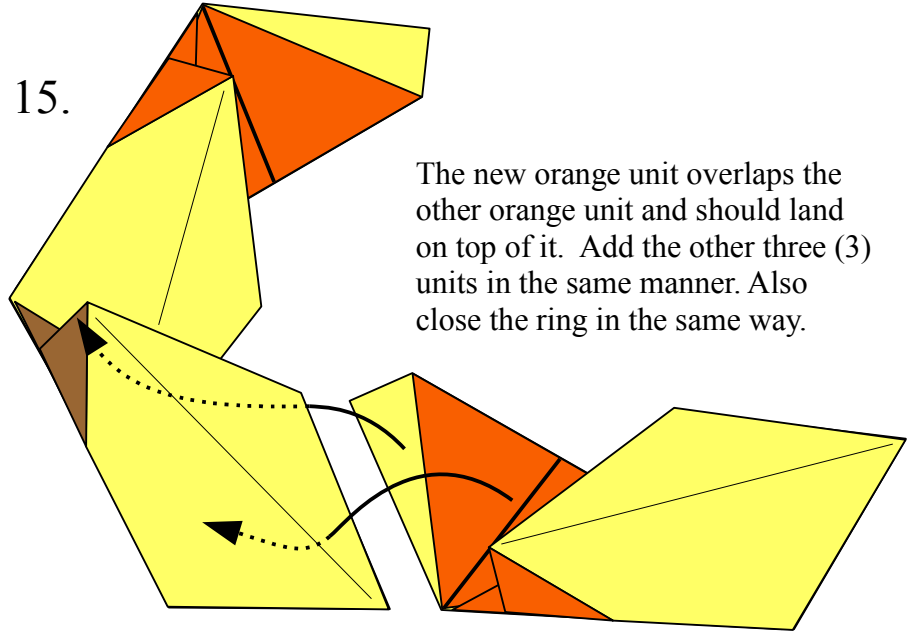
Result. Fold six (6) of these.

# Assembly

14.



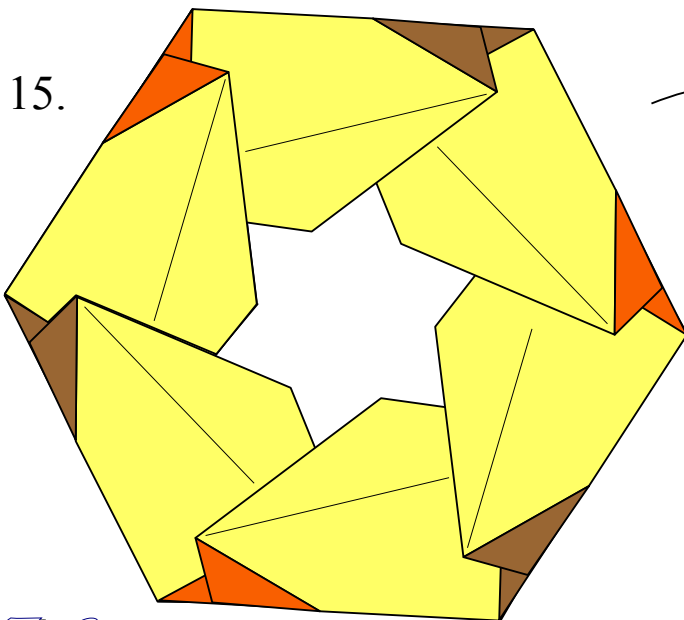
15.



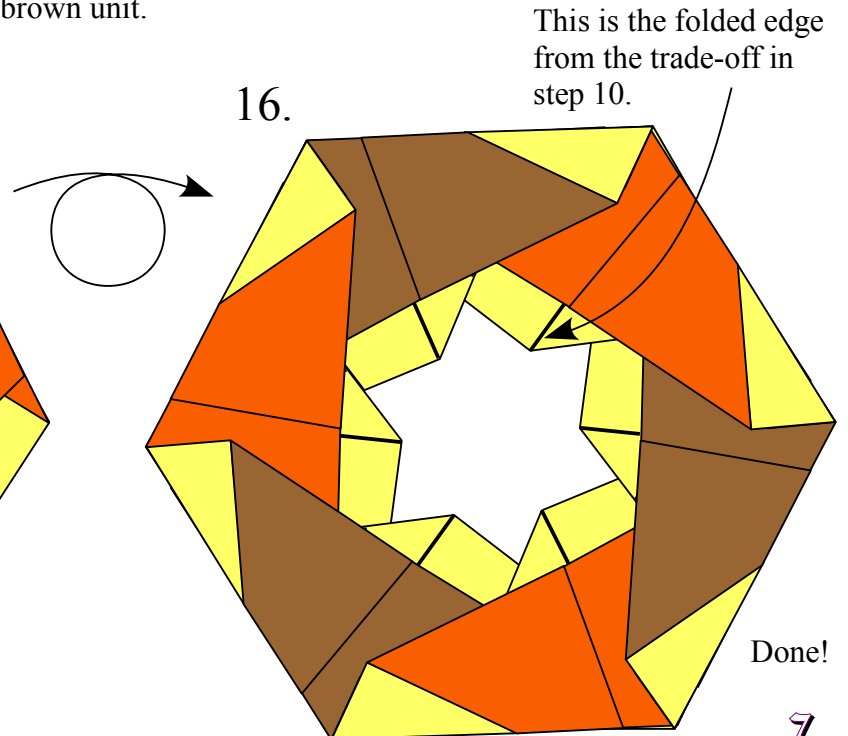
The new orange unit overlaps the other orange unit and should land on top of it. Add the other three (3) units in the same manner. Also close the ring in the same way.

Slide the units into each other, interleaving the layers of paper. The brown flap with the colorful square corner which is sandwiched between layers of its own flap goes into the pocket of the orange unit. The back flap of the orange unit goes behind the brown unit. It doesn't quite fit right if you put it in front of the yellow square corner showing on the brown unit.

15.



16.



This is the folded edge from the trade-off in step 10.

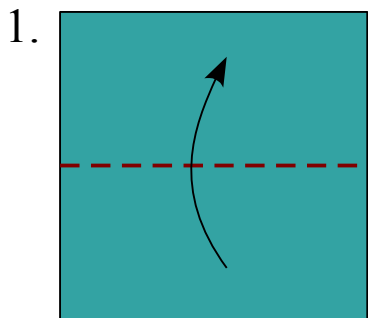
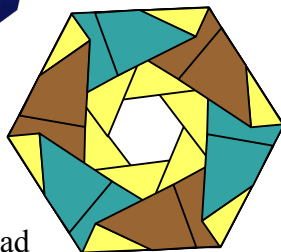
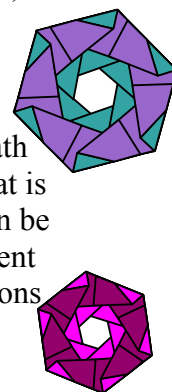
Done!

# Triple Hex

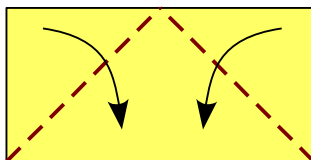
By Wensdy Whitehead

**Recommended Paper:** Six (6) thick 1.5-3" (40-75mm) squares.

The unit for this wreath has a blintz corner that is non-structural and can be folded in many different ways to create variations on this model.

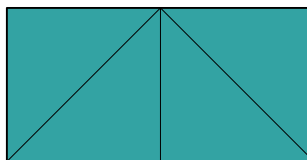


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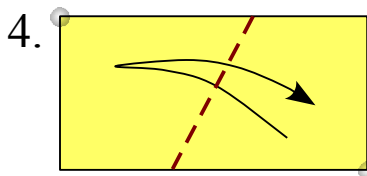
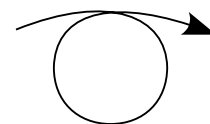


2.

Fold only the top layer.

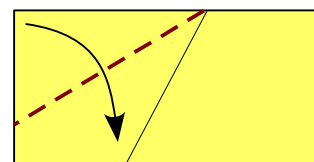


3.



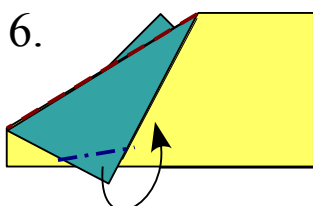
4.

Fold corner to corner and unfold.



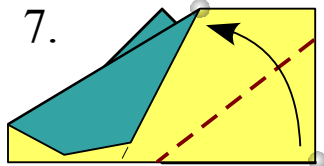
5.

Bisect the angle.



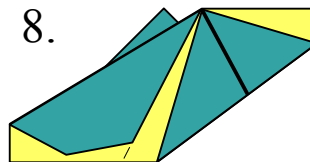
6.

RAT mountain fold to hide corner.

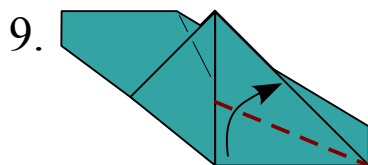
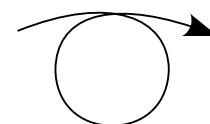


7.

Fold square corner to obtuse (blunt) corner.

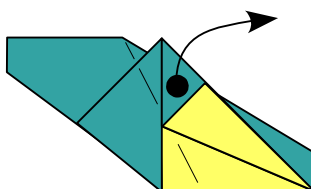


8.



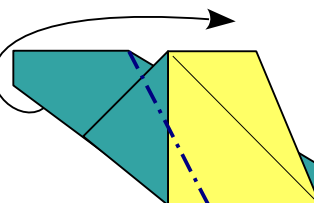
9.

Bisect the angle. (Fold only the top layer.)



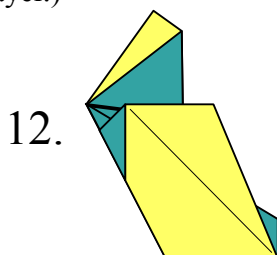
10.

Unfold one crease.



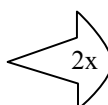
11.

Mountain fold the existing crease to complete the unit.



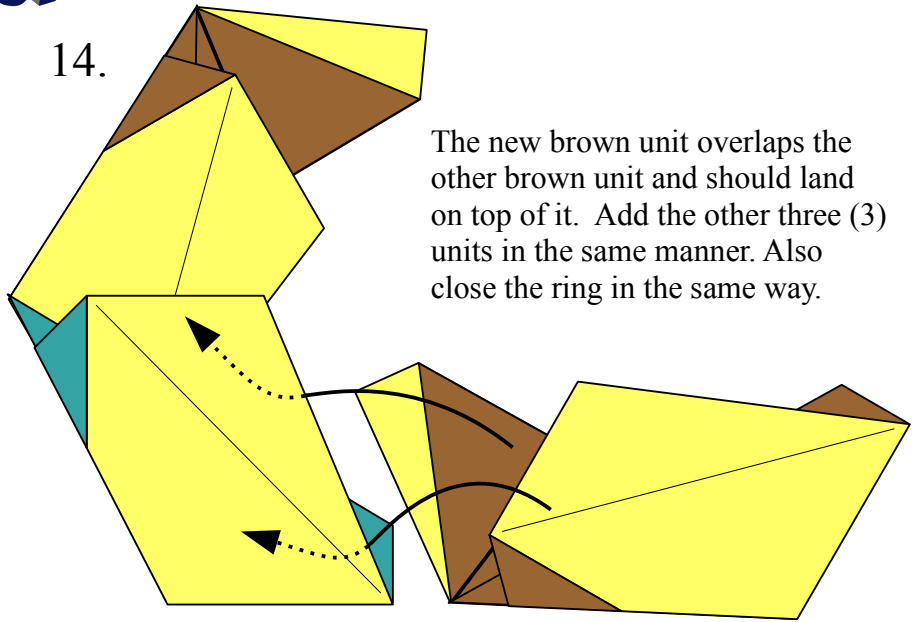
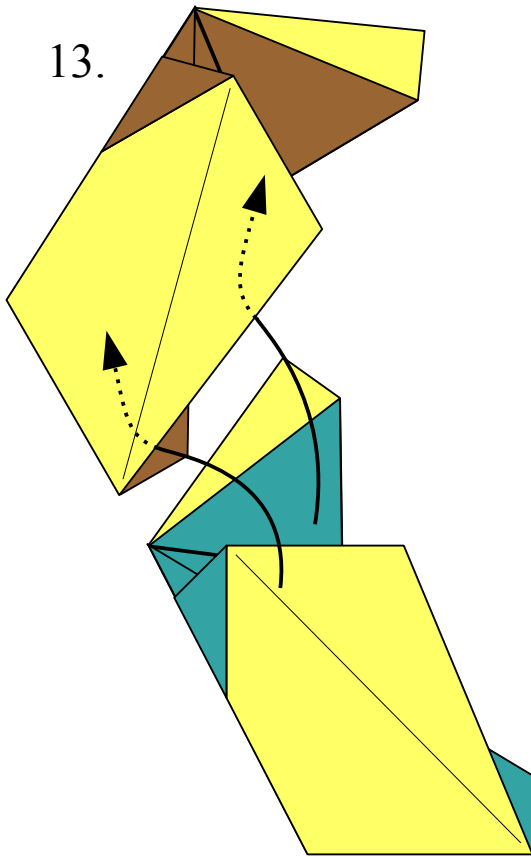
12.

The Triple Hex unit. Fold 6 and assemble like Starry Space.

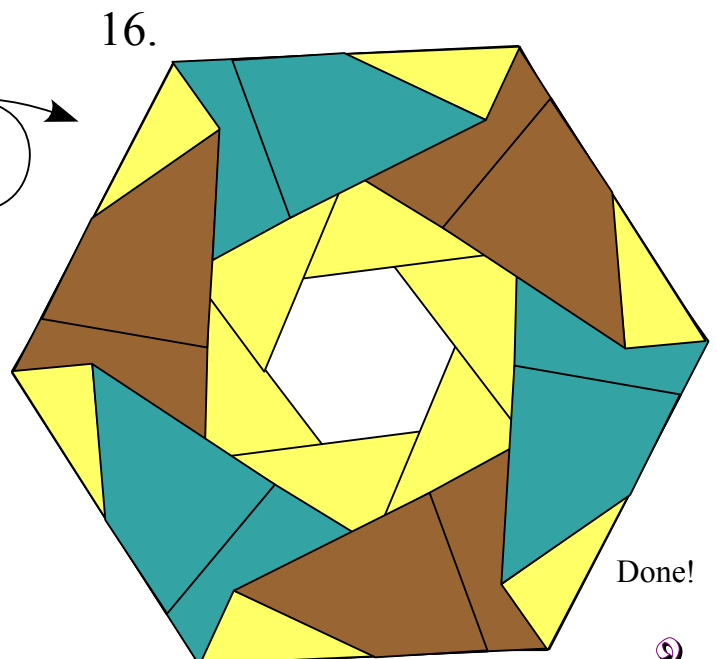
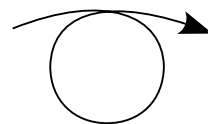
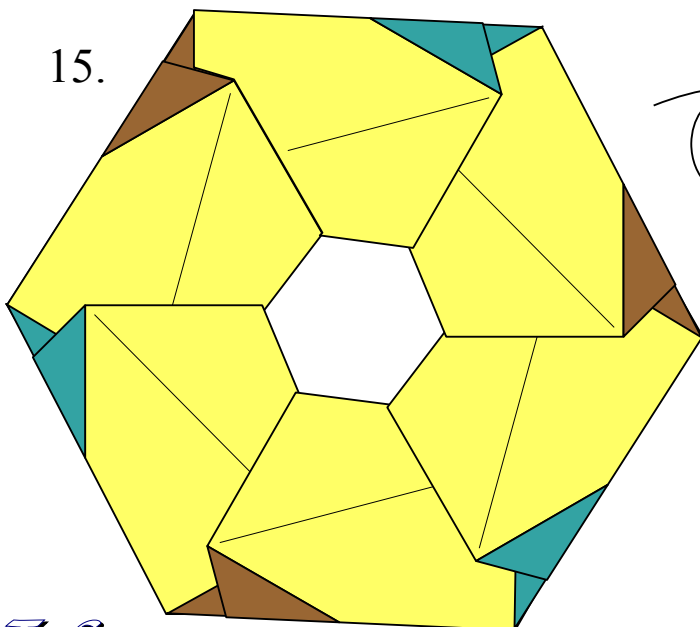




# Assembly

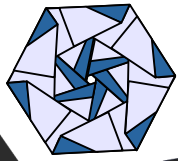


Slide the units into each other, interleaving the layers of paper. The teal flap with the colorful square corner which is sandwiched between layers of its own flap goes into the pocket of the brown unit. The back flap of the brown unit goes behind the teal unit. It doesn't quite fit right if you put it in front of the yellow square corner showing on the teal unit.



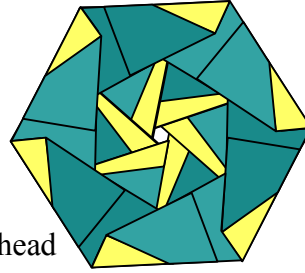
Done!

# Hex Vortex

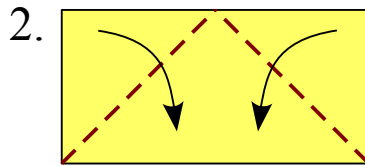
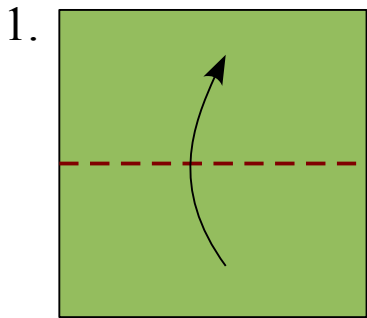


By Wensdy Whitehead

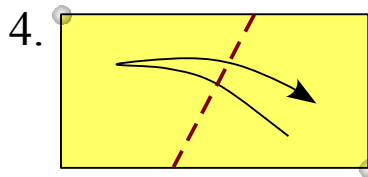
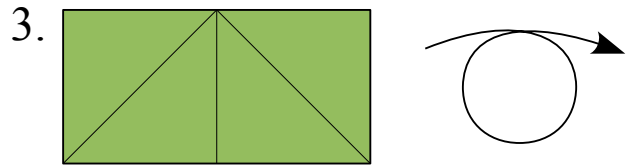
**Recommended Paper:** Six (6) thick 1.5-3" (40-75mm) squares.



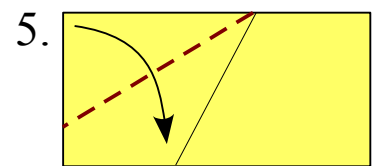
The unit for this wreath has a blintz corner that is non-structural and can be folded in many different ways to create variations on this model.



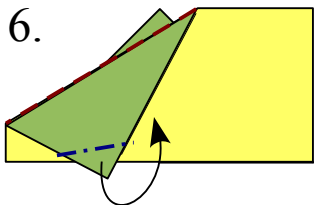
Fold only the top layer.



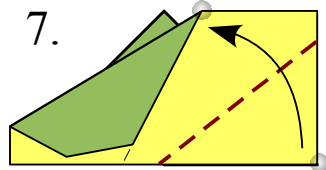
Fold corner to corner and unfold.



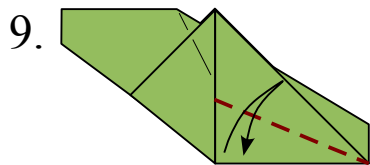
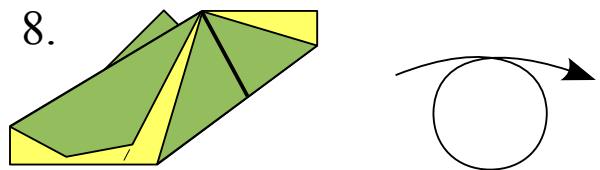
Bisect the angle.



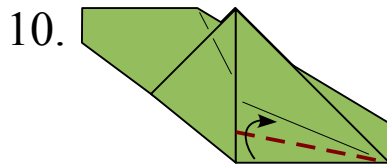
RAT mountain fold to hide corner.



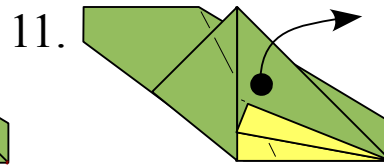
Fold square corner to obtuse (blunt) corner.



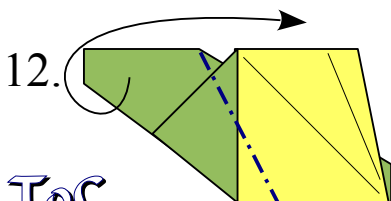
Bisect the angle. (Fold only the top layer and unfold.)



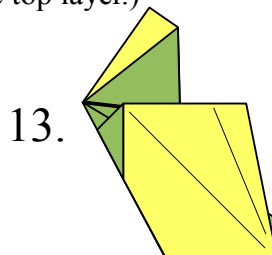
Bisect the new angle. (Fold only the top layer.)



Unfold one crease.

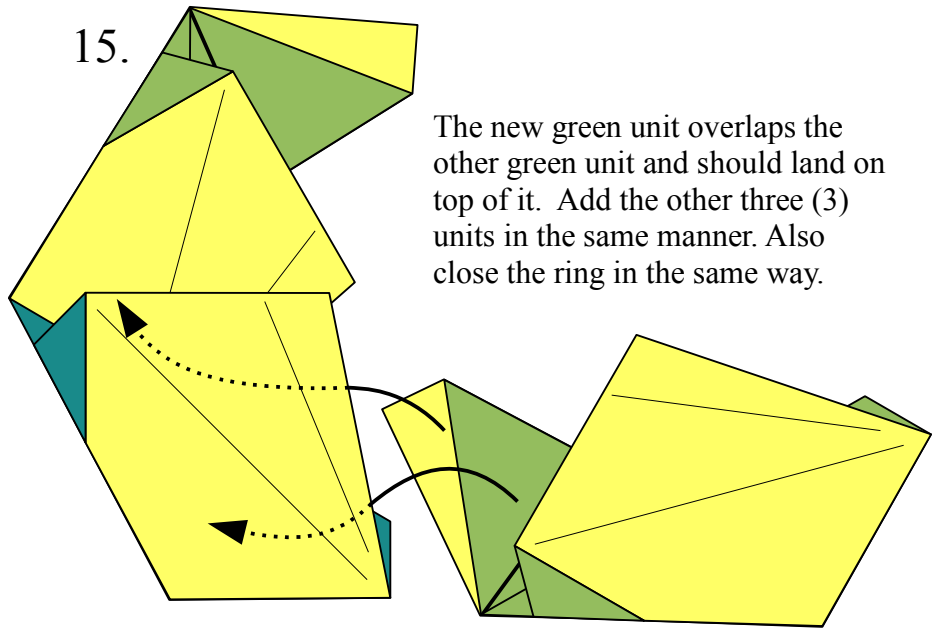
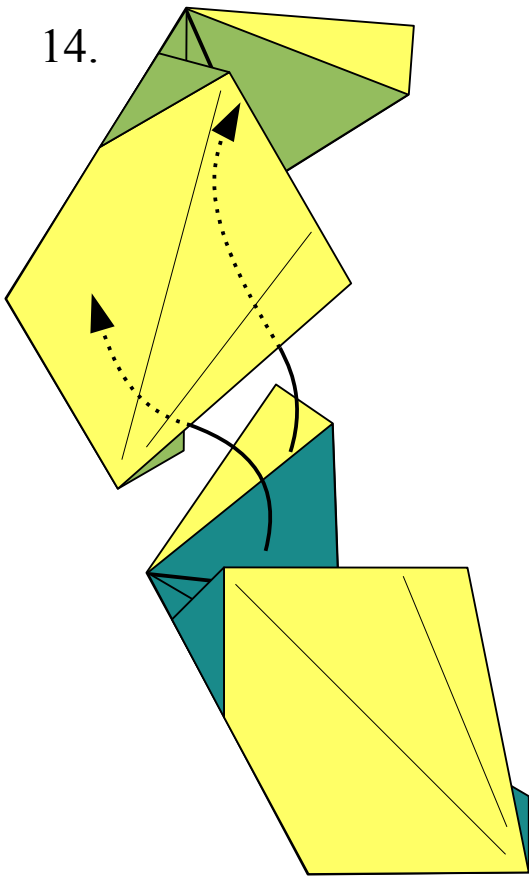


Mountain fold the existing crease to complete the unit.

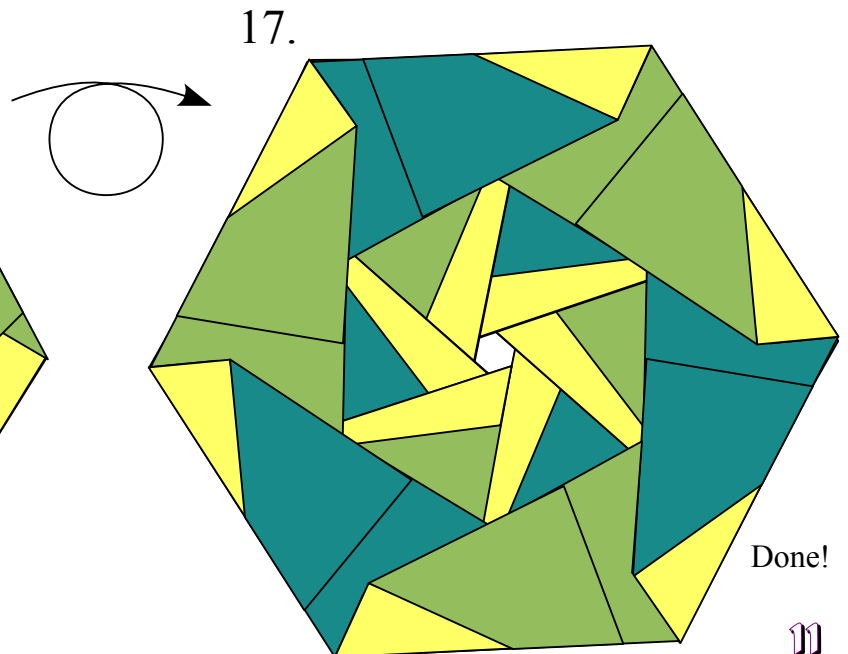
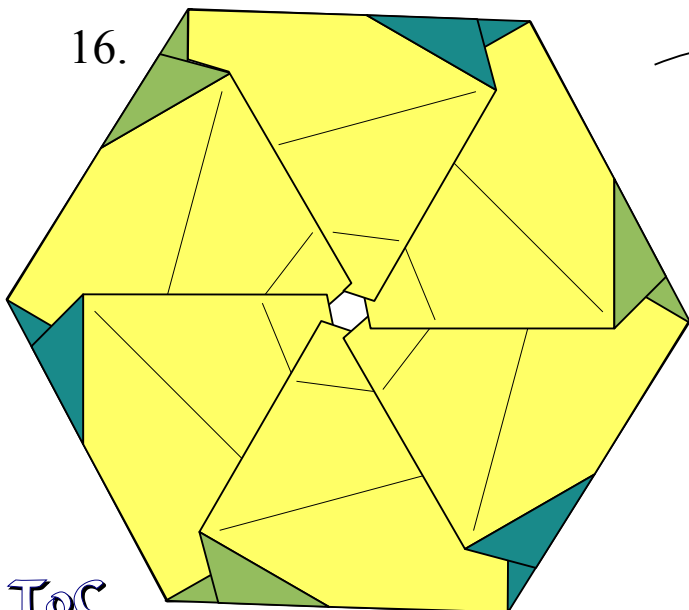


The 4<sup>th</sup> variant. Fold six (6) to assemble.

# Assembly

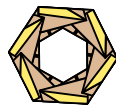


Slide the units into each other, interleaving the layers of paper. The teal flap with the colorful square corner which is sandwiched between layers of its own flap goes into the pocket of the green unit. The back flap of the green unit goes behind the teal unit. It doesn't quite fit right if you put it in front of the yellow square corner showing on the teal unit.



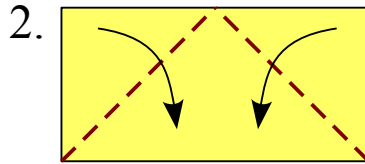
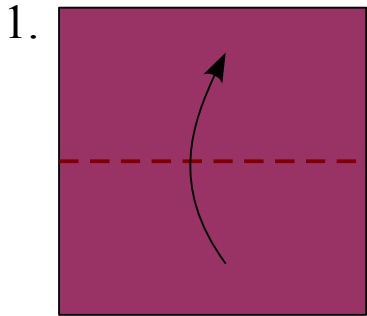
# Hexagonal Ring

By Wensdy Whitehead

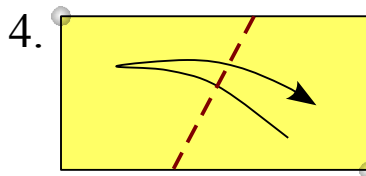
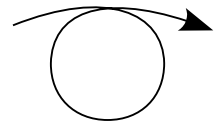
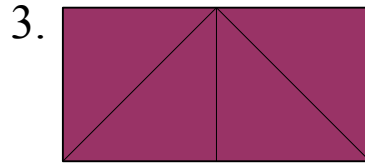


**Recommended Paper:** Six (6) thick 1.5-3" (40-75mm) squares.

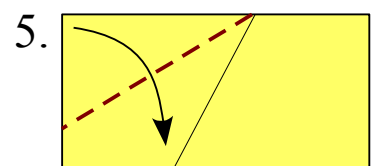
The unit for this wreath has a blintz corner that is non-structural and can be folded in many different ways to create variations on this model. Those that do not change the shape of the ring can be used for the [Ring of Rings](#); others are decorative as single rings, as is the case with [Starry Space](#).



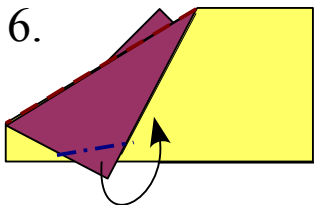
Fold only the top layer.



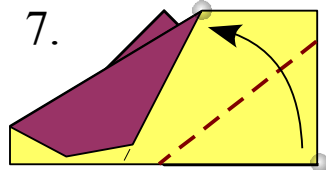
Fold corner to corner and unfold.



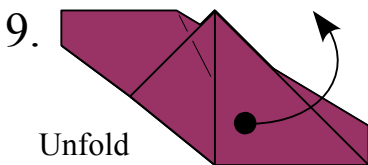
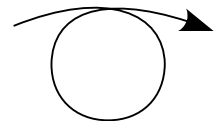
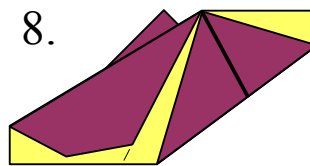
Bisect the angle.



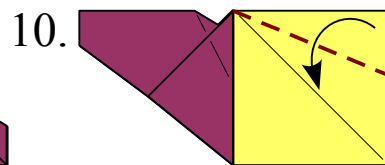
RAT mountain fold to hide corner.



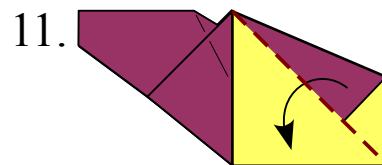
Fold square corner to obtuse (blunt) corner.



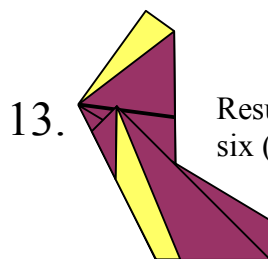
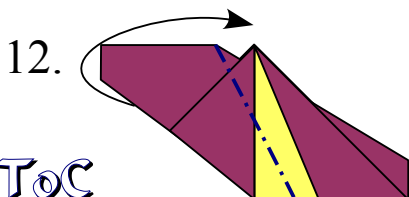
Unfold



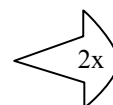
Bisect the angle.



Refold

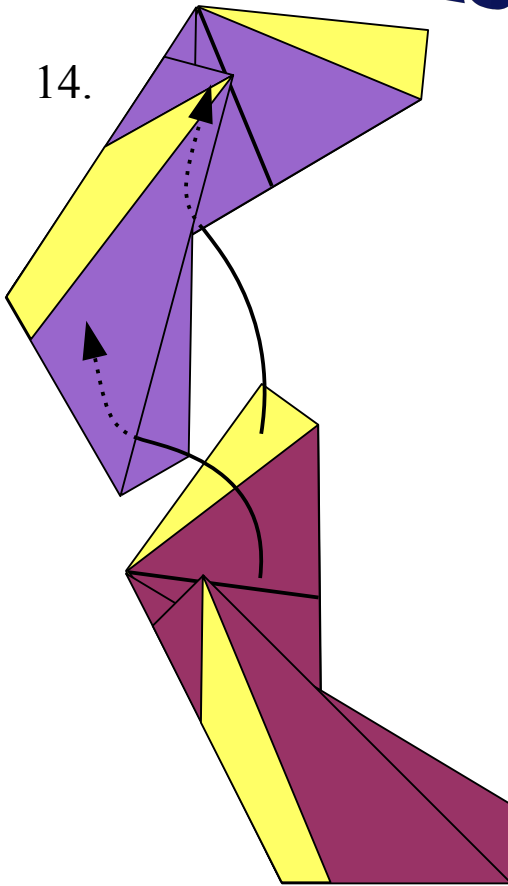


Result. Fold six (6) of these.

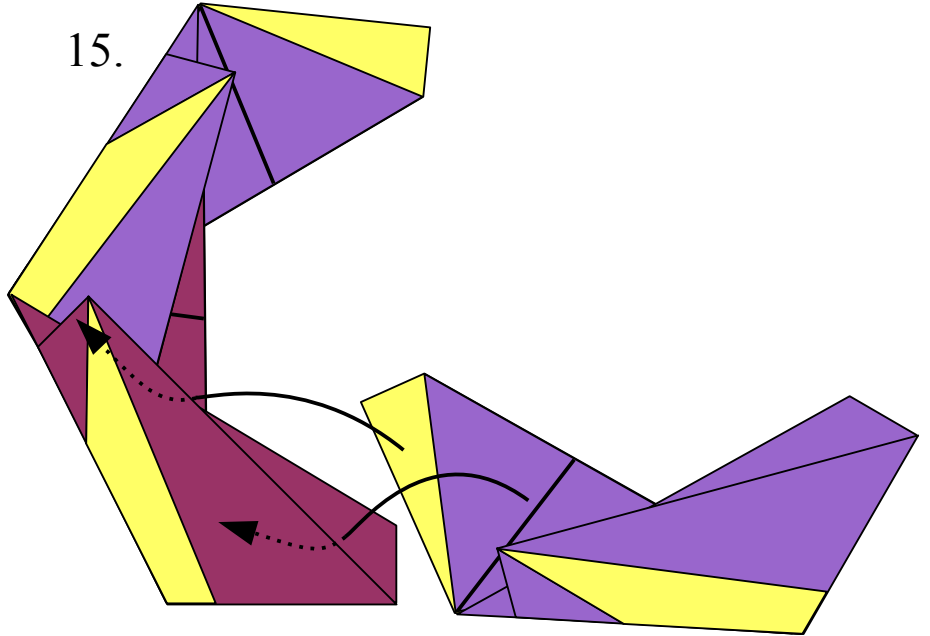




# Assembly



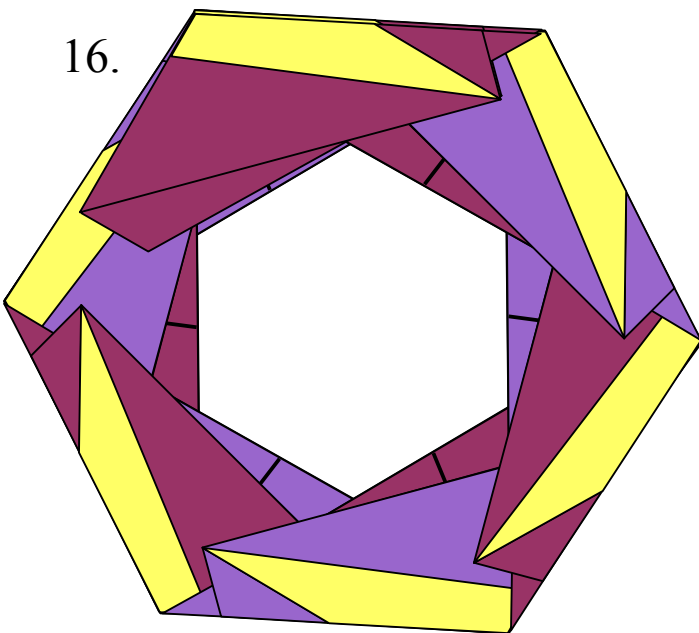
14.



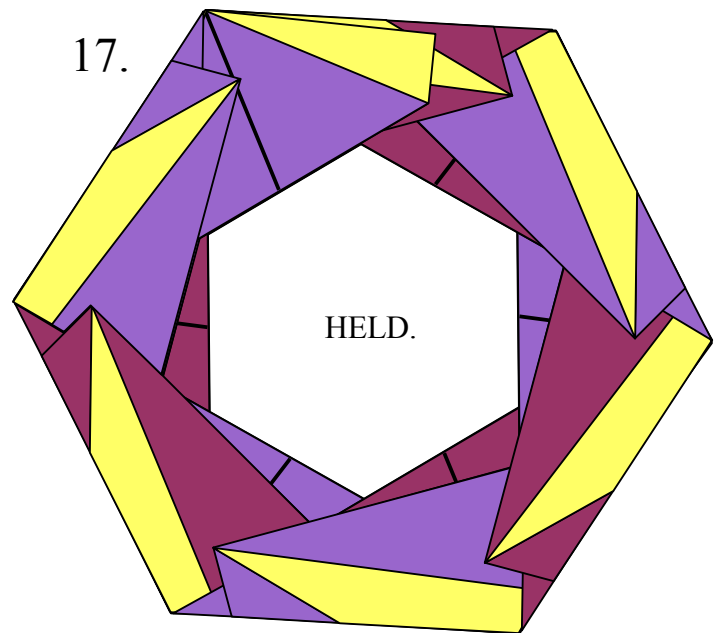
15.

Slide the units into each other, interleaving the layers of paper. The mauve flap with the colorful square corner which is sandwiched between layers of its own flap goes into the pocket of the violet unit. The back flap of the violet unit goes behind the mauve unit. It doesn't quite fit right if you put it in front of the yellow square corner showing on the mauve unit.

The new violet unit overlaps the other violet unit and should land on top of it. Add the other three (3) units in the same manner. If you are making a single ring, also close the ring in the same way. For a Ring of Rings, leave each individual ring open to link it with other rings, but it likes to spring into a snake and fall apart, so push the top end behind the other end so tension holds it temporarily.



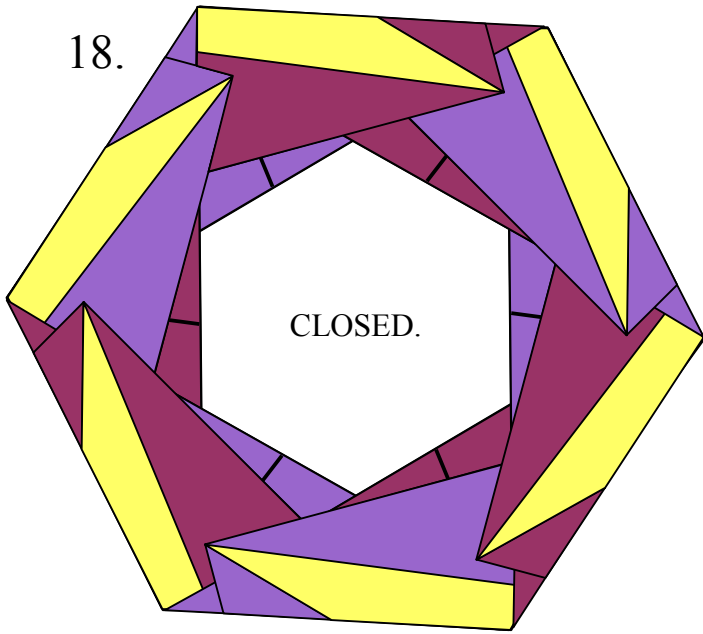
16.



17.

HELD.

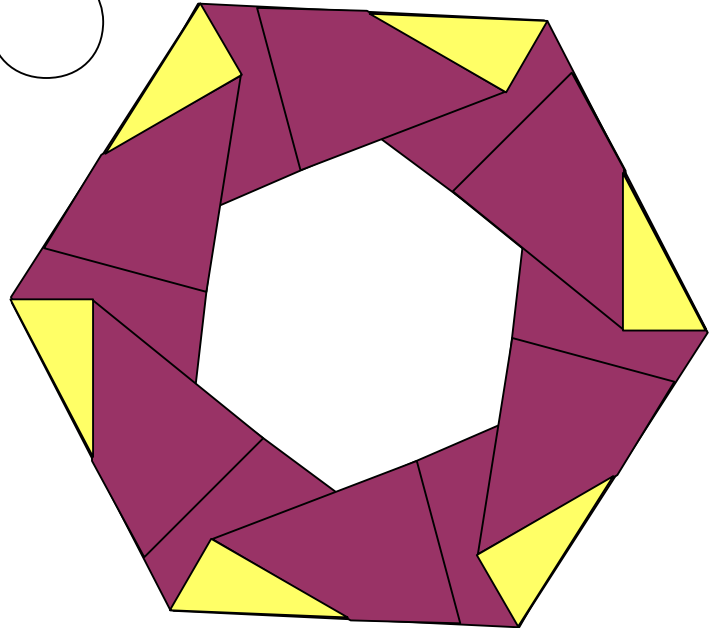
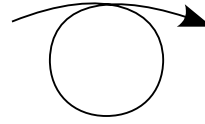
18.



CLOSED.

front

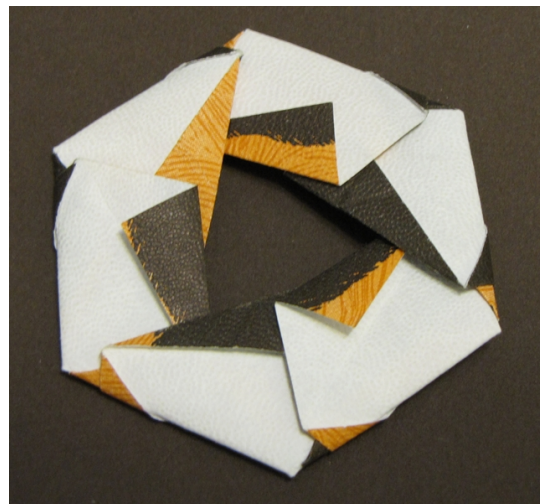
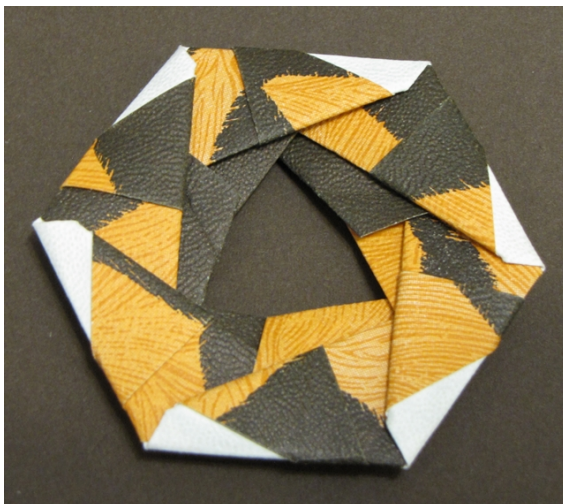
Done!



back

# Mix & Match

The units for the Hexagonal Ring, Starry Space, Hex Vortex, Triple Hex and practically any other of the myriad minor variants are interchangeable because they all attach the same way. Mix up different variants at your own risk. Try to turn the center into a triangle instead of a hexagon or star using two variants!



# Specialty Units

A subset of variations on the [Hexagonal Unit](#) can also form the [Ring of Rings](#). More importantly, they can be incorporated among the standard units as specialty units to add detail to representational drawings. Many of these specialty units utilize the [kasane technique](#).

There is one notable specialty unit that cannot form a Ring of Rings. The [Pointy Specialty Unit](#) to add hair, cat ears or horns changes the outer shape of the hexagon. The Ring of Rings accommodates it only on the outer rim. Elsewhere the points would get thoroughly bashed trying to go through other rings and munged out of the way rather than neatly folded out of the way. Even on the outer rim, the method of adding the no-longer-perfectly-hexagonal ring requires a bit of modification to avoid bashing the corner.

# Kasane Units

All the variations of the hexagonal unit love thick paper. Even 1” (25cm) squares prefer 20-28lb. copy paper to kami. Most of the examples for [Ring of Rings Recipes](#) used such 1” paper. This implies wiggle room for at least a couple layers of thinner paper. Laminating thinner papers into a thicker paper would work well and allow much greater control of duo colors and textures. That gluing and cutting operation is more (and messier) work than necessary.

Kasane (pronounced **kah-sah-nay**) folding – folding multiple layers of paper – is a simpler and more flexible option. The edges of the basic [Hexagonal Units](#) (for the [Hexagonal Ring](#) that makes the [Ring of Rings](#), [Ringed Planet](#), [Chaos Theory](#) and [Nestagons](#)) hide well, so when paper creep would show the layer beneath, the effect mostly hides. Some of the other variations might be able to use this effect decoratively with thin duo papers.

Simple kasane units just treat the two (or more) layers as one. Unlike laminated paper, these layers can fold separately, allowing divergent folds to further control the color change scheme for even more creative patterns. Representational drawings can use this for greater resolution and little shapes that would otherwise be unavailable, such as the winking eye.

For more information kasane folding, see Eric Kenneway's classic “Complete Origami A-Z.”

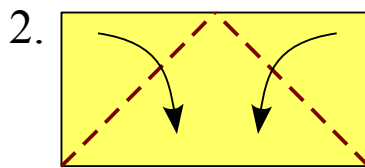
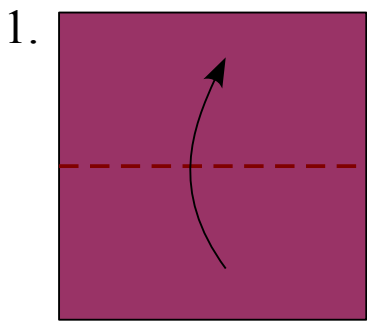
# Pointy Unit

By Wensdy Whitehead

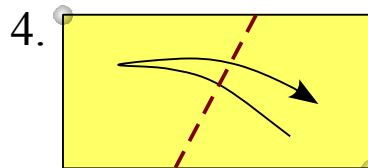
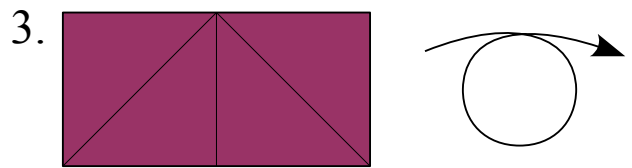
**Recommended Paper:** Six (6) thick 1.5-3" (40-75mm) squares.

This is a specialty variation of the [Hexagonal Unit](#) primarily for use on the rim of the [Ring of Rings](#); but which can of course also form a stand-alone six-unit wreath. The point changes the shape enough that this unit cannot substitute for the Hexagonal Unit everywhere in the Rings. Take care not to bash the corner when linking.

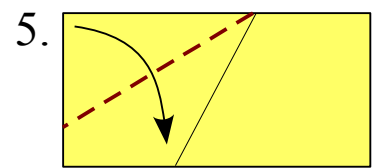
This specialty unit adds hair, cat ears and horns to various emoji.



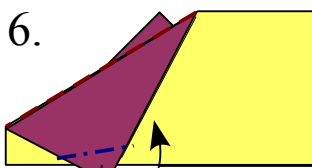
Fold only the top layer.



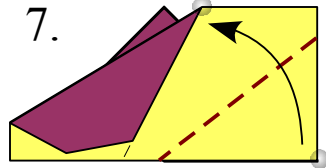
Fold corner to corner and unfold.



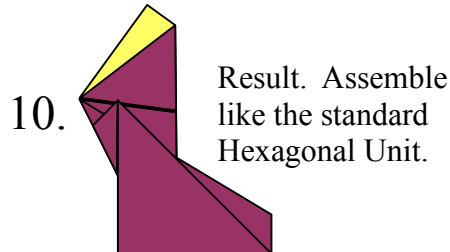
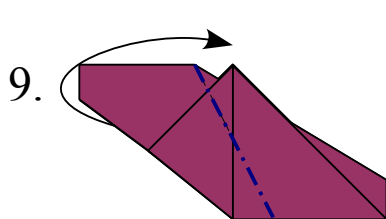
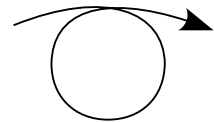
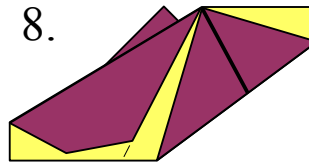
Bisect the angle.



RAT mountain fold to hide corner.



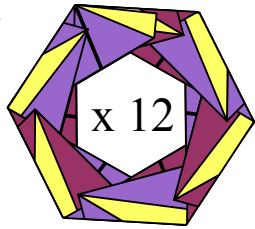
Fold square corner to obtuse (blunt) corner.





# Ring of Rings

## 12 Doubly Linked Hexagons



For your first Ring of Rings, it is easiest to make twelve (12) single color Hexagonal Rings of various colors. You can better see which ring is passing through which other rings this way. More interesting color patterns abound. Recipes for some follow the Ring of Ring instructions..

Options:

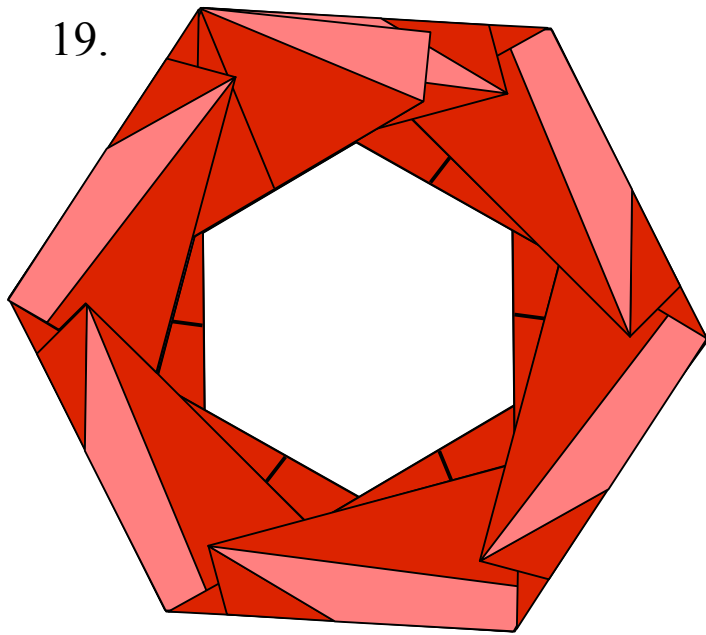
- one (1) ring of each of twelve (12) colors
- two (2) rings of each of six (6) colors
- three (3) rings of each of four (4) colors

You will need half a gross (72) of units. 2.5"-3.5" memo cube, copy paper or even scrapbooking paper are great ways to start. Even small, this model loves thick paper!

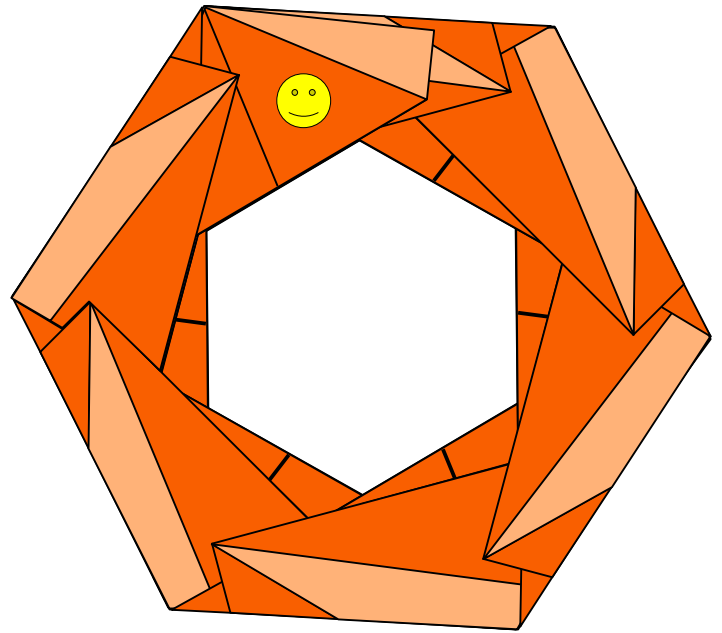
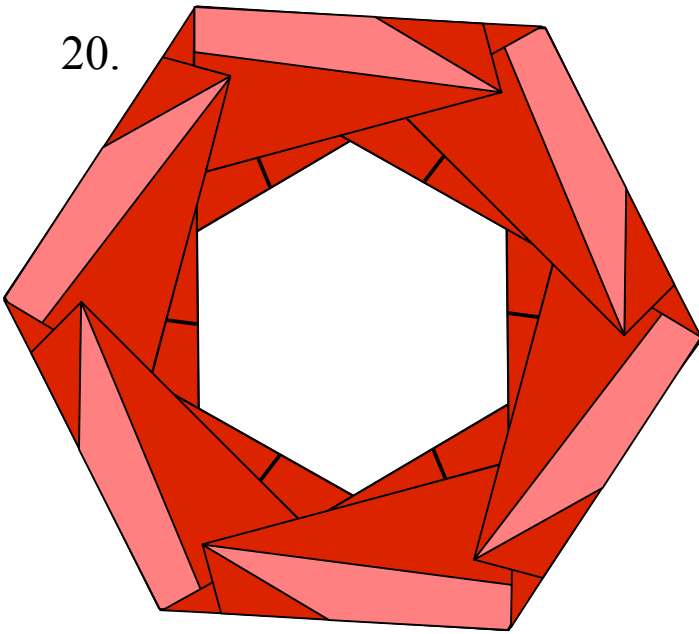
For the Rainbow Ring:

x 12	x 12	x 12
x 12	x 12	x 12

19.

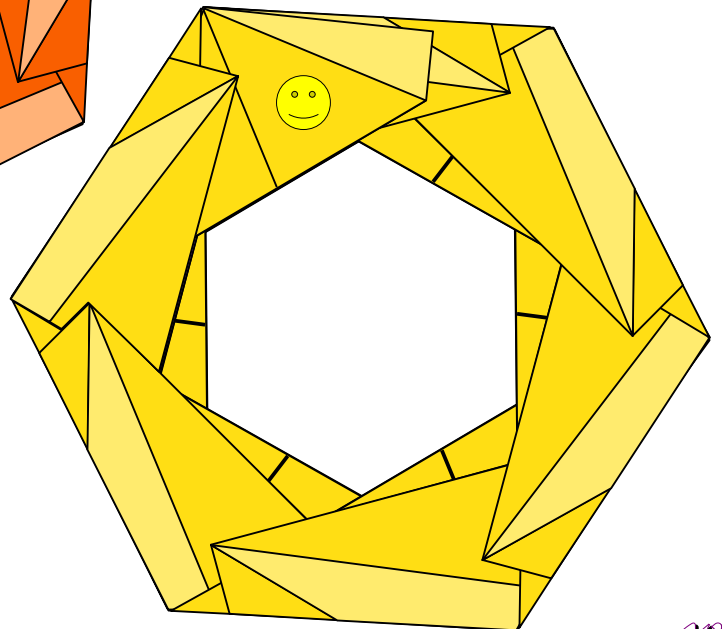
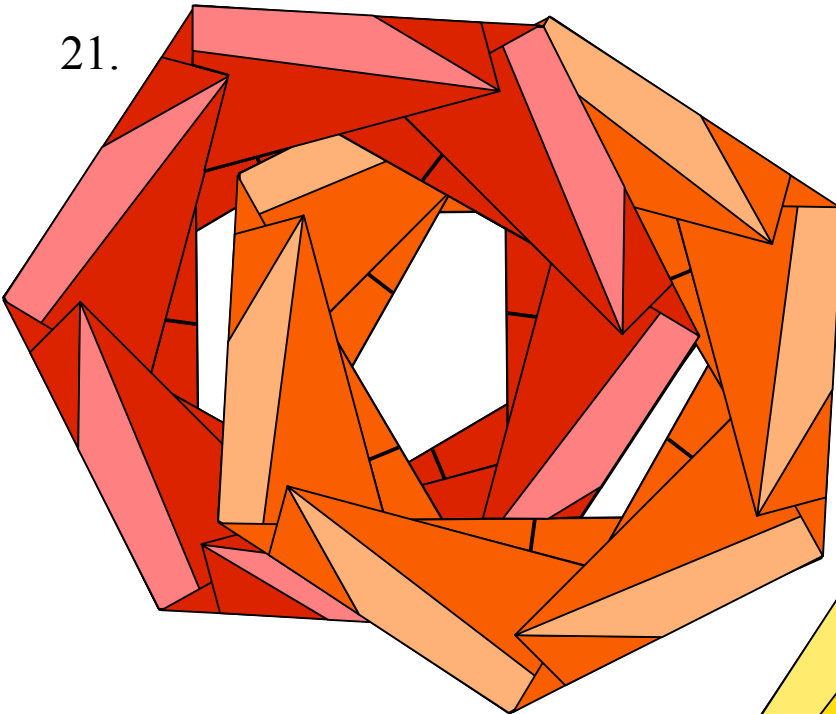


20.



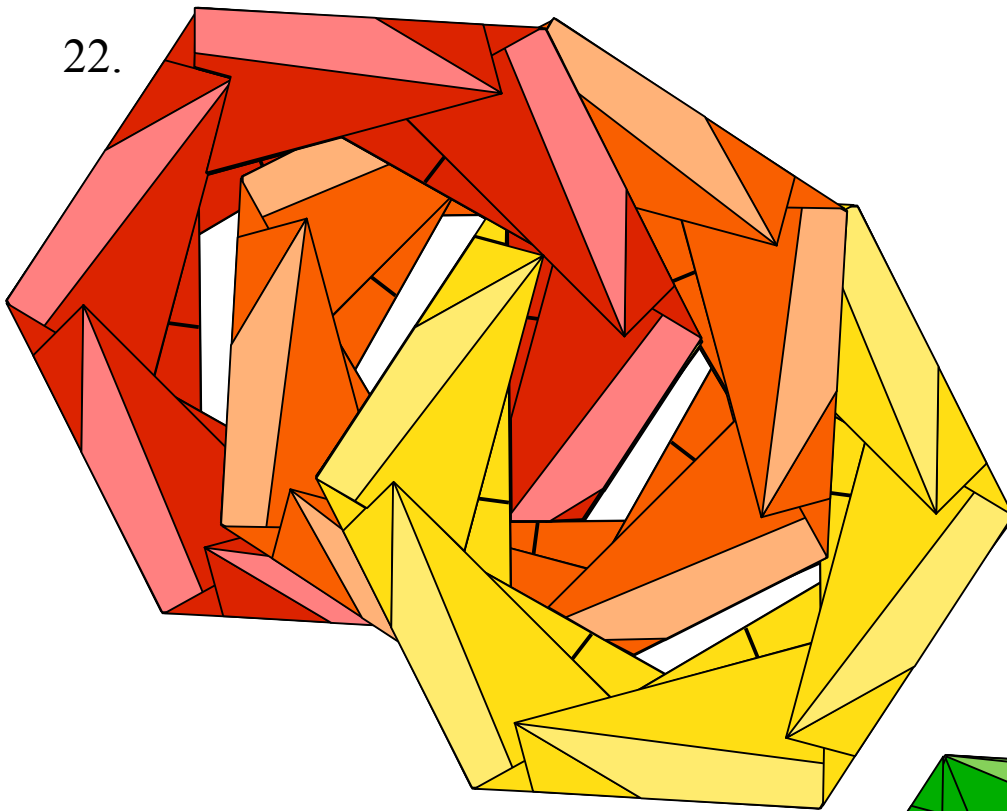
Start with the one closed ring (left). Unhook the temporary hold on the next ring counting clockwise around the Ring of Rings. Take the end with sandwiched tab (marked with a smiley face) and thread it through the closed ring from the top. Close the ring.

21.



Pass the third (3<sup>rd</sup>) ring through both the first (1<sup>st</sup>) and second (2<sup>nd</sup>) rings in the same manner. Close the third (3<sup>rd</sup>) ring.

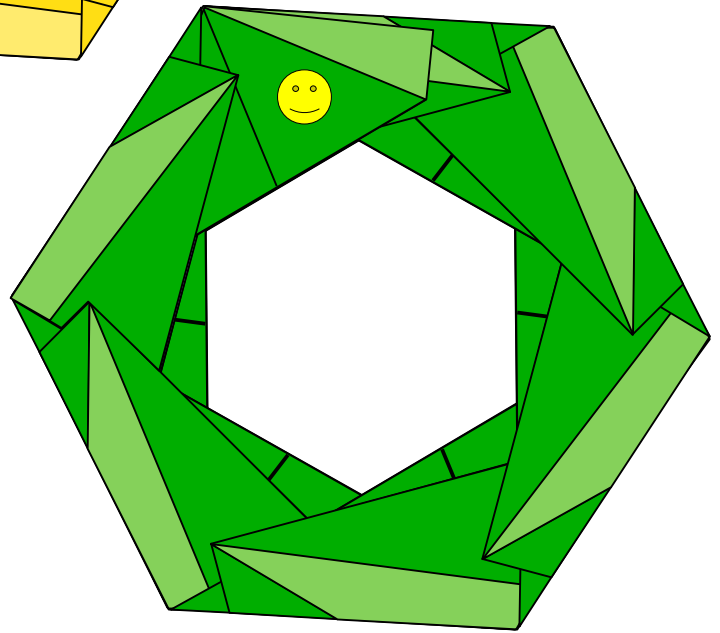
22.



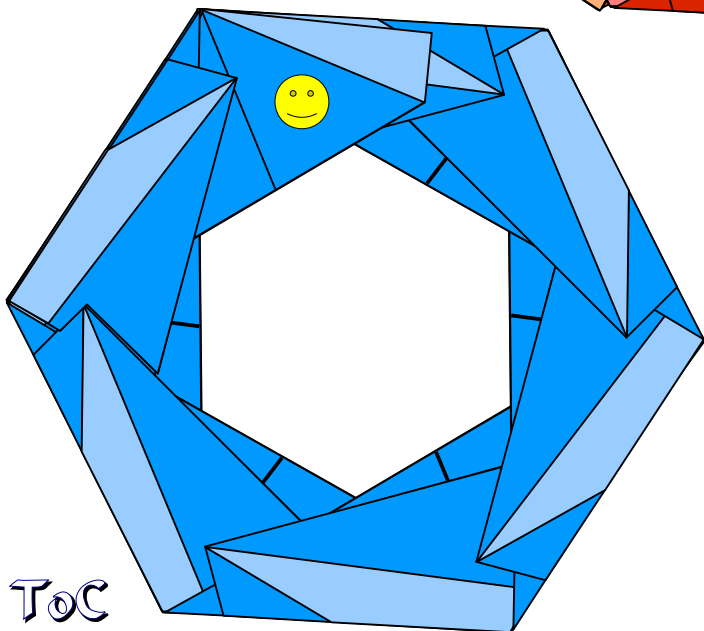
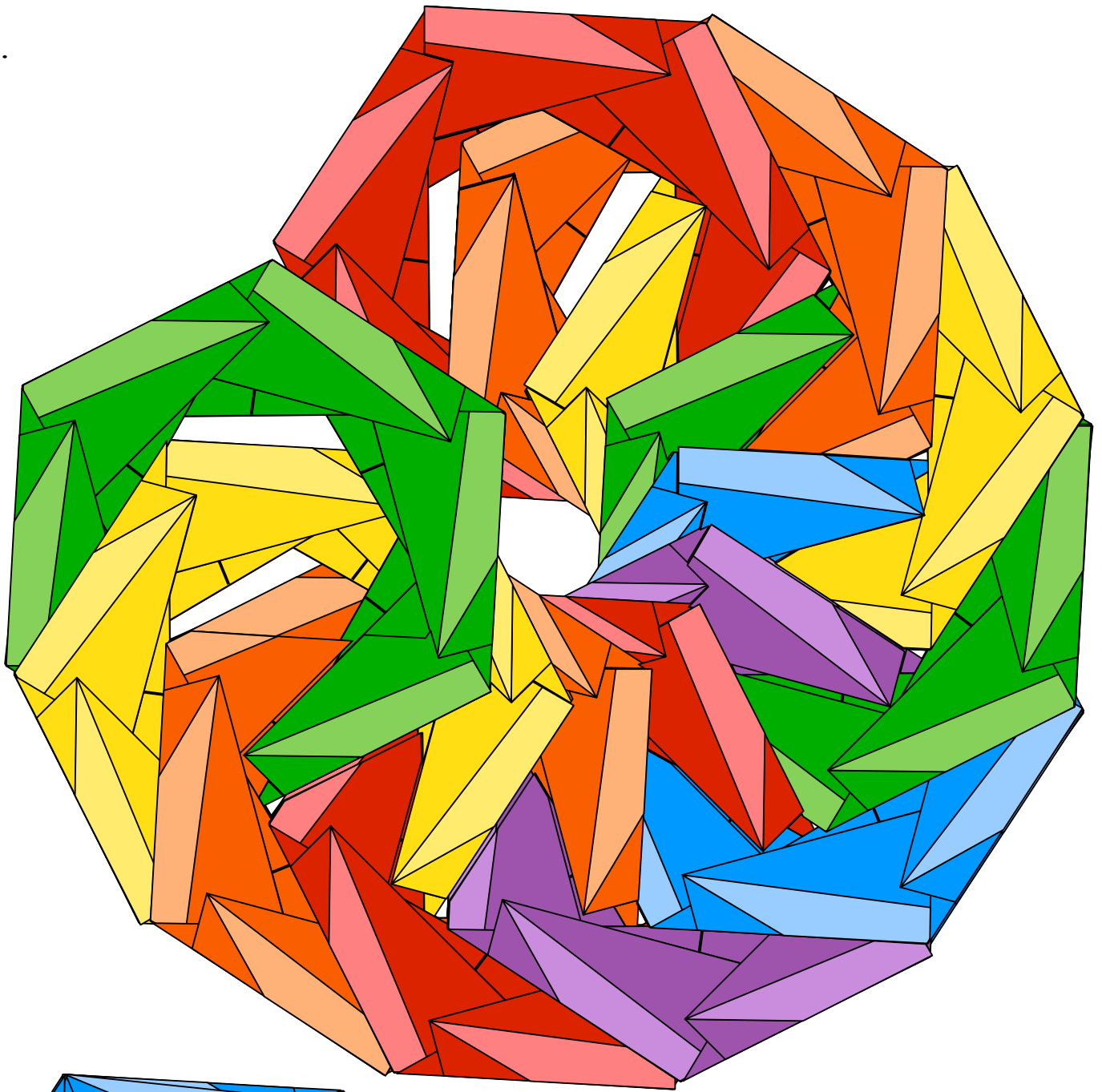
The fourth (4<sup>th</sup>) ring passes through both the second (2<sup>nd</sup>) and third (3<sup>rd</sup>) rings in the same manner. Continue adding the fifth (5<sup>th</sup>) through tenth (10<sup>th</sup>) rings by passing them through the previous two (2) rings in this manner. The eleventh (11<sup>th</sup>) and twelfth (12<sup>th</sup>) rings must do a bit more. Close each Hexagonal Ring before adding the next one.

With just three (3) rings, the links were still very loose. With the four (4) they start fitting more tightly and stiffly. The fifth (5<sup>th</sup>) may be the tightest fit to slide through the opening, but then the spacing becomes set and the sixth (6<sup>th</sup>) through tenth (10<sup>th</sup>) units link more easily.

As more units accrue, it becomes noticeably easier to pass exactly two (2) units of the end marked with the smiley face through the preceding rings. For the final rings, it is vital. For these solid color rings, it only affects the ease of assembly, but for more complex patterns, it is essential for keeping track of the proper rotation of each hexagonal ring.



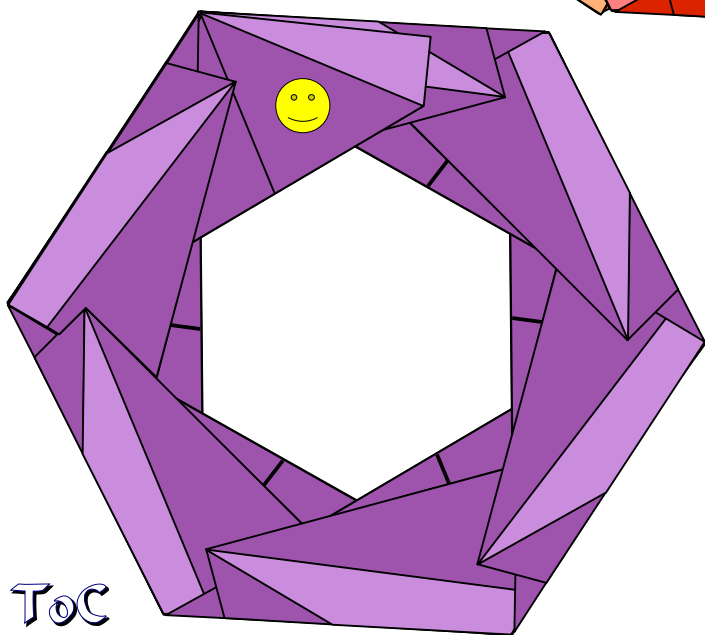
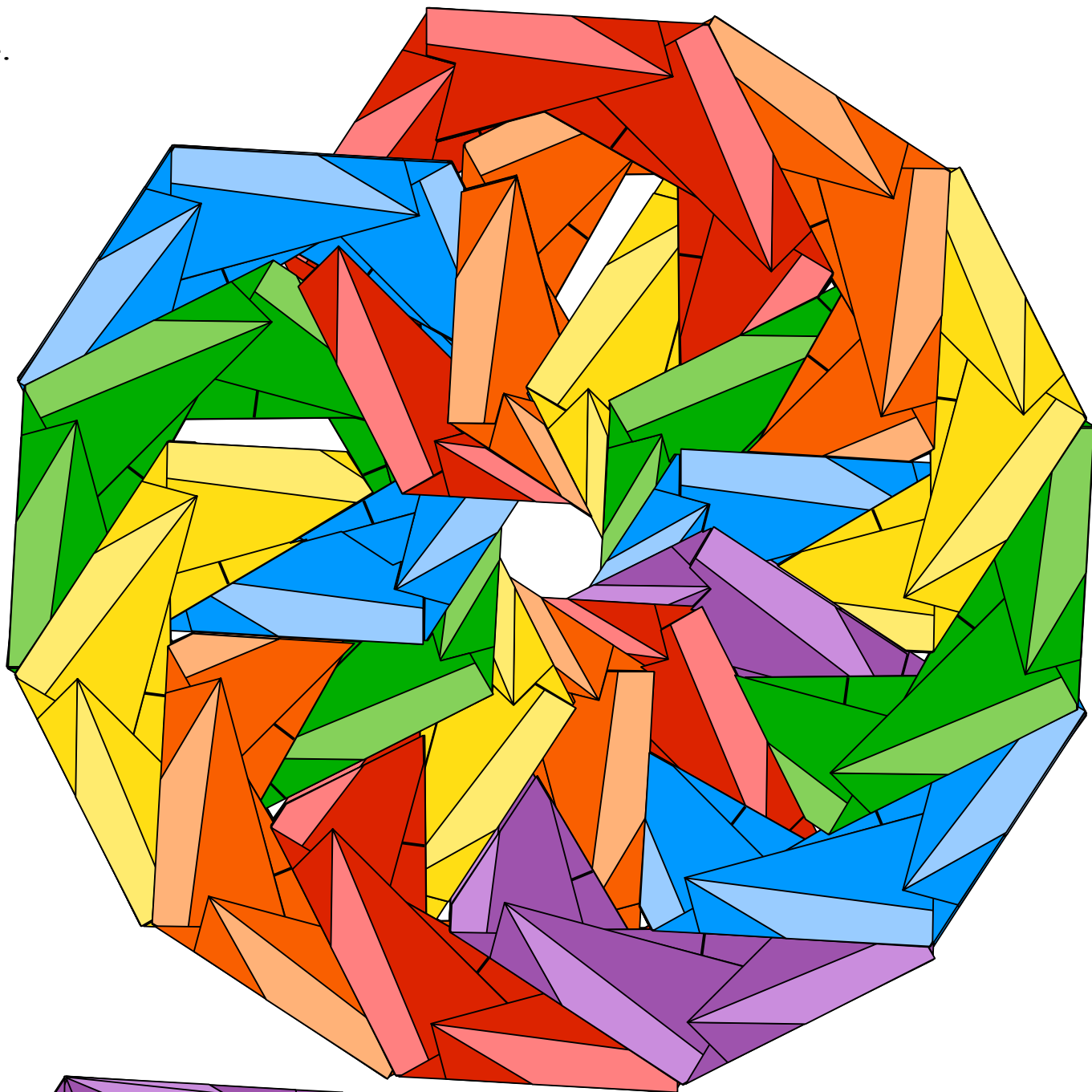
23.



Like the preceding rings, the eleventh (11<sup>th</sup>) ring passes two units of the end marked with a smiley face down through the preceding two rings, but it must also start to close and complete the ring of rings by passing its other end up through the first ring. Close the eleventh (11<sup>th</sup>) Hexagonal Ring.



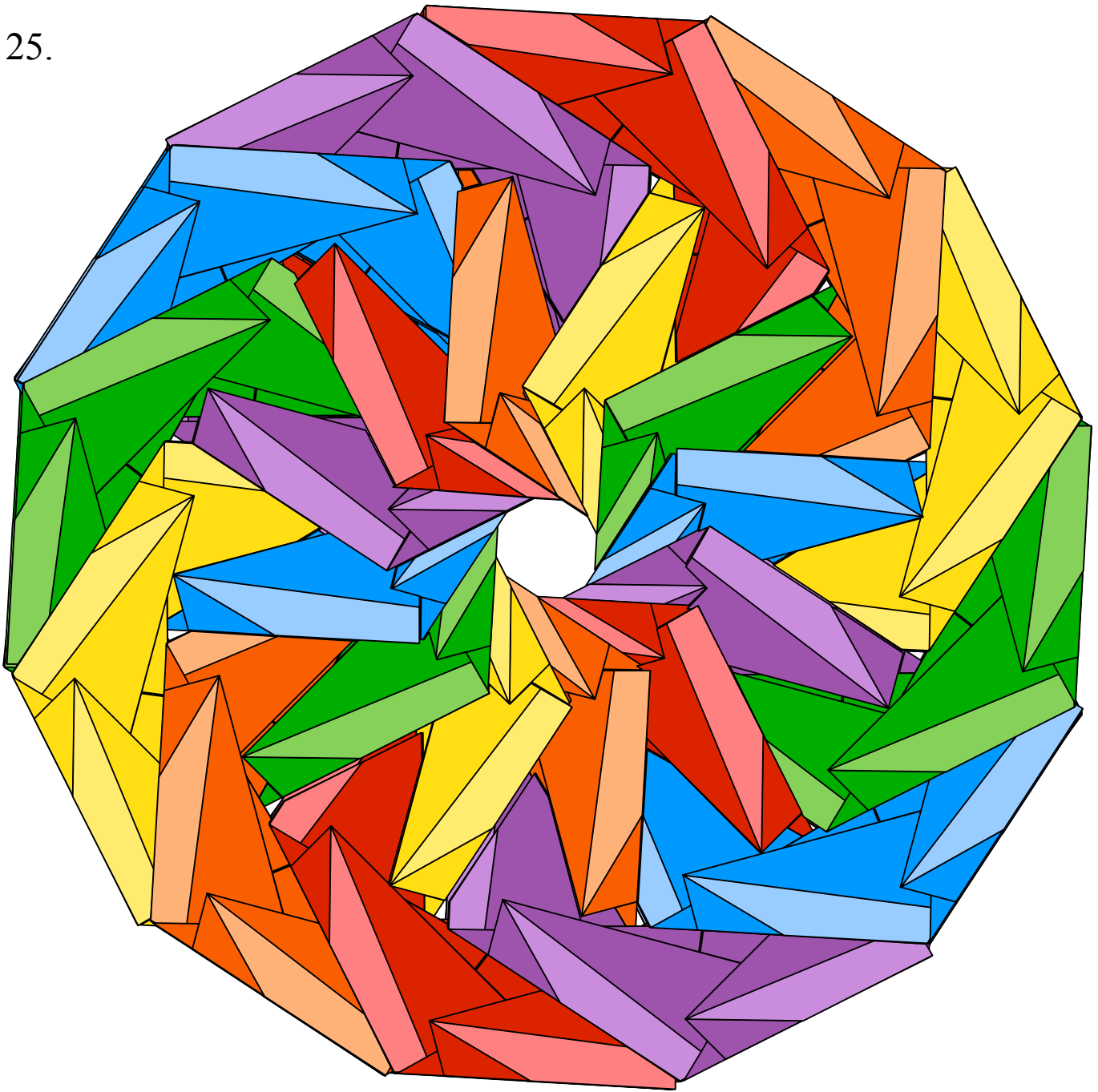
24.



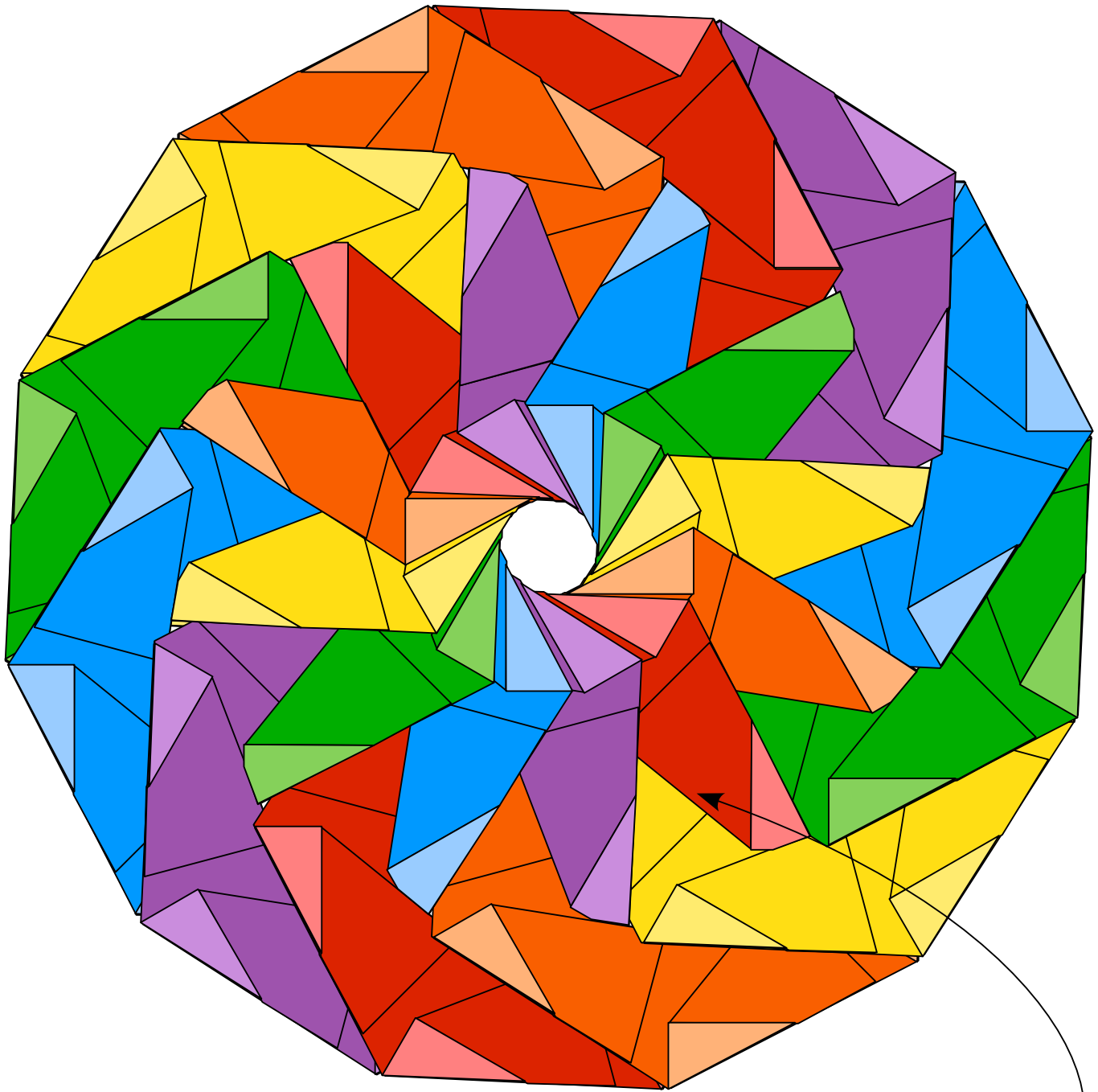
Like the preceding rings, the twelfth (12<sup>th</sup>) ring passes two units of the end marked with a smiley down through the preceding two rings, but it must also complete the ring of rings by passing its other end down through the center of the Ring of Rings and up through the first two Hexagonal Rings.

Close the twelfth (12<sup>th</sup>) Hexagonal Ring. Depending on the size and thickness of the paper, it may be easier to close the final hexagonal ring after threading it through all the gaps by removing the unit marked with the smiley face, attaching it to the other end, then reconnecting it to the unit to which it was originally attached.

25.



Depending on the size, thickness and slickness of your paper, the Ring of Rings will have more or less play in it. Adjust it to nice symmetry from both front and back (see next diagram). If it has too much play in it (feels too loose, constantly needs readjusting), use thicker paper next time. Even with very small units (e.g. 1" paper), thicker paper (such as copy paper) is preferable to kami.



A bit of irregularity in a small overlap can cause persistent symmetry problems characterized by a fold unrolling to shift a bit as seen from the front. Check the overlaps on the back if this is the case. For example, red should land above yellow at this edge.

Done!

# Recipes for Those Intricate Patterns

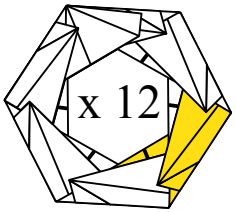
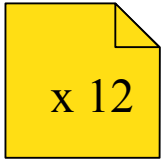
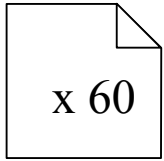
Solid color rings of one- or two-tone paper provide quite rewarding results, but those rings lock tightly enough in place, so there is no reason to restrict rings to only one paper each. Complexity beacons. Far more intricate designs are possible with multiple colors. These patterns and drawings require precise control of the rotation of each ring in the [Ring of Rings](#). The first few rings flop about and must be controlled very consciously so they stiffen into the right places as more rings join them, but latter rings become automatic by leaving the temporary opening of each ring such that just two units should pass through the preceding two rings.

Knowing what to put where can also get finicky. Changing the plan on the fly is difficult because of the two stages of assembly. Practice helps, but so can the following recipes and planning tools in the form of [coloring pages](#).

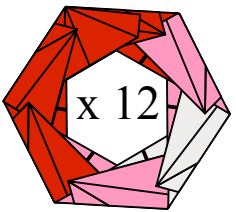
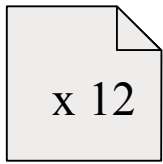
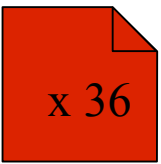
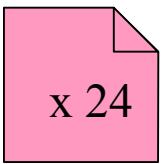
The recipe list is in order of approximate difficulty starting with the easiest patterns. Cut the paper as shown, substituting colors as you please. Fold units for the [Hexagonal Rings](#) from that paper and assemble into the rings shown with the gap where shown. Assemble the Ring of Rings; if there is more than one color pattern of hexagon, follow the specific order shown,



# Sunny-Side Up



# Concentric

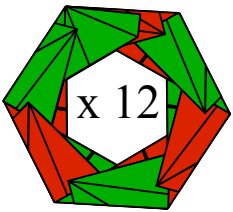
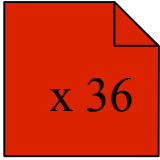
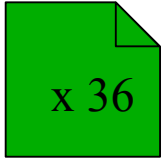


ToC

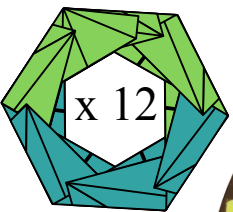
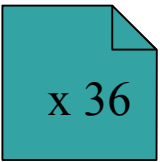
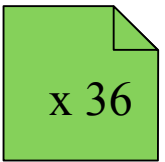




# X-mas Wreath

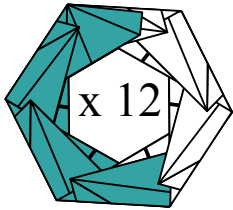
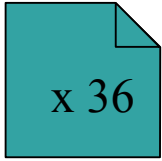
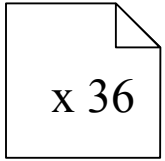


# Starburst

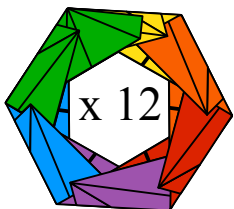
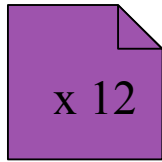
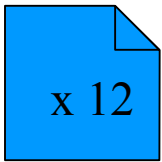
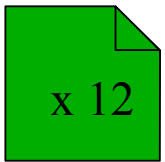
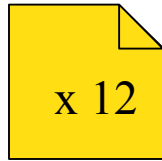
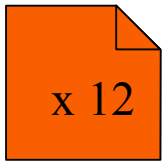
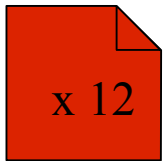




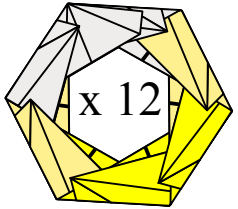
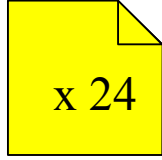
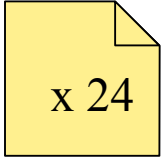
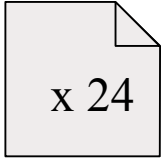
# Star Wheel



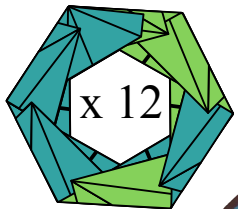
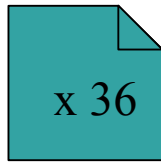
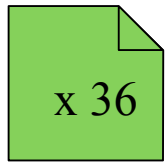
# Rainbow Star



# Sunshine

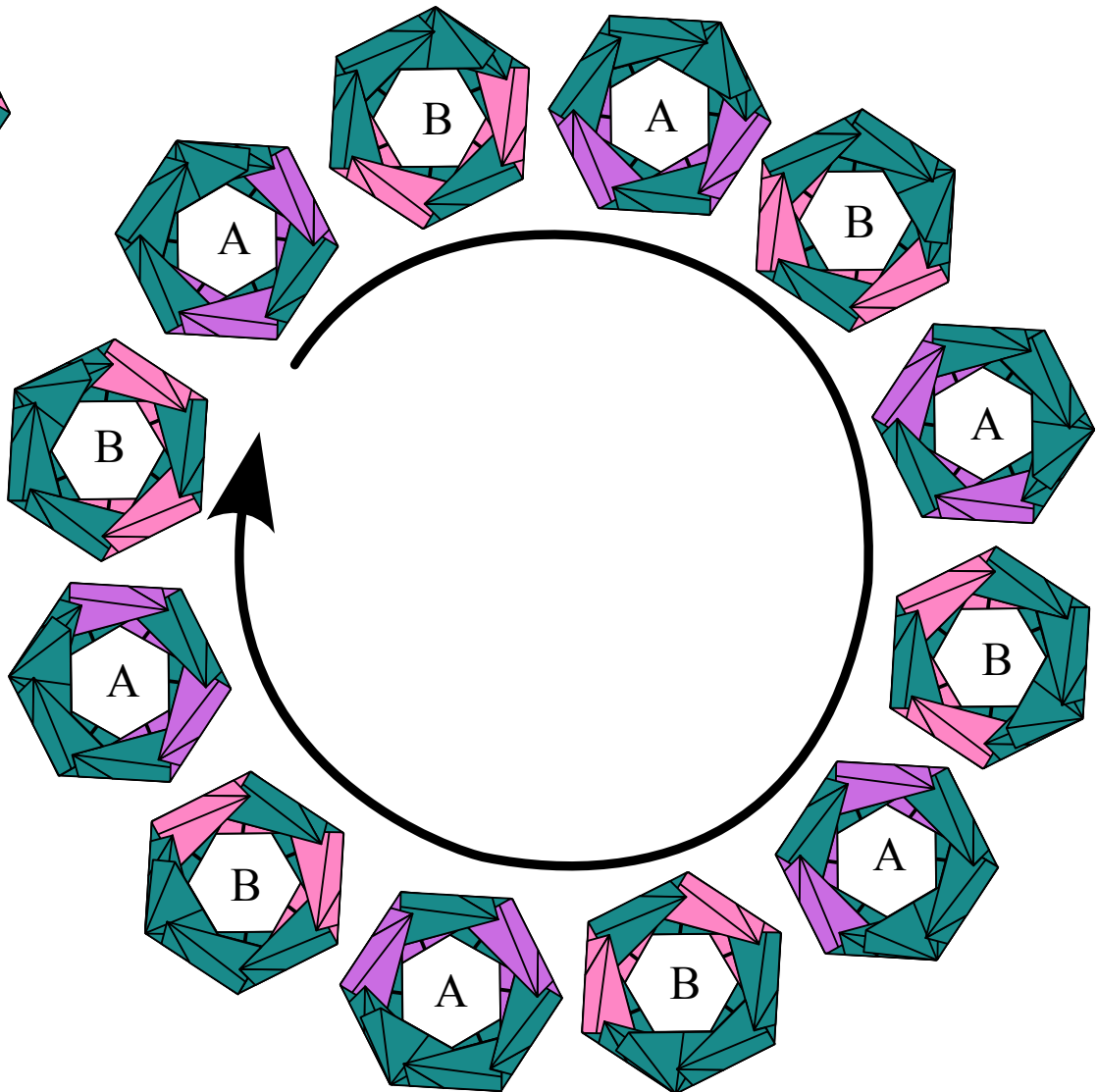
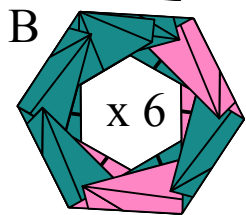
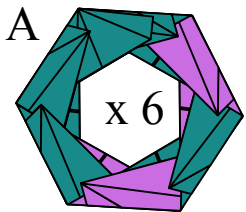
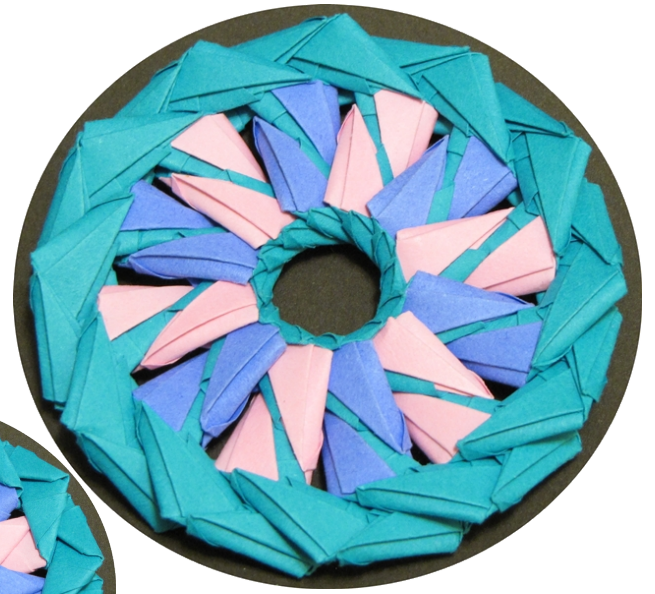
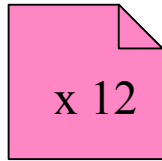
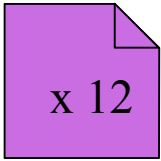
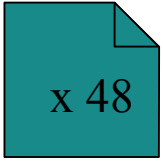


# Stained Glass One-Color

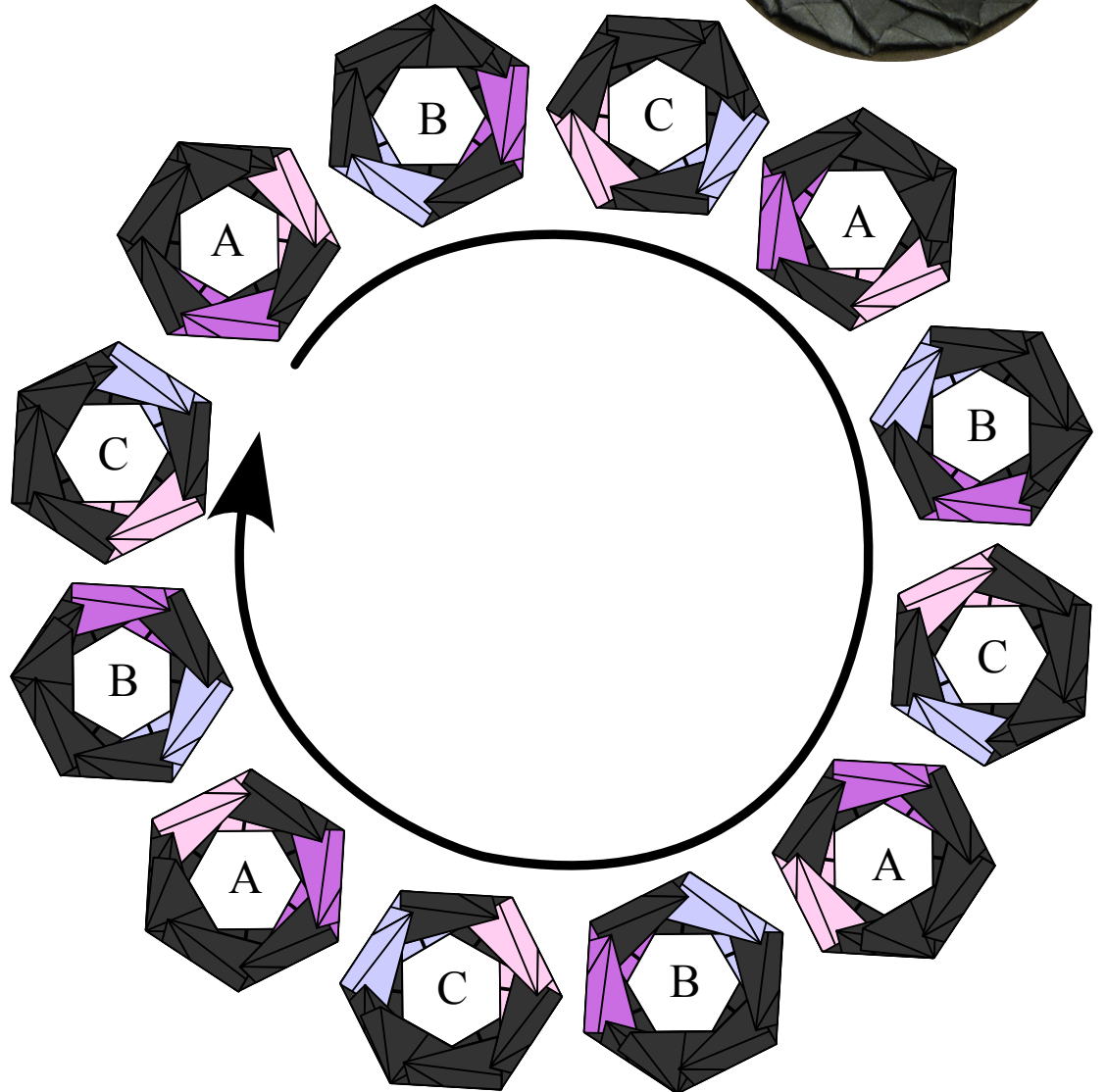
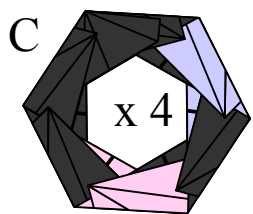
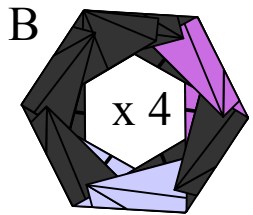
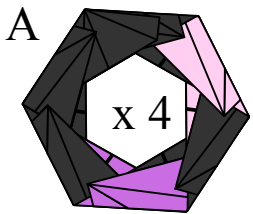
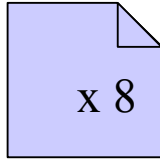
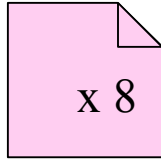
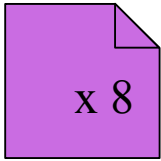




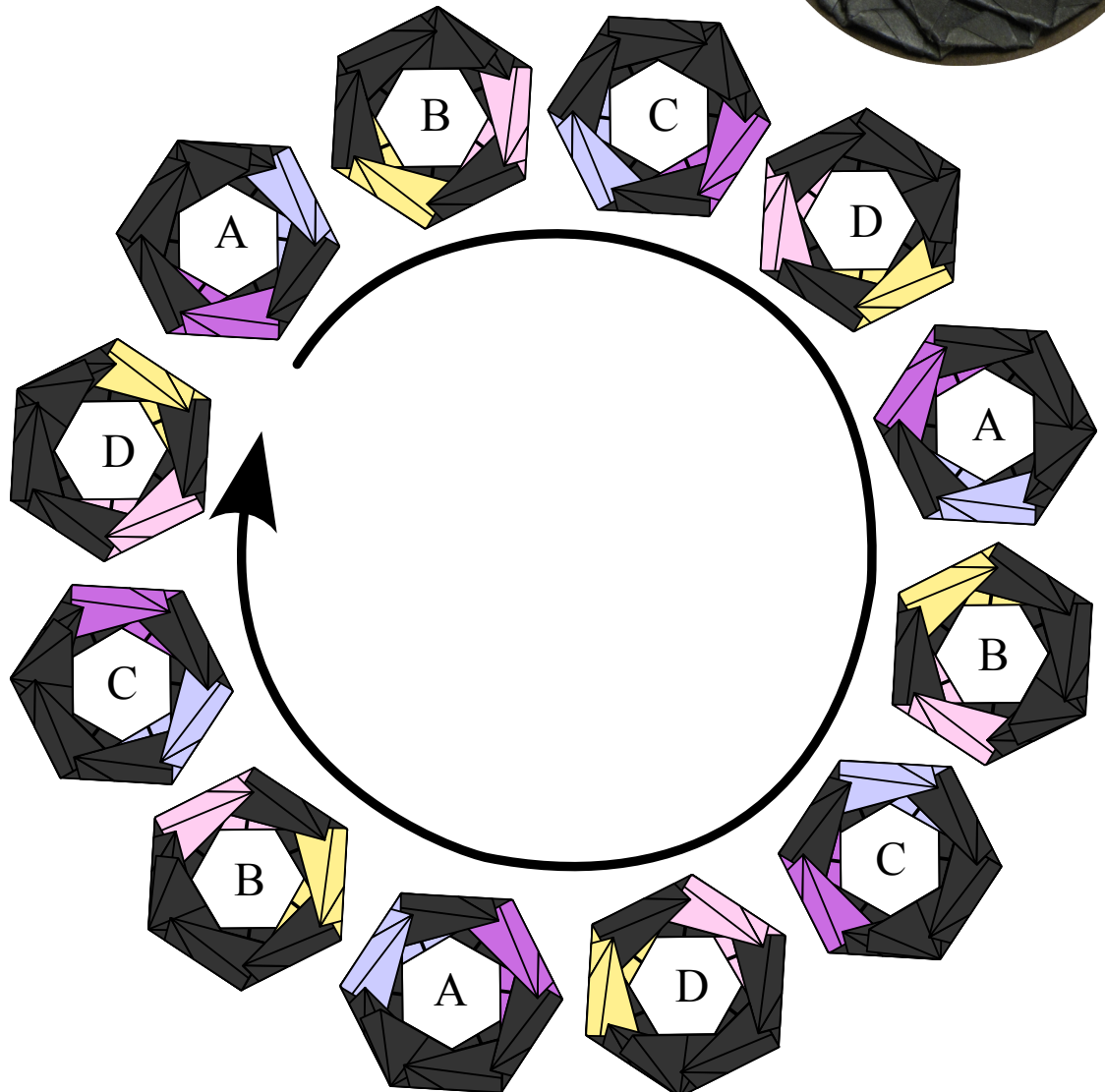
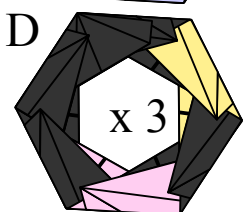
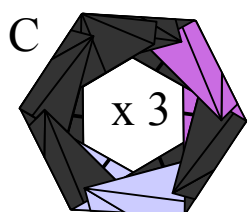
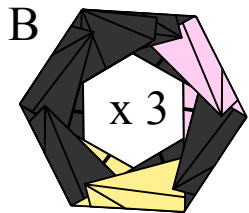
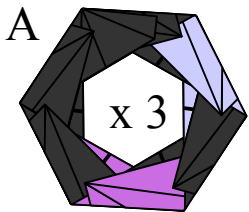
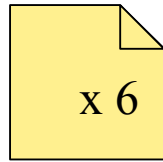
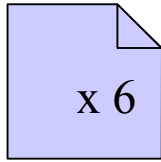
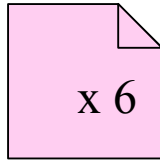
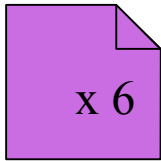
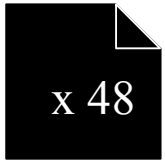
# Stained Glass Two Color



# Stained Glass Tri-Color

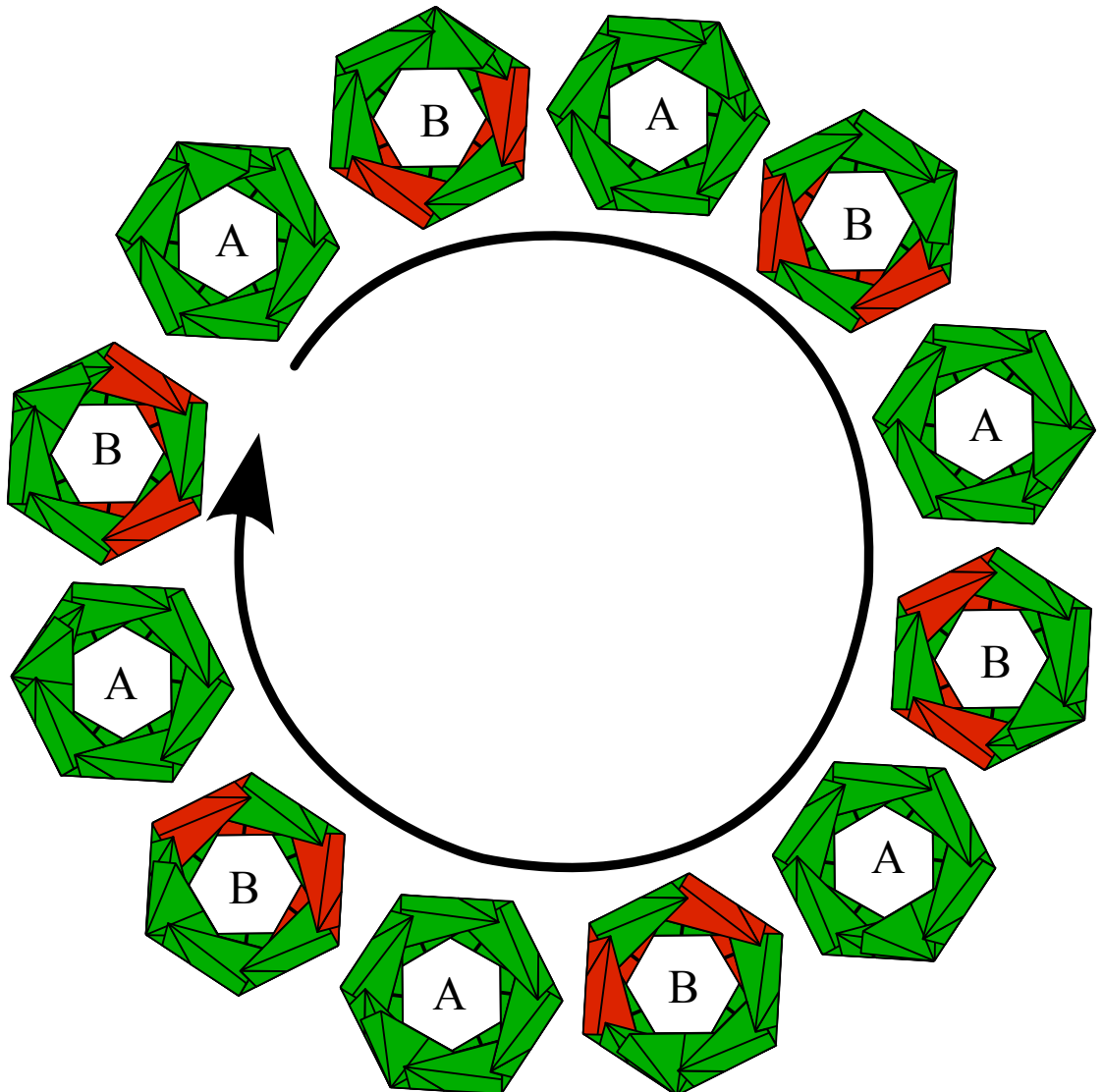
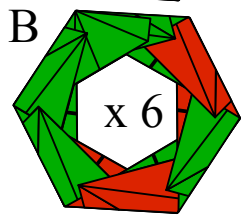
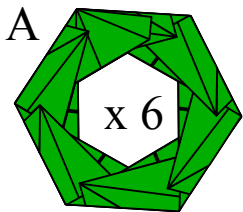
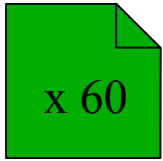
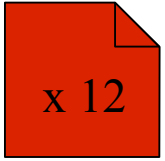


# Stained Glass Quad-Color



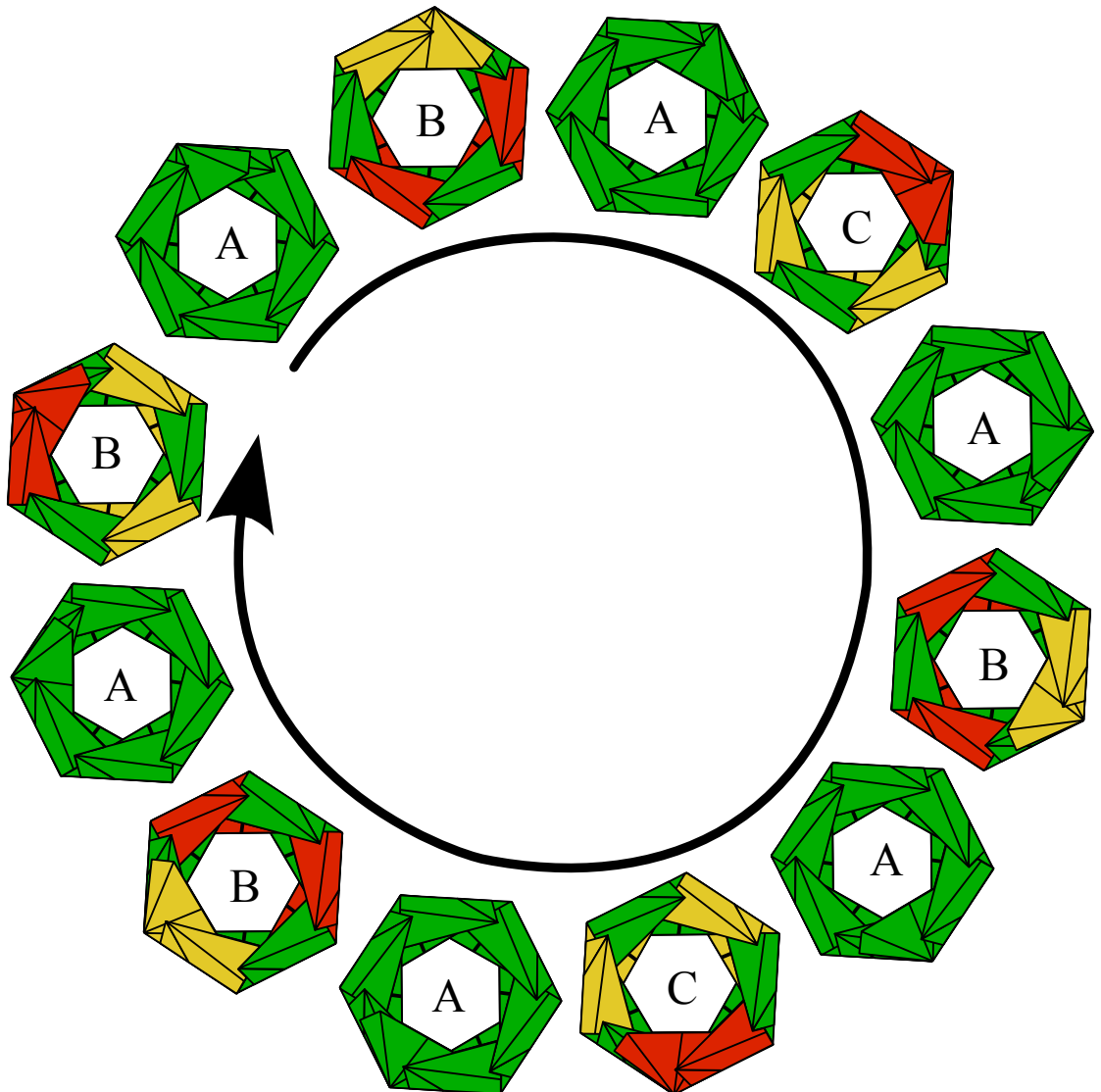
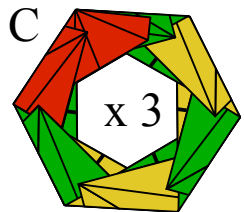
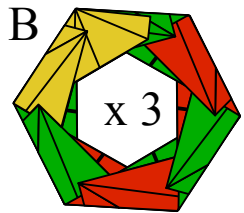
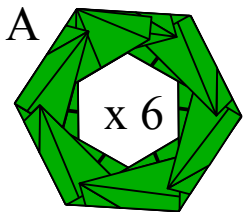
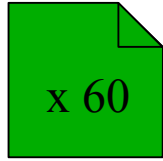
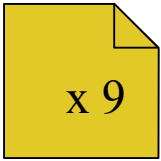
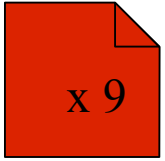


# X-mas Wreath II

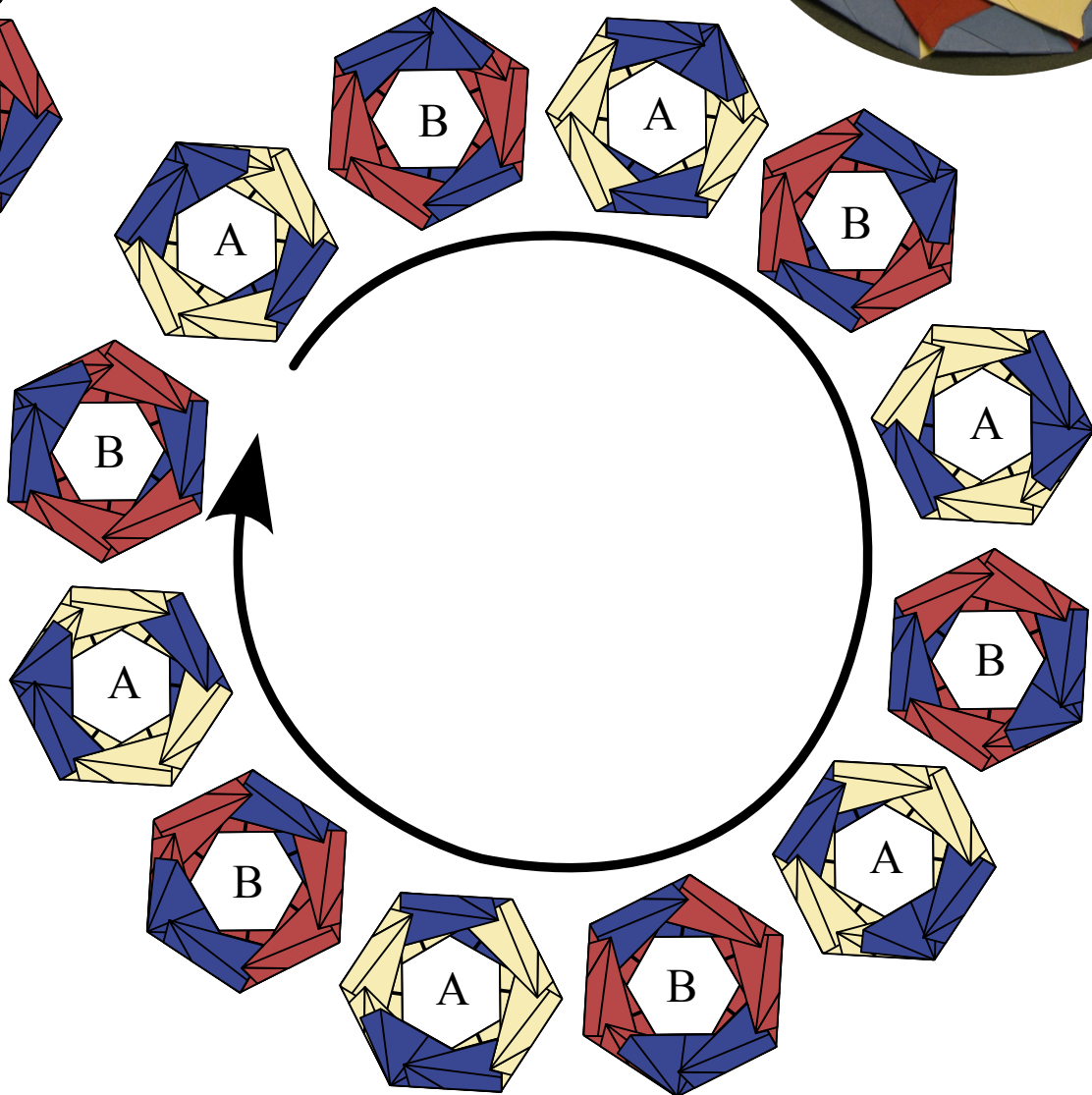
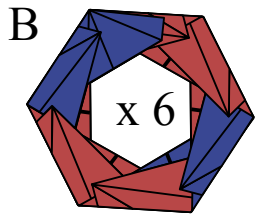
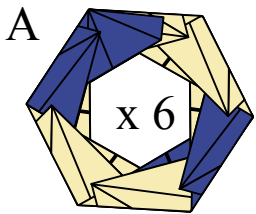
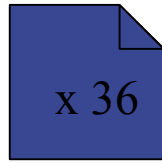
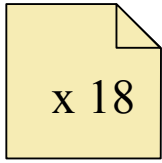
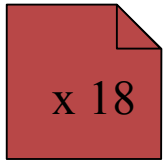
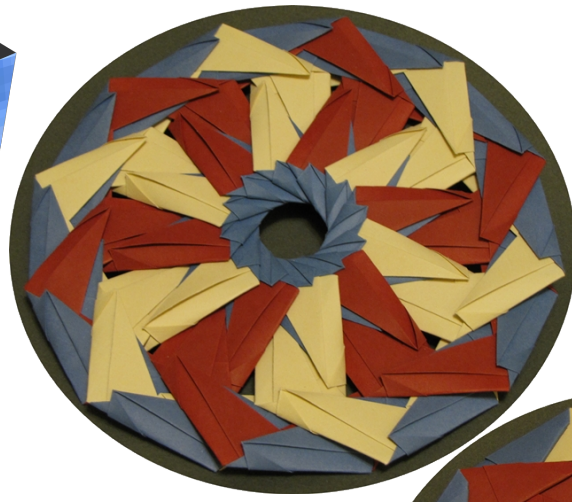




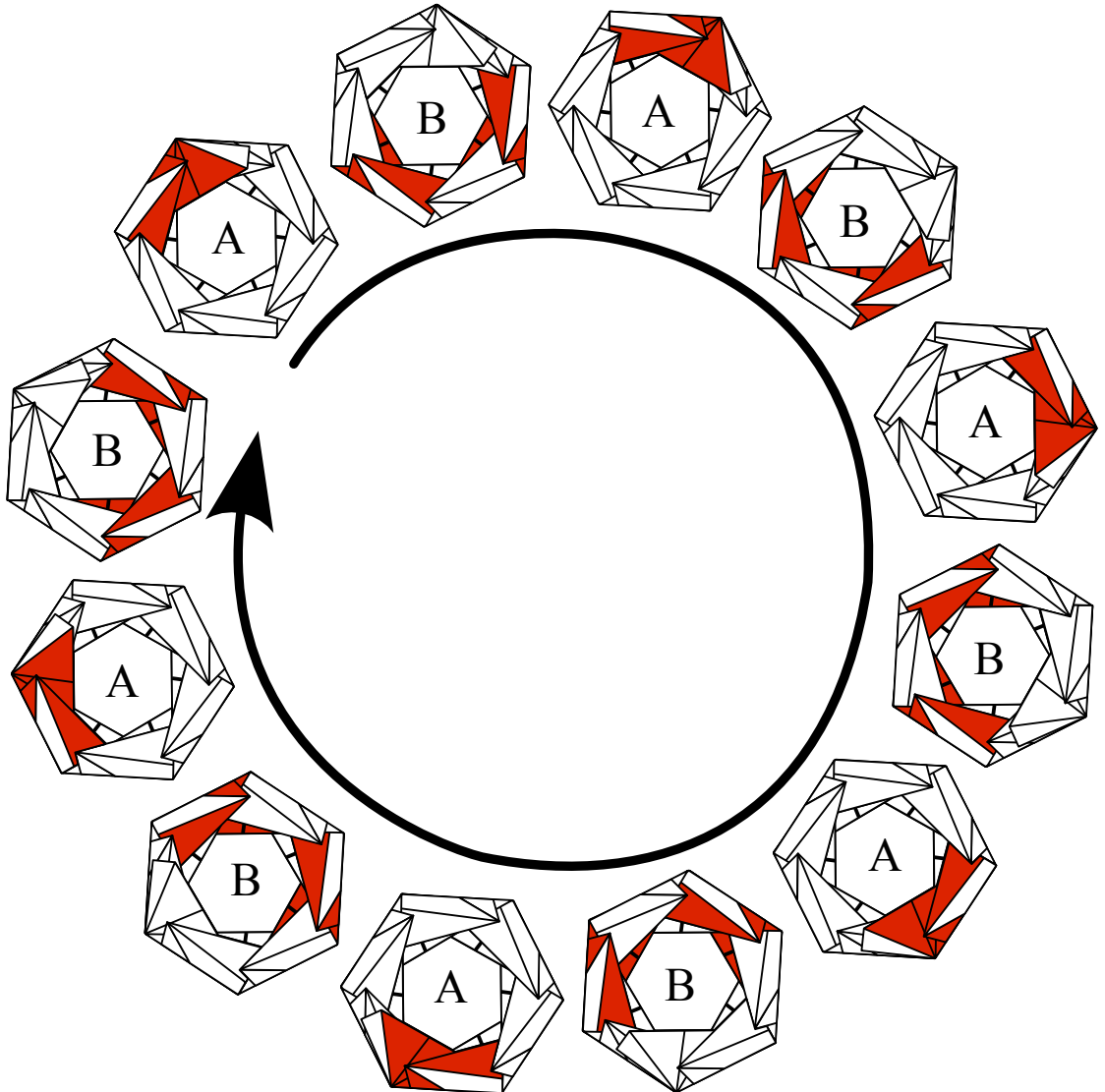
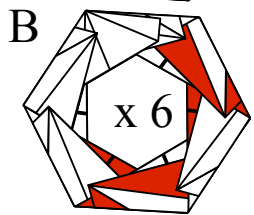
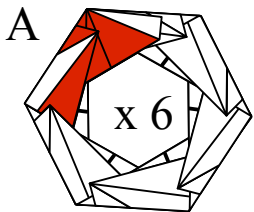
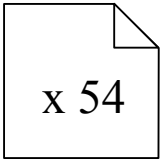
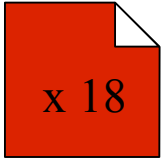
# X-mas Wreath III



# Old Glory

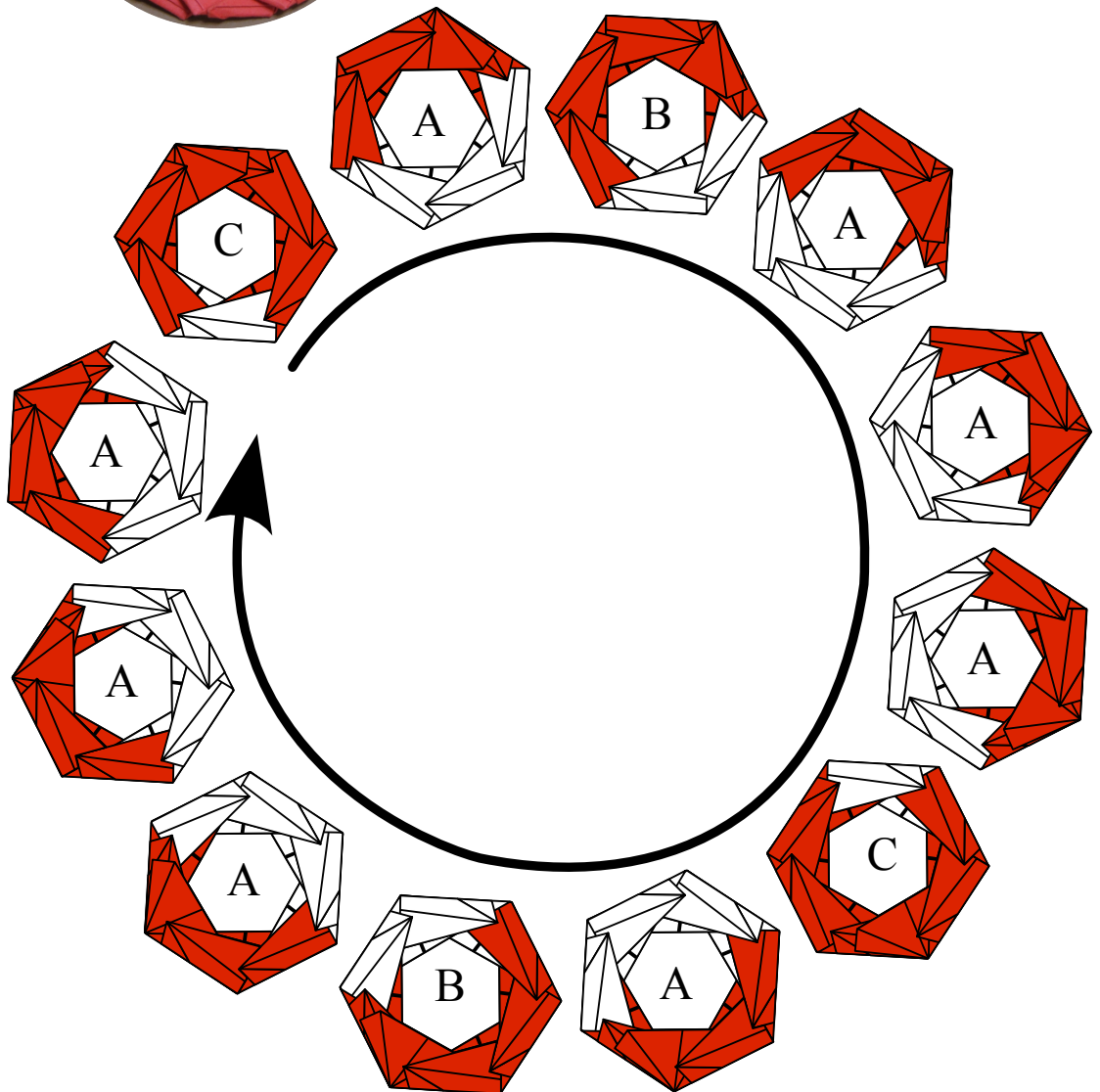
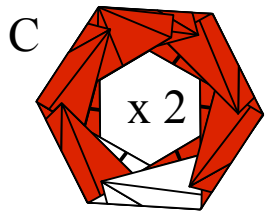
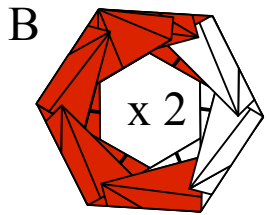
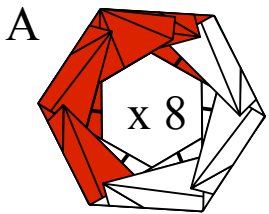
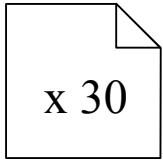
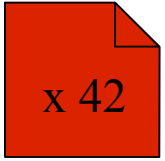


# Peppermint Candy

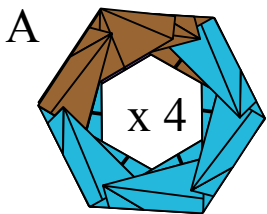
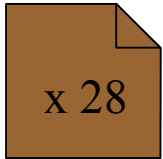
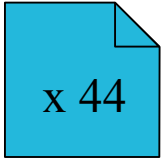




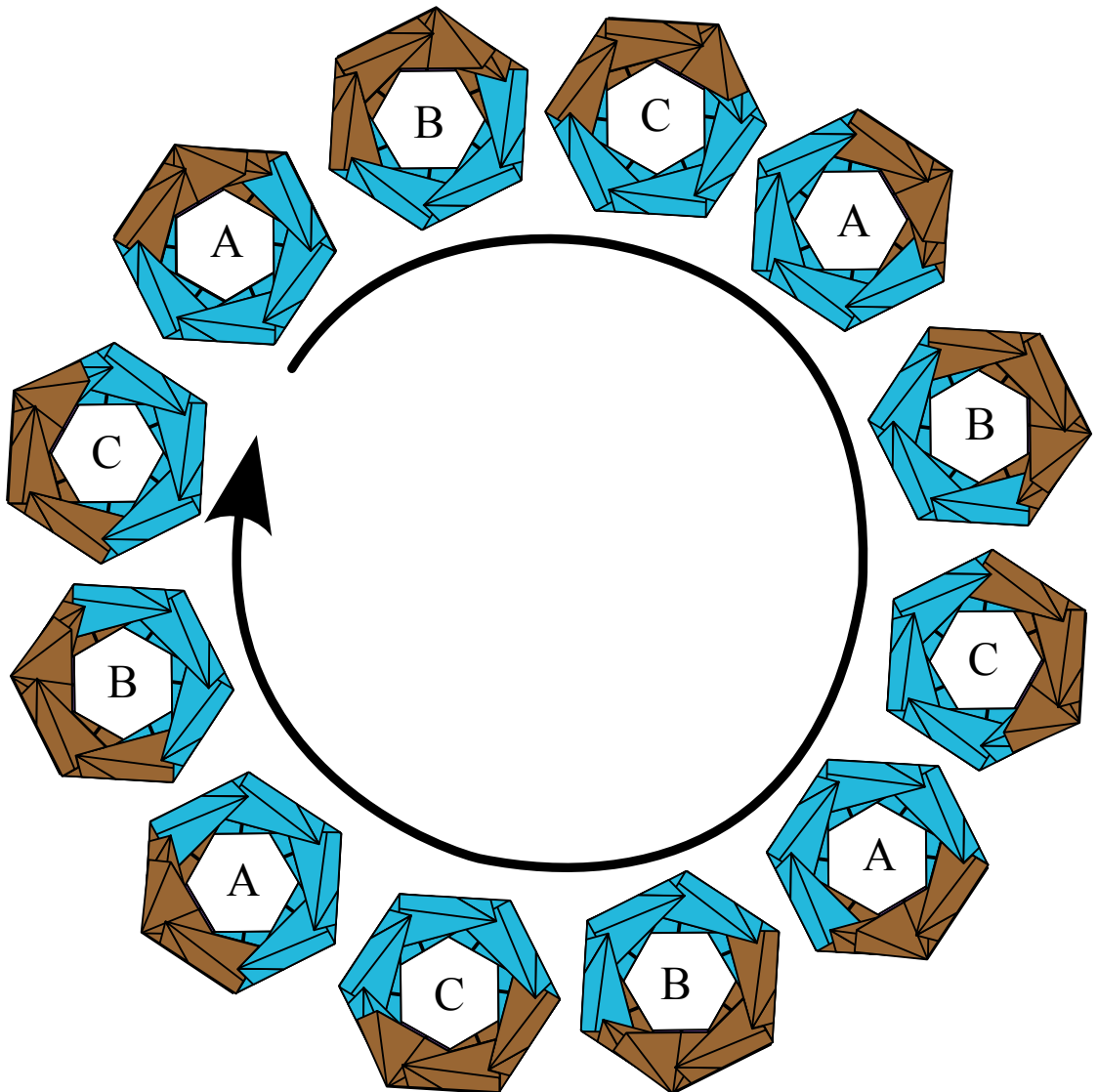
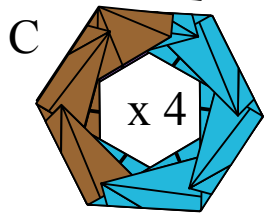
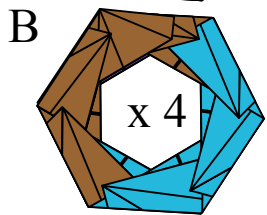
# Do Not Donut



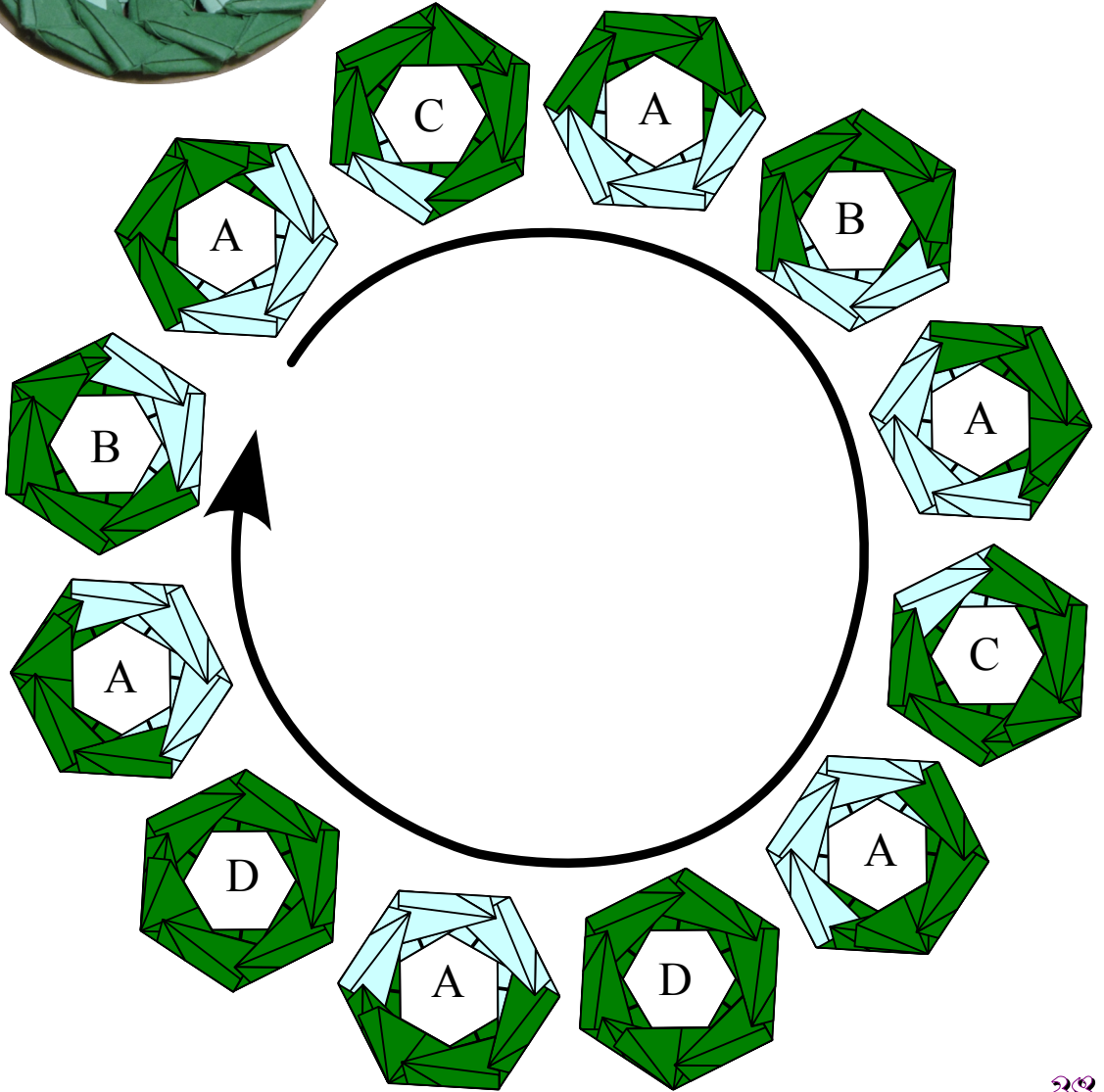
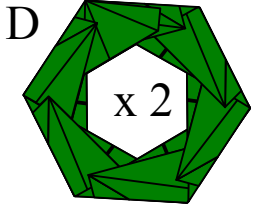
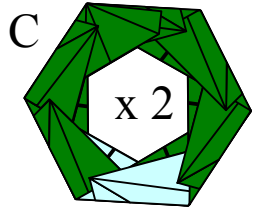
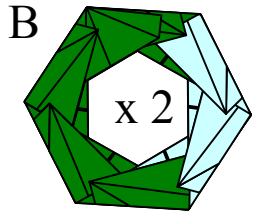
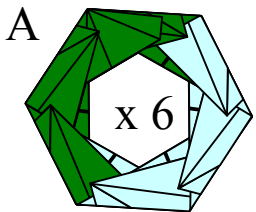
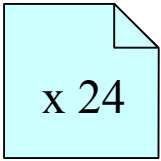
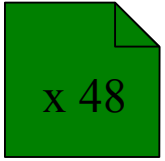
# Square Peg, Round Hole



There's a hole,  
there's a hole,  
there's a hole in the  
square peg in the  
round hole...

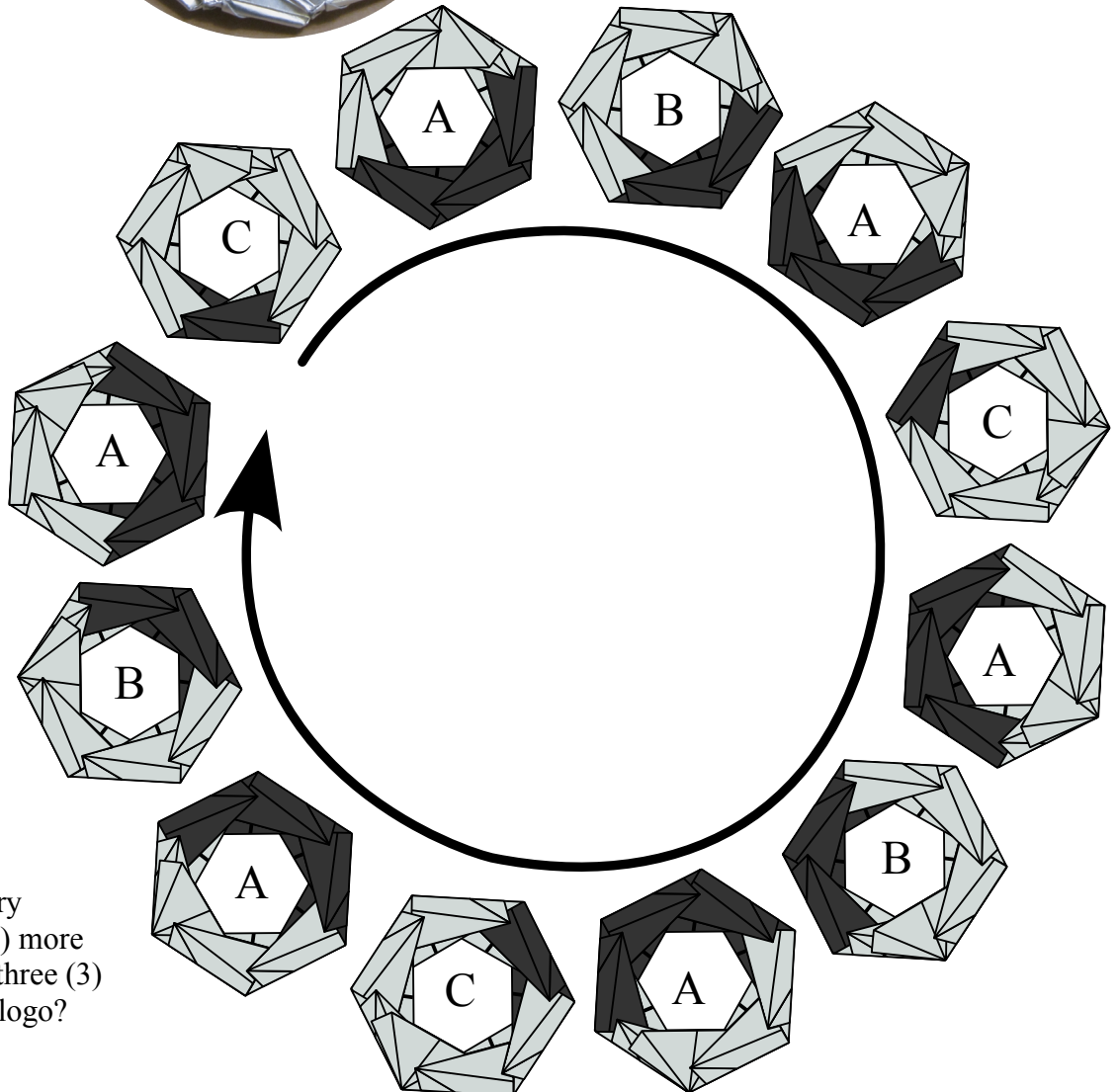
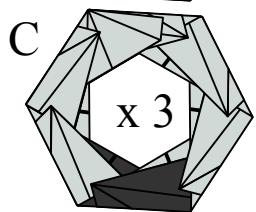
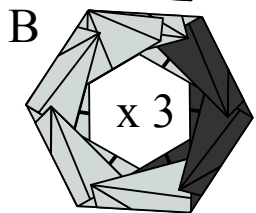
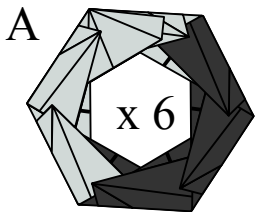
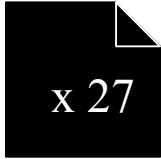
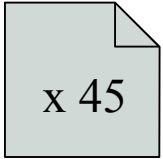


# 72-Piece Peace of Paper



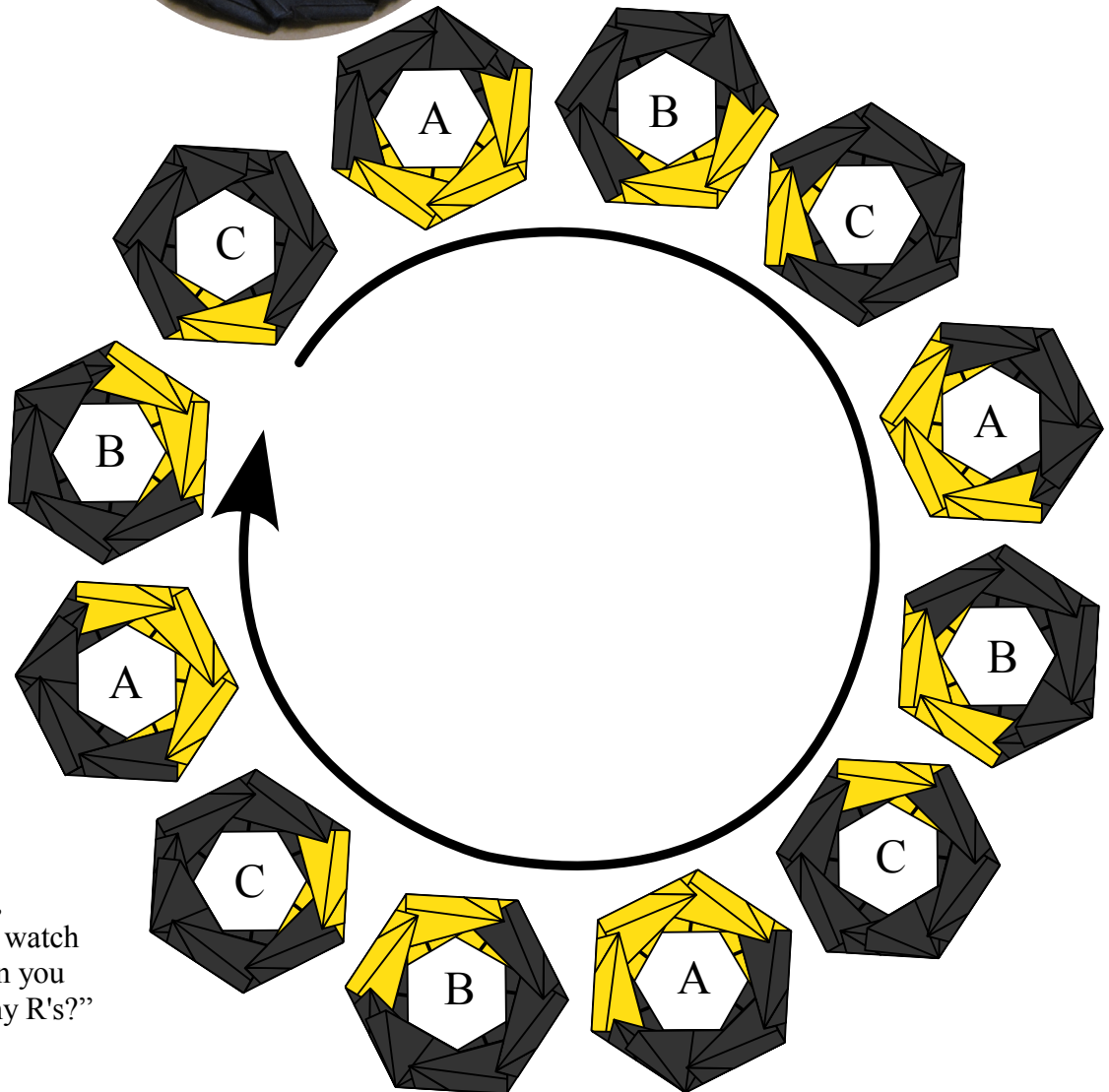
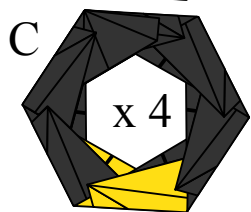
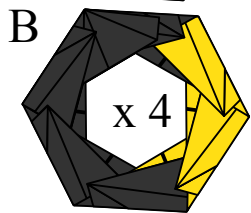
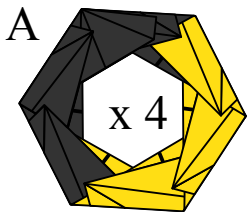
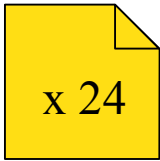


# Steering Wheel



For a cool variant, try substituting three (3) more A hexagons for the three (3) B's. Recognize the logo?

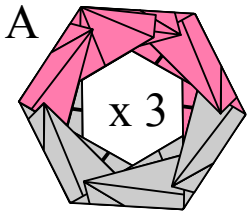
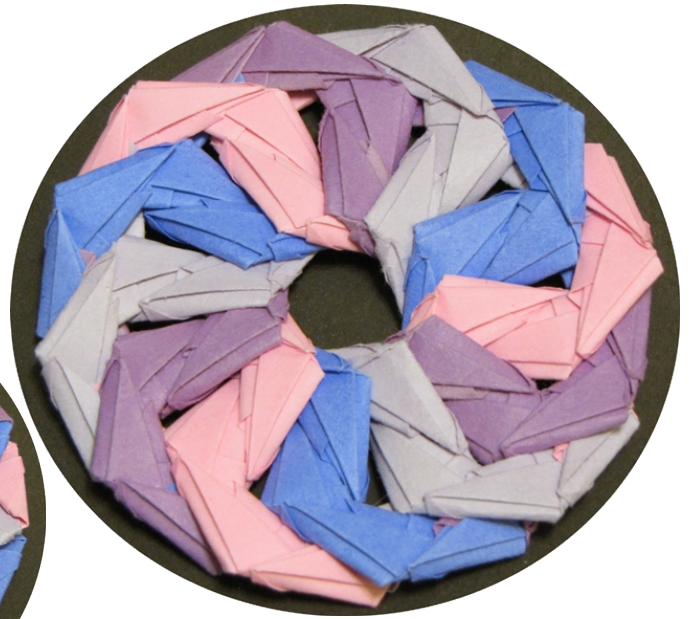
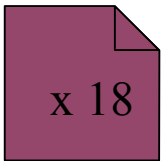
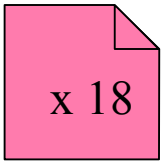
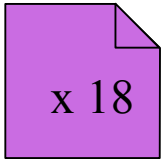
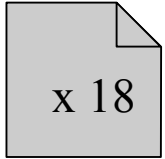
# Railroad Crossing, Watch Out For The Cars. Can You Fold That Without Any R's?\*



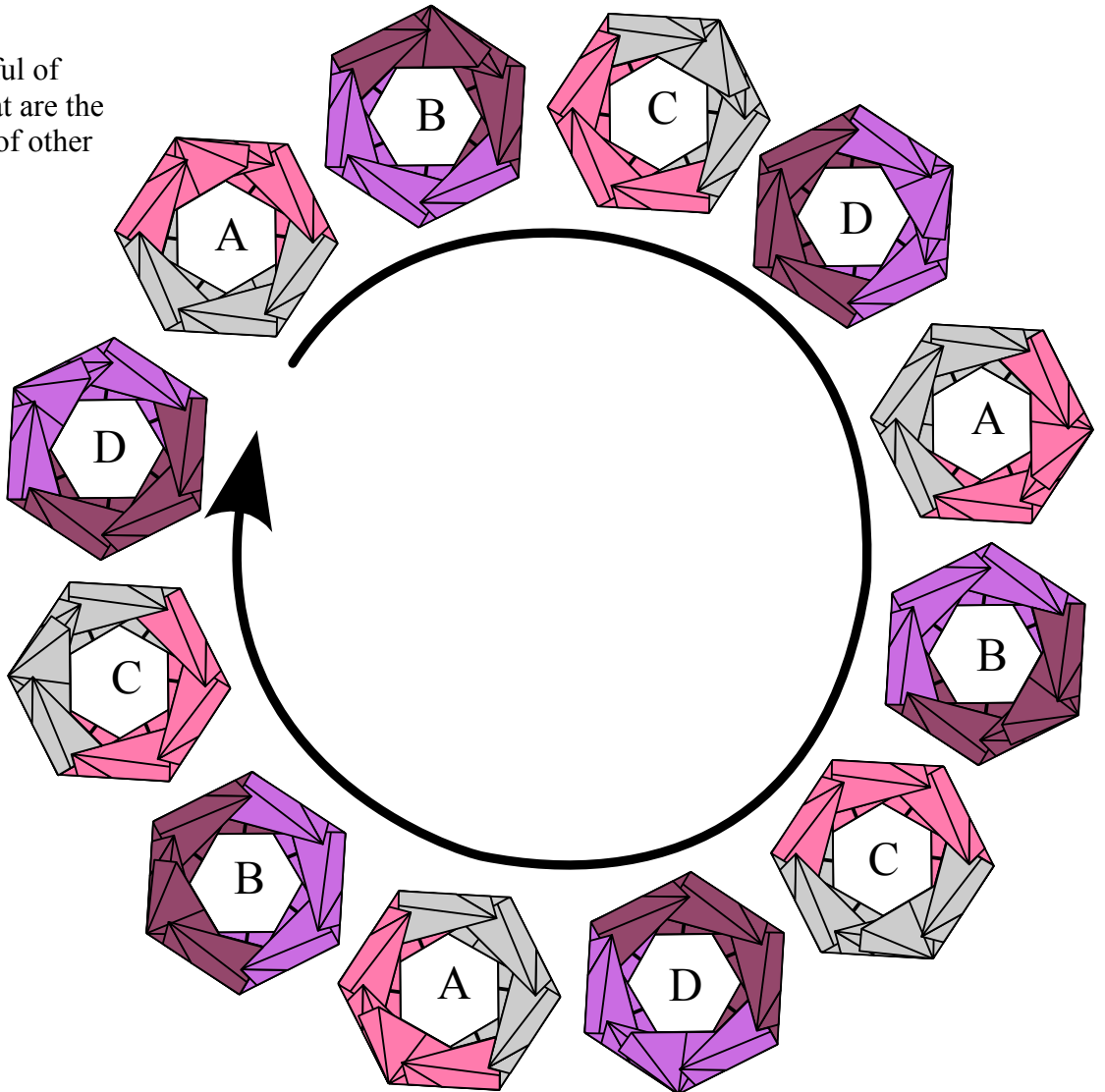
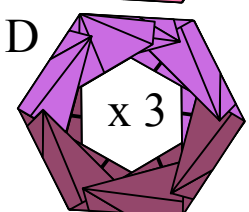
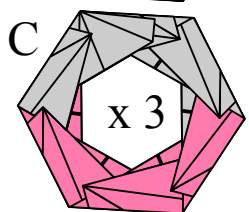
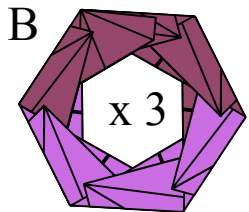
\* From the old joke,  
"Railroad Crossing, watch  
out for the cars. Can you  
spell that without any R's?"



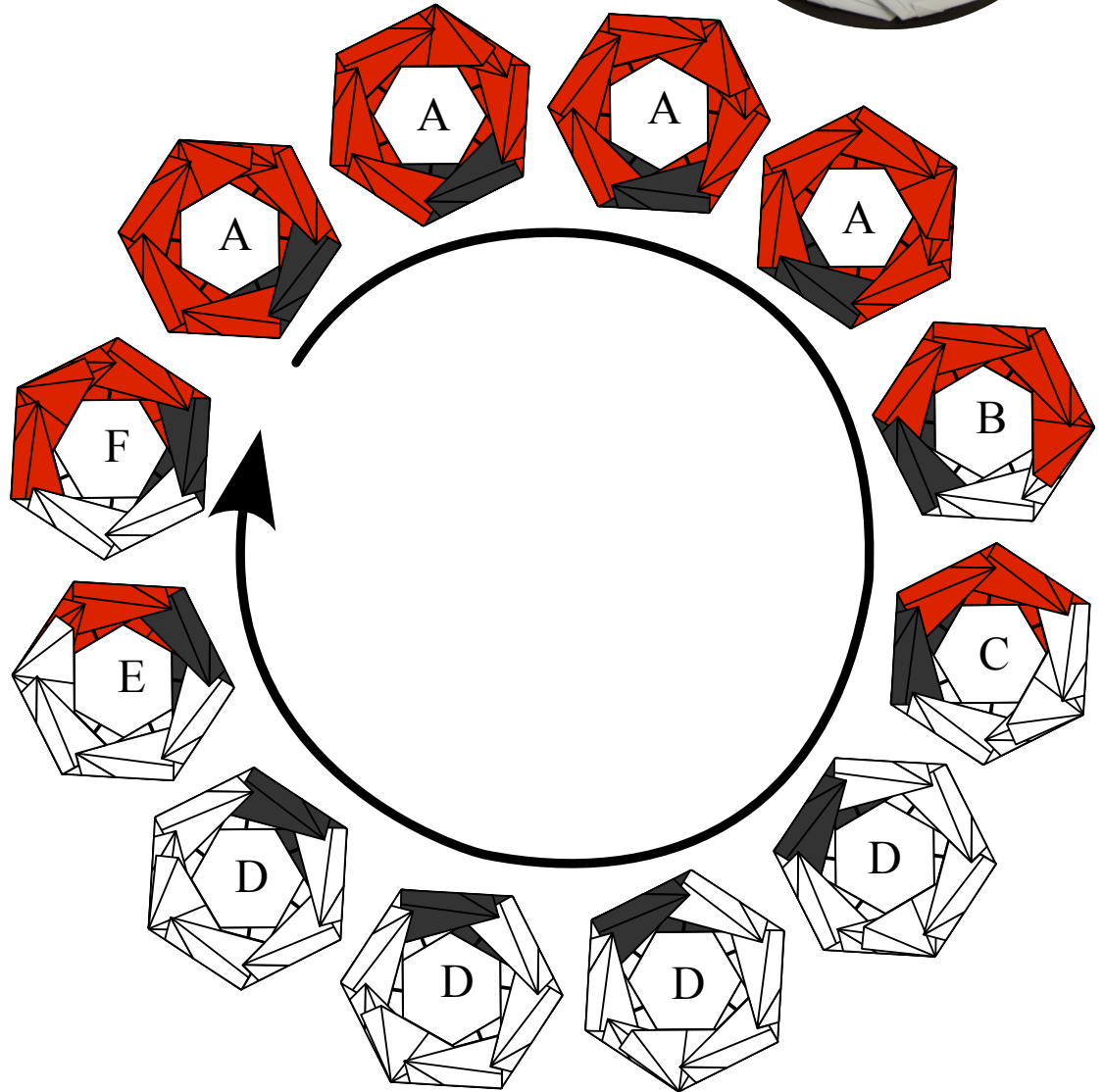
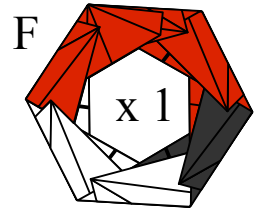
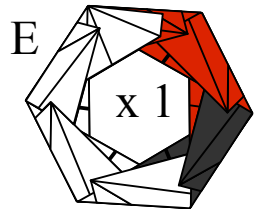
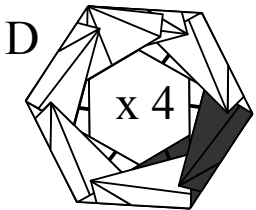
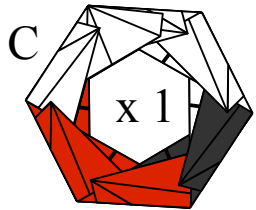
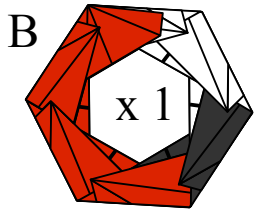
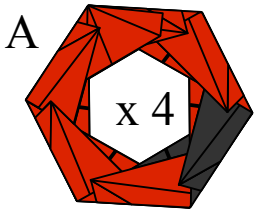
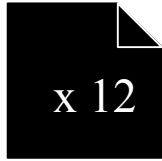
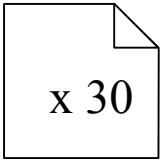
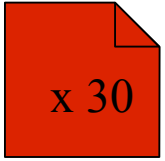
# S-Hooks



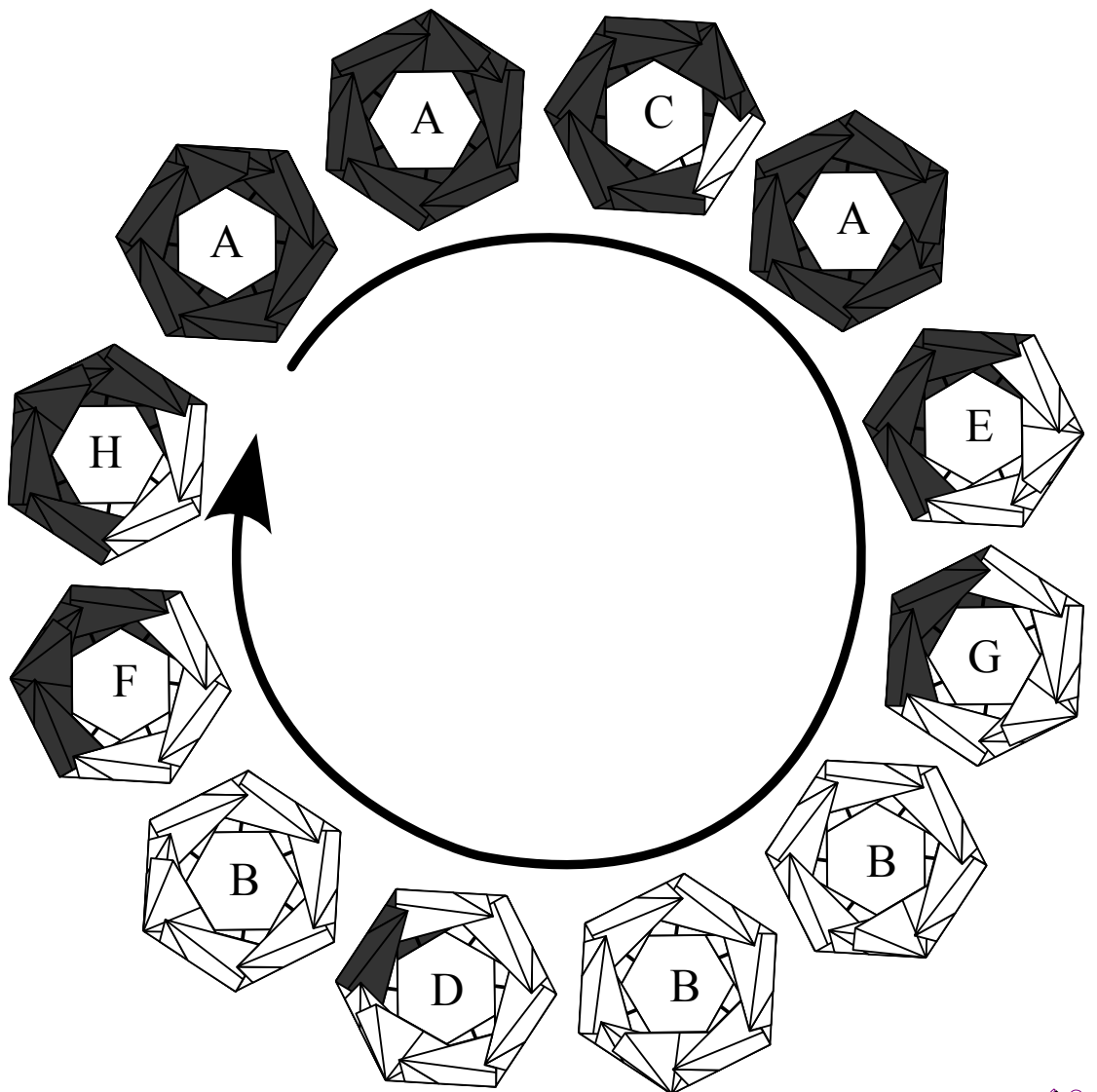
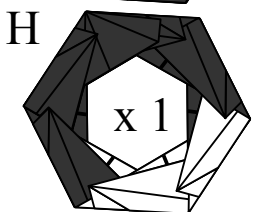
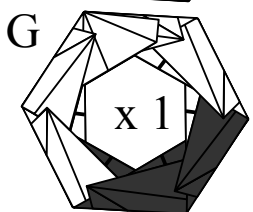
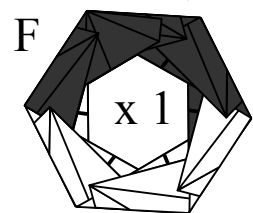
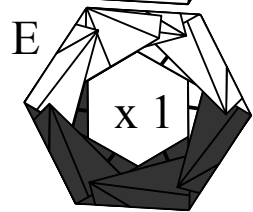
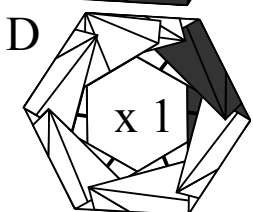
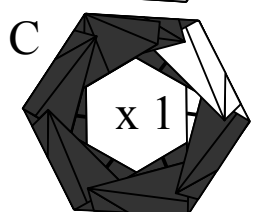
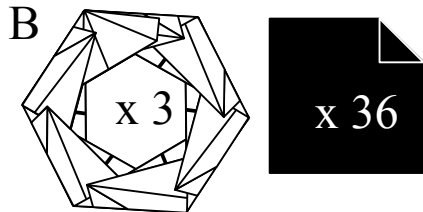
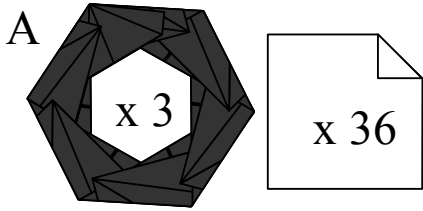
Be careful of units that are the inverse of other units.



# POKE-A-ROUND

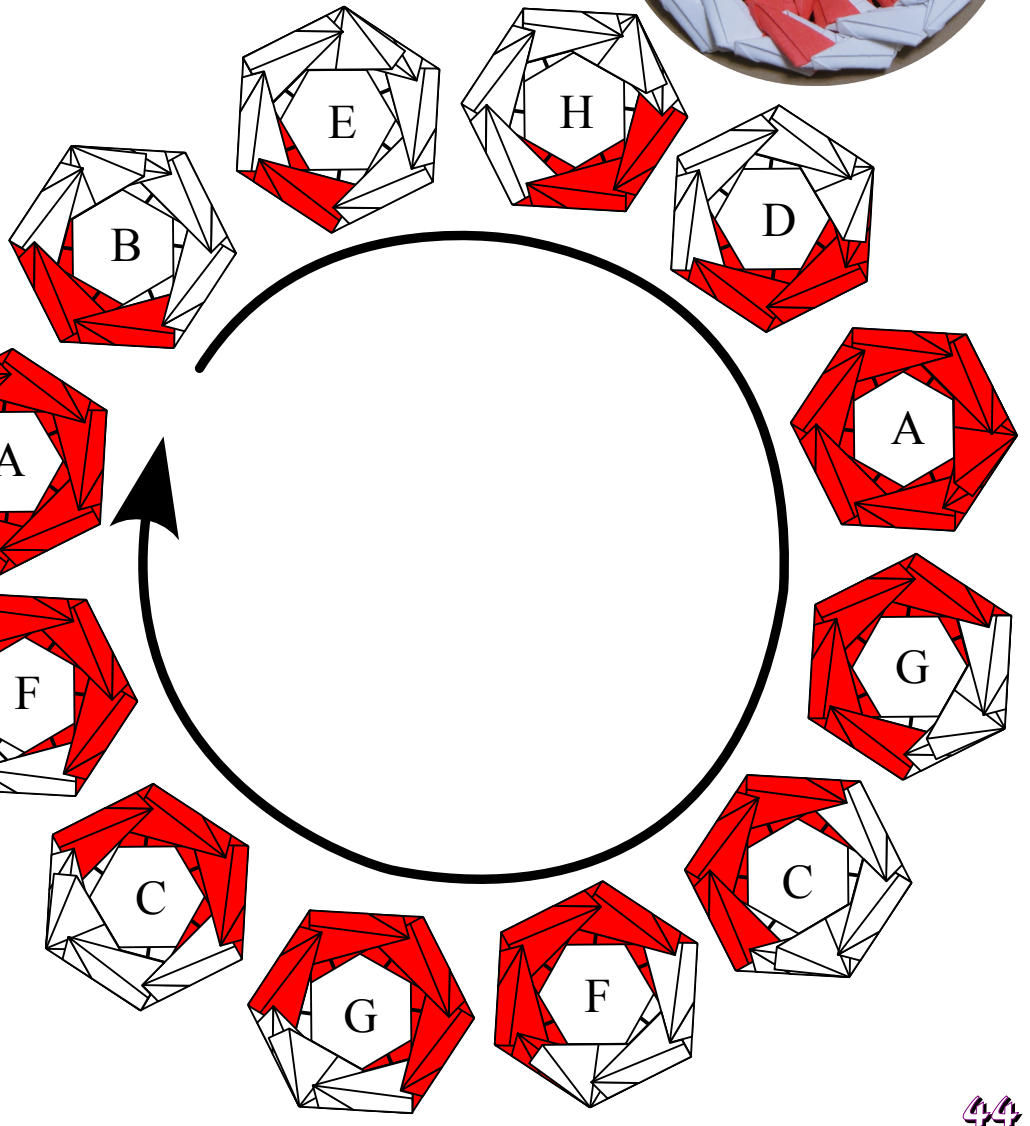
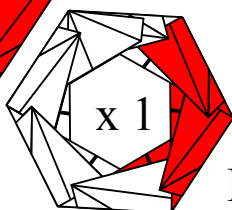
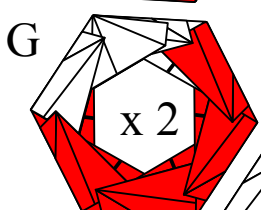
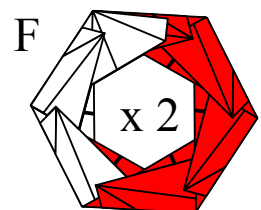
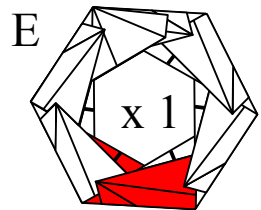
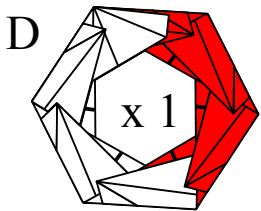
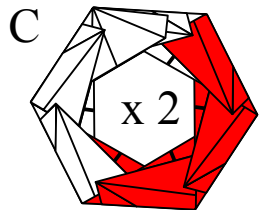
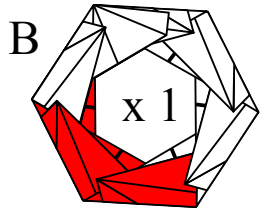
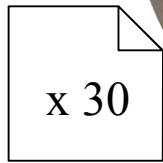
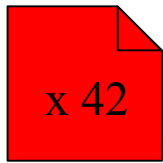
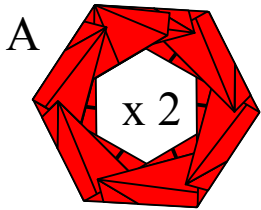


# Yin-Yang



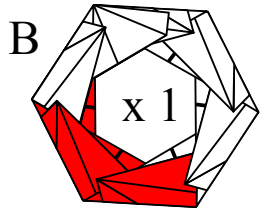
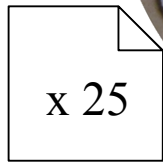
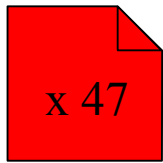
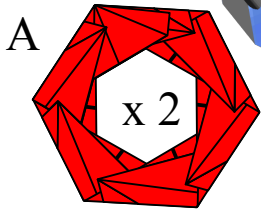
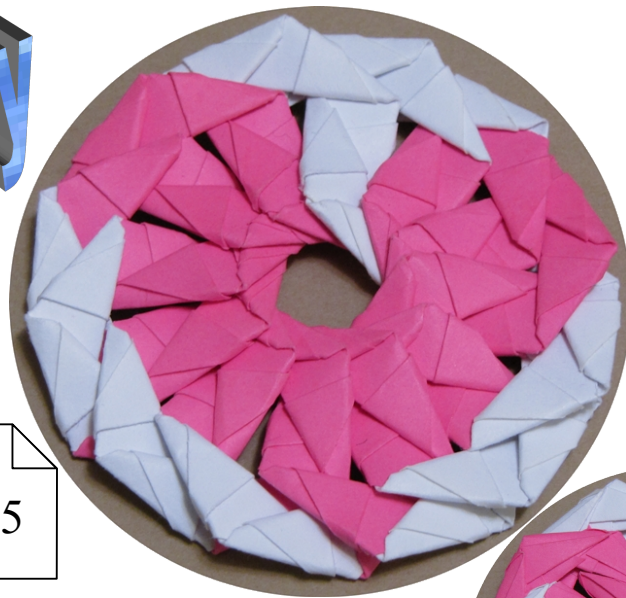


# Heart

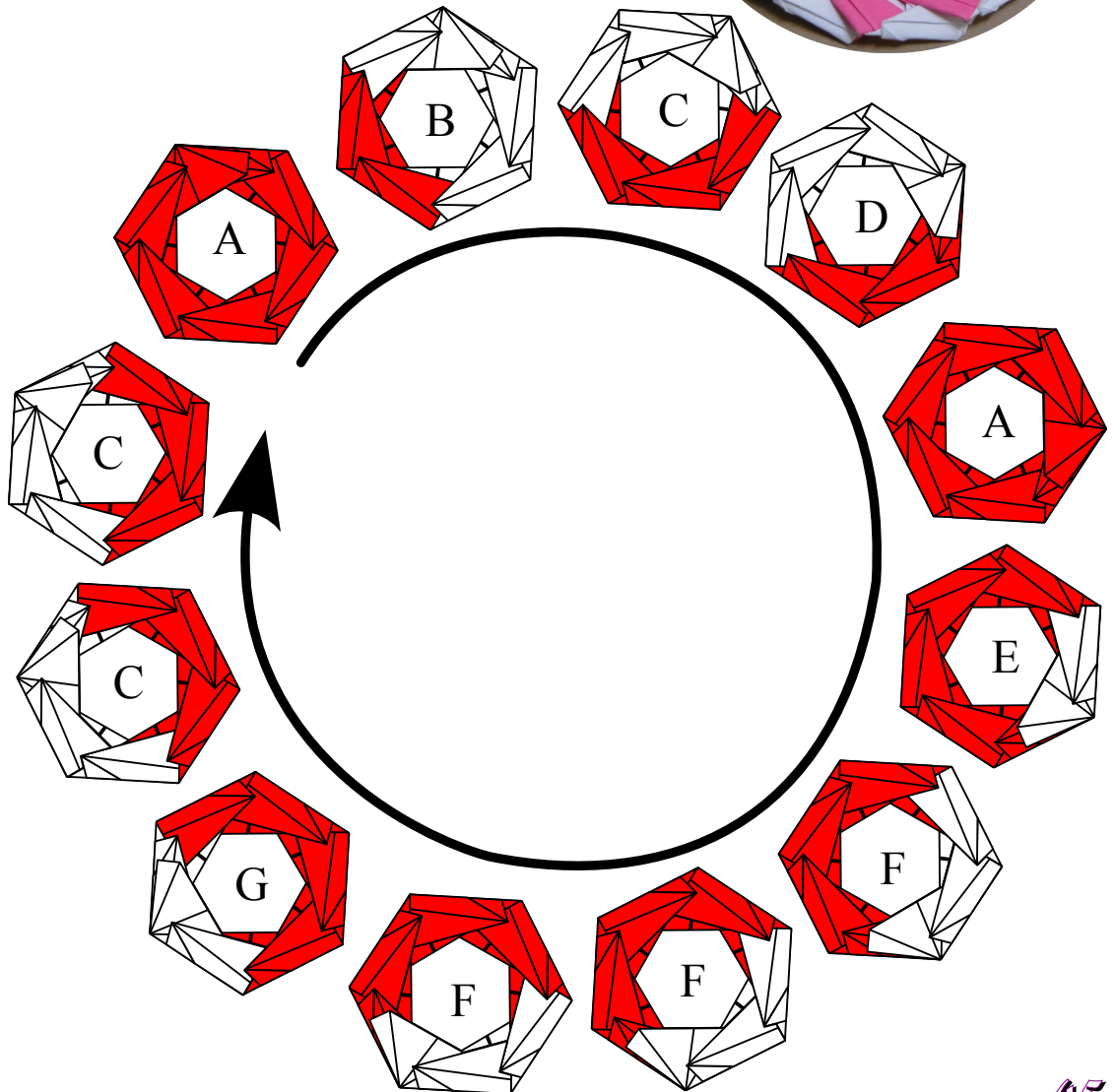
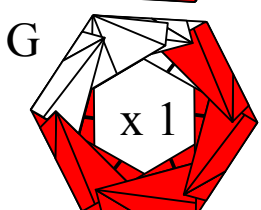
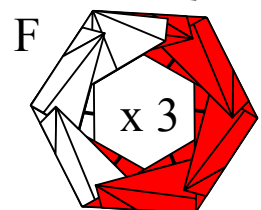
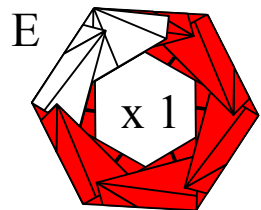
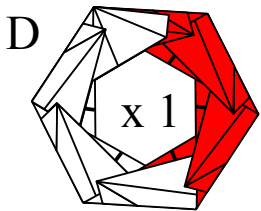
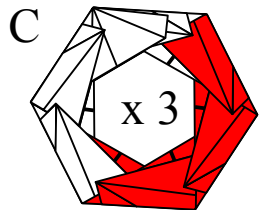




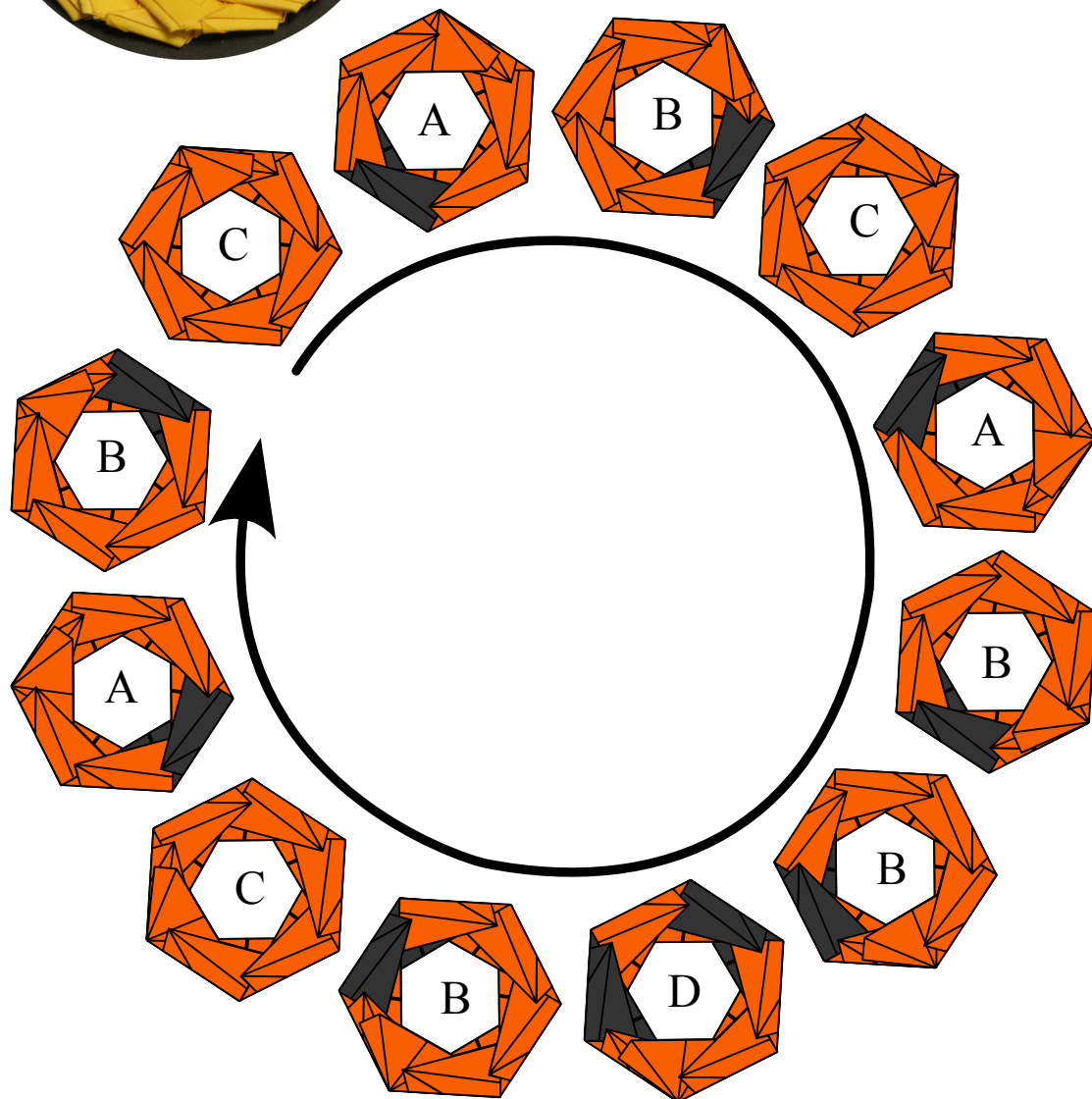
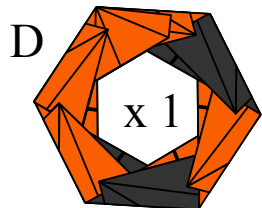
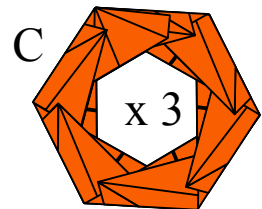
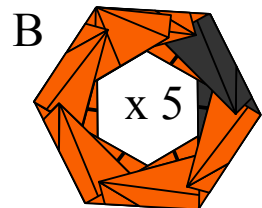
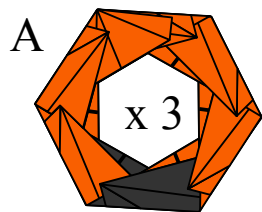
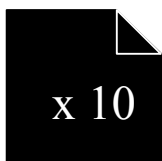
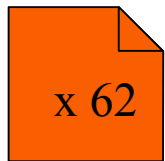
# Artsy Heartsy



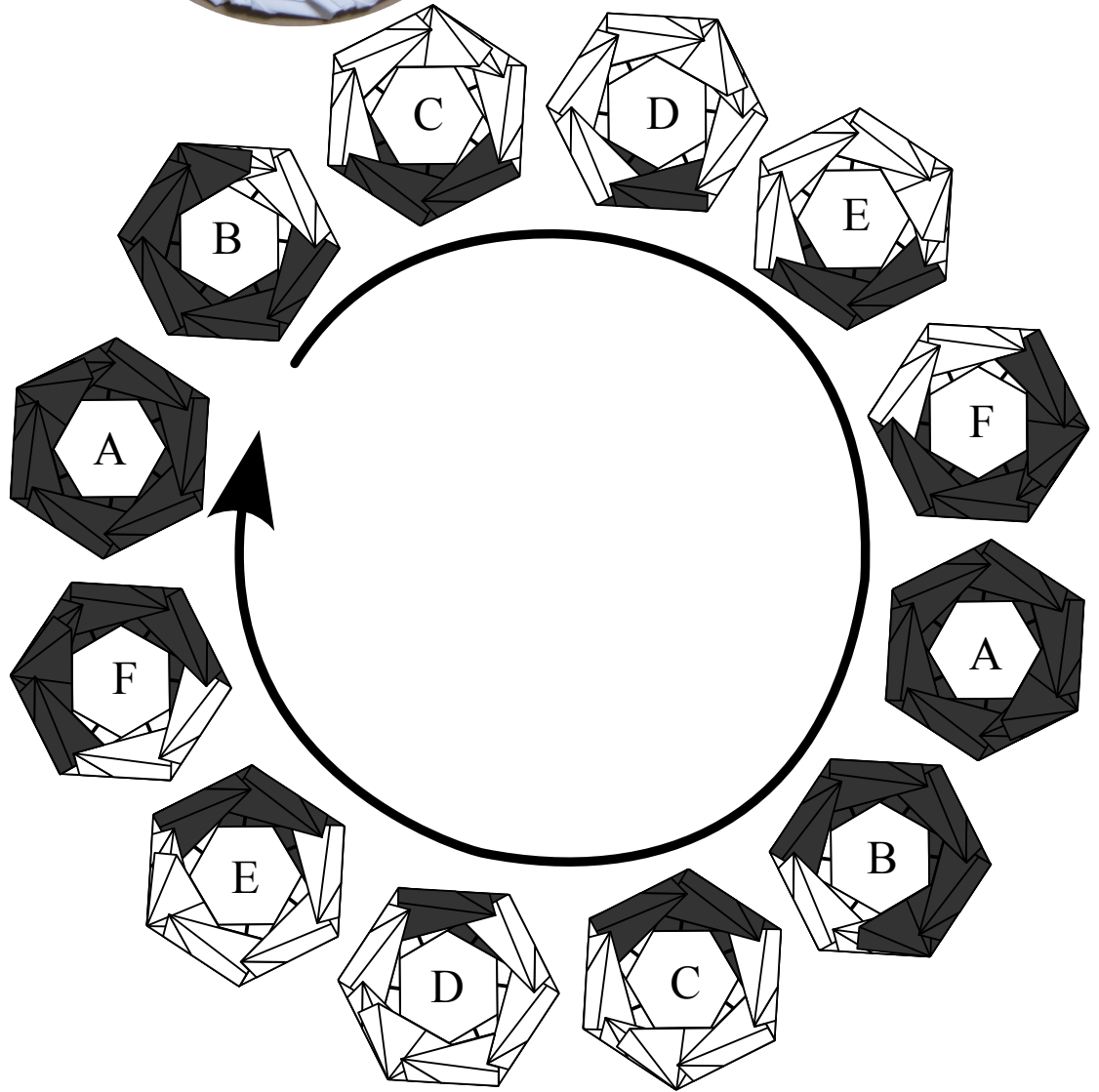
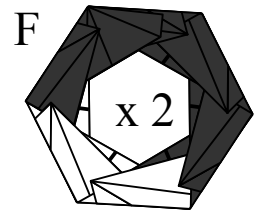
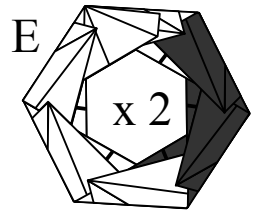
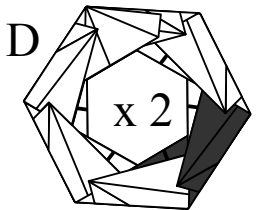
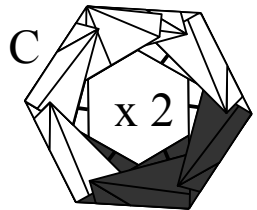
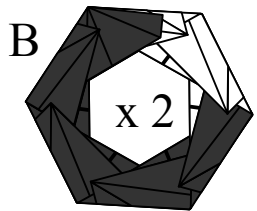
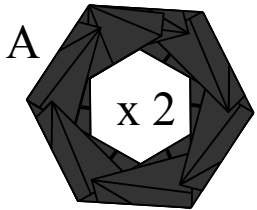
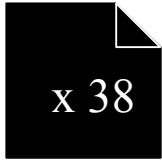
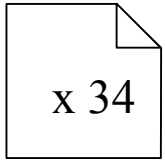
There are lots of possible slight variations on hearts, including ones for the other side.



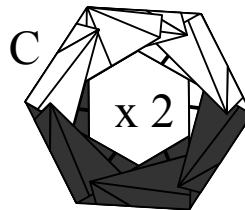
# Jack-O-Lantern



# Bow Ties Are Cool

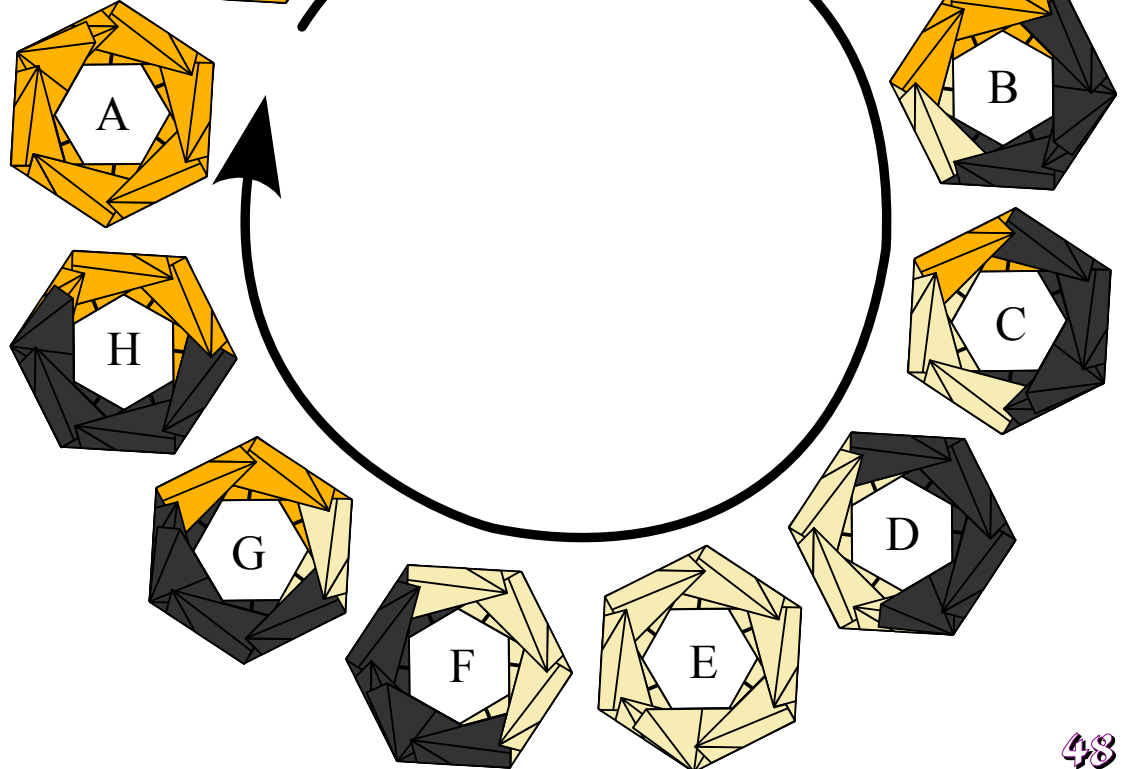
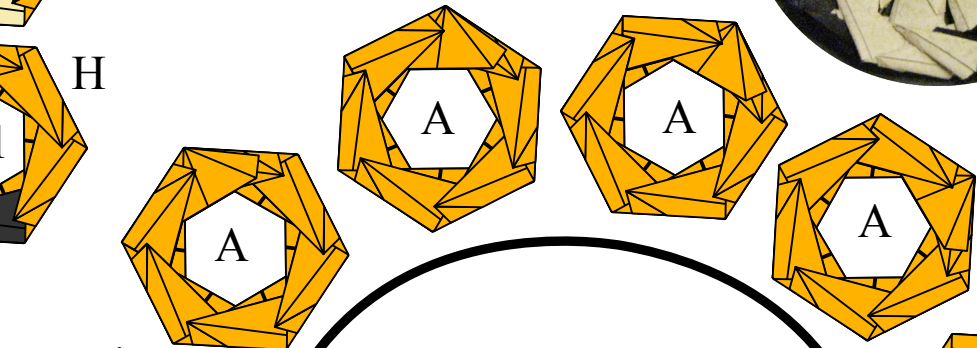
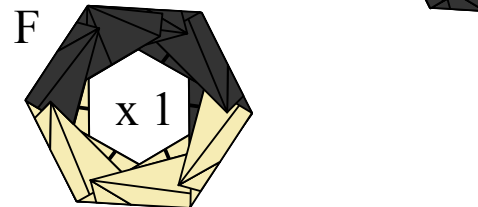
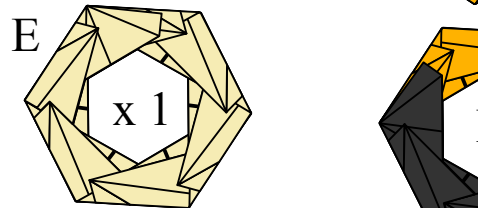
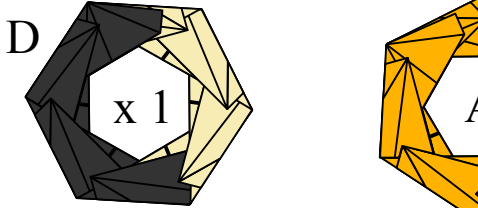
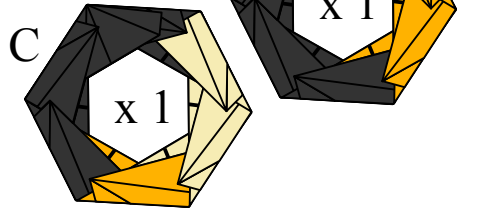
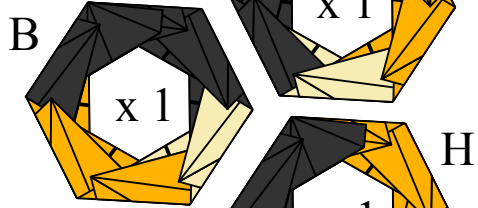
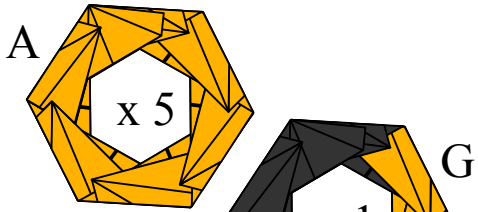
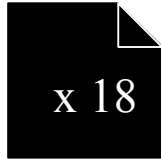
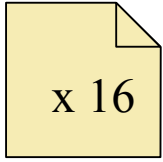
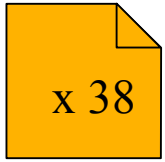


For a cool variant,  
try this simple  
substitution:.



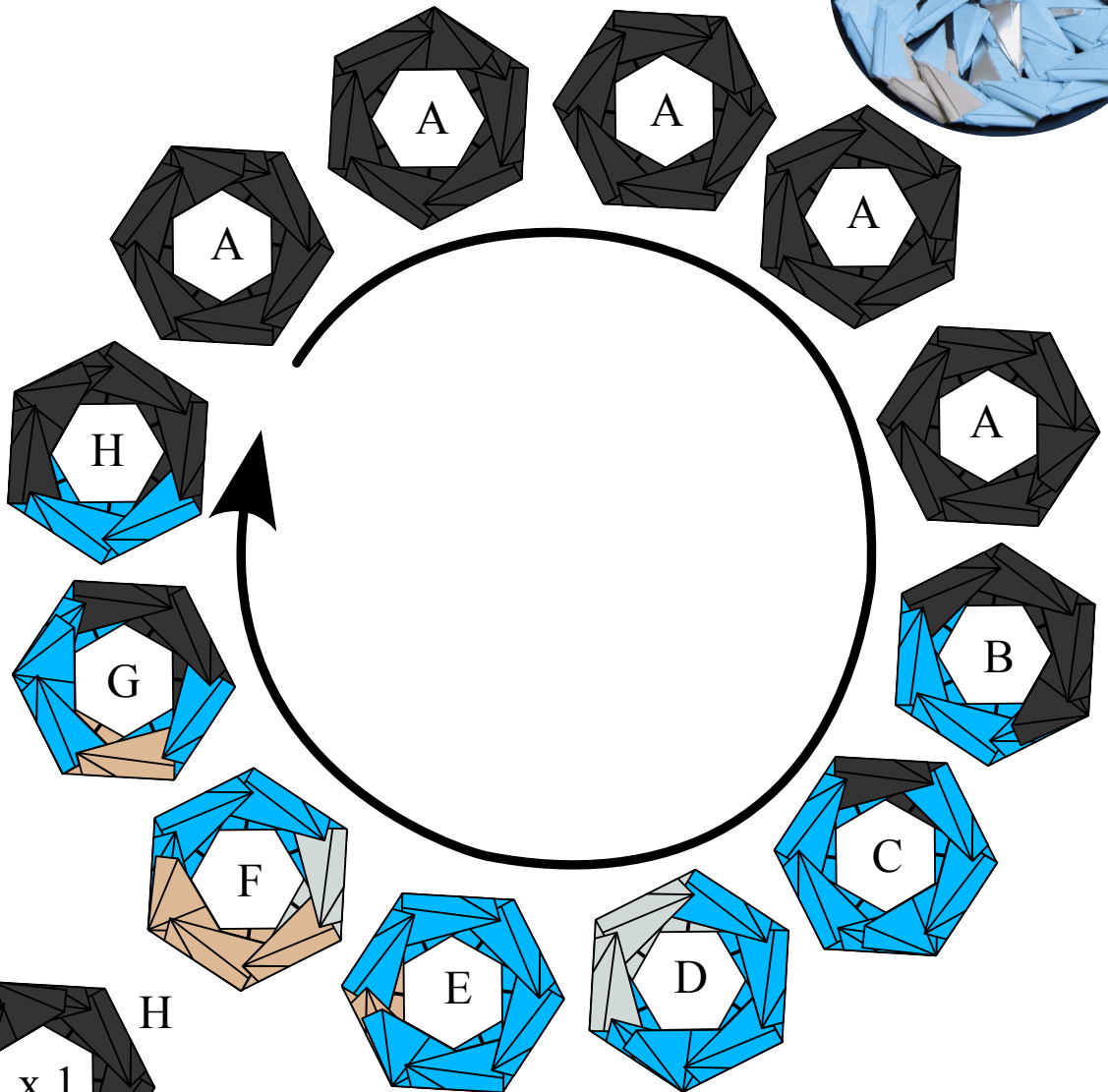
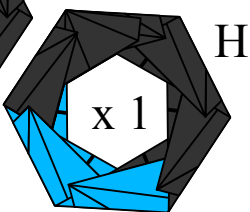
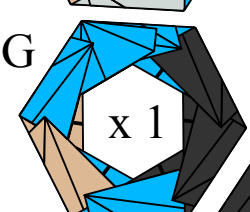
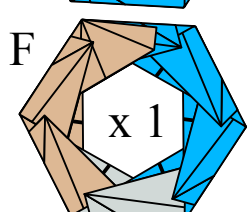
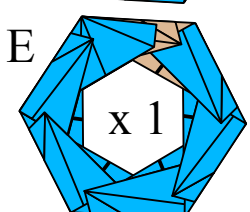
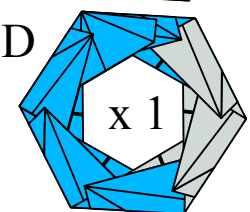
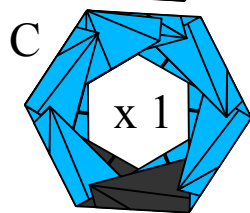
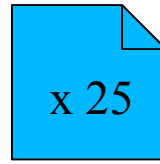
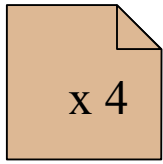
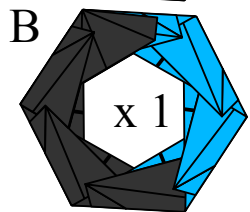
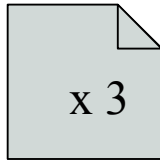
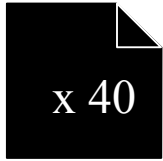
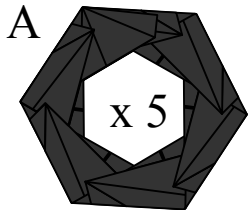


# Mushroom





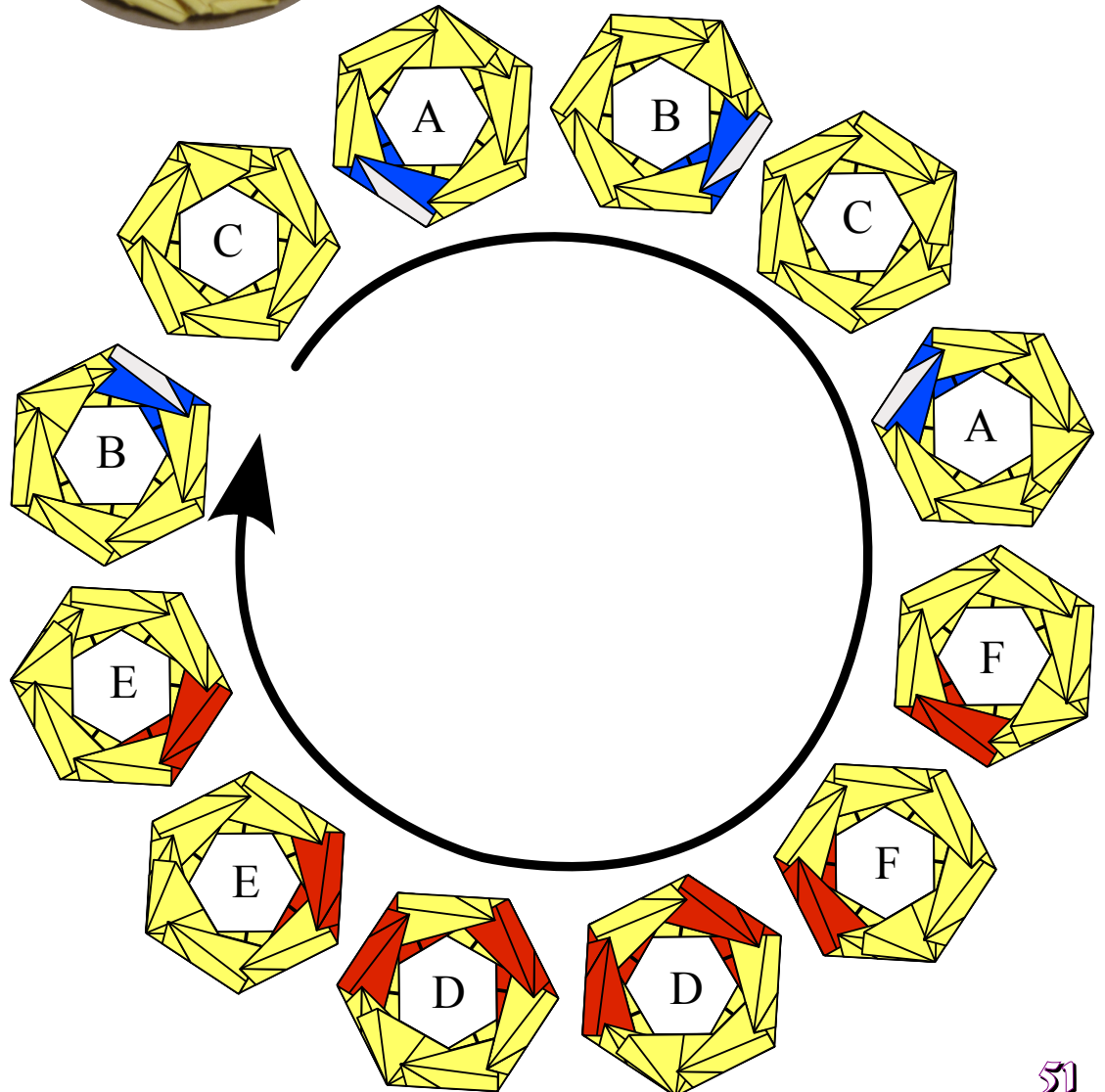
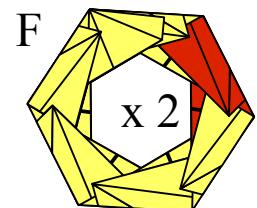
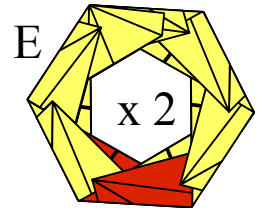
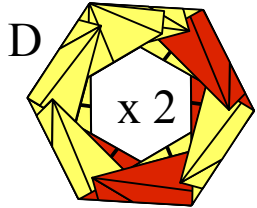
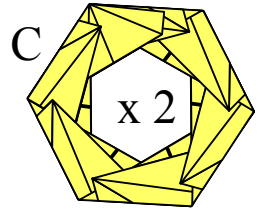
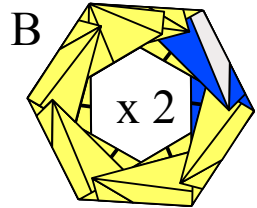
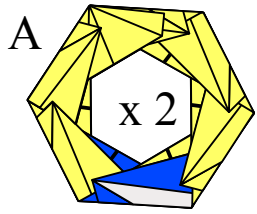
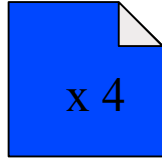
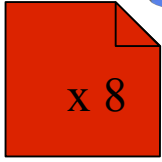
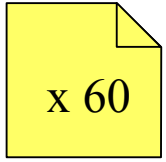
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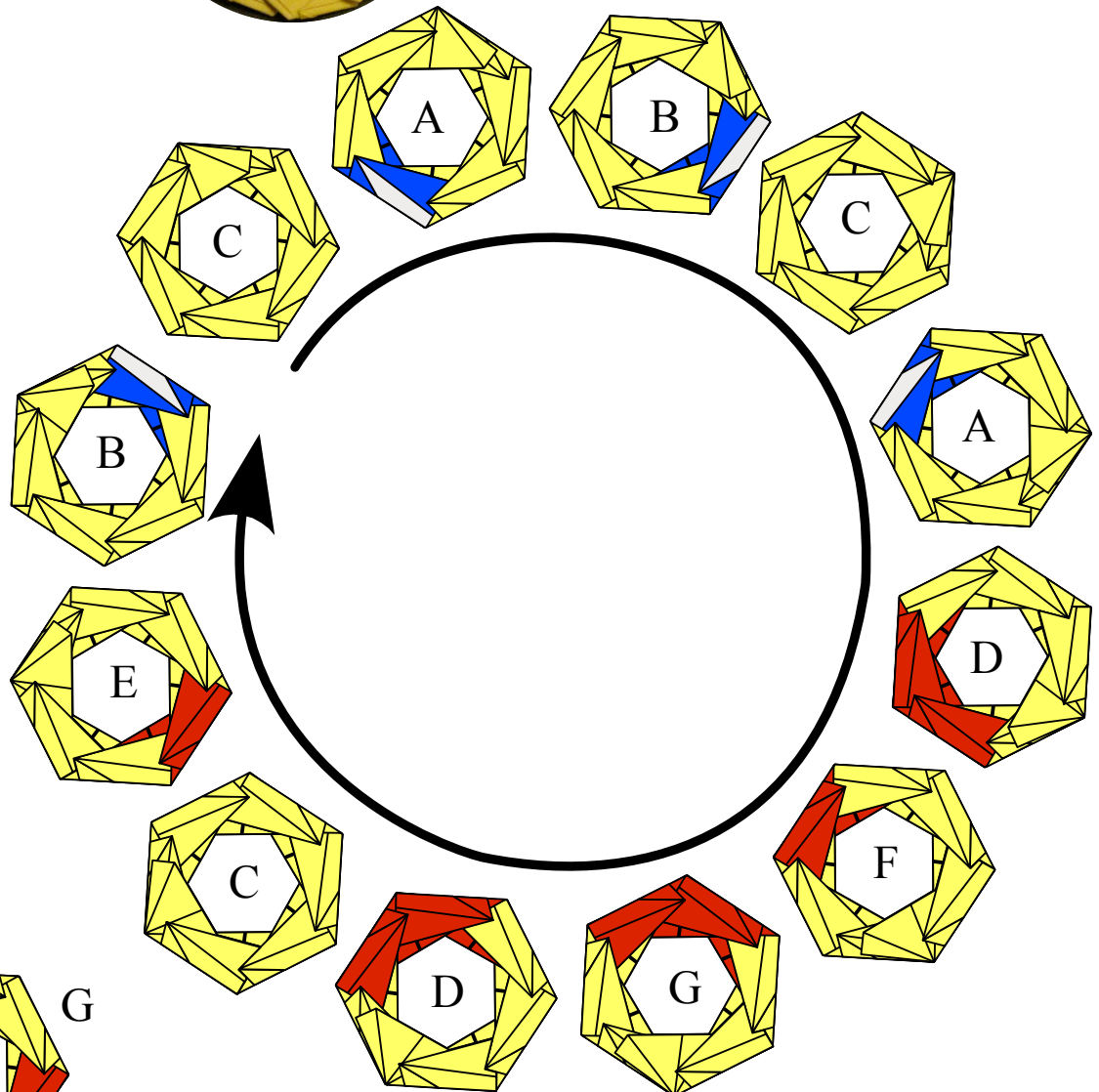
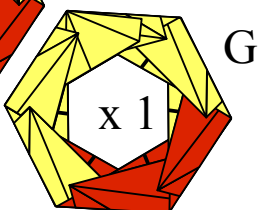
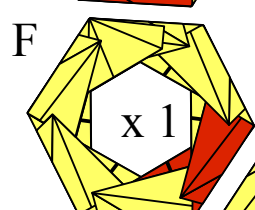
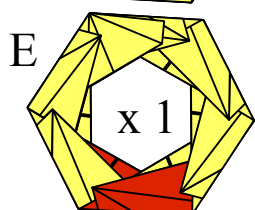
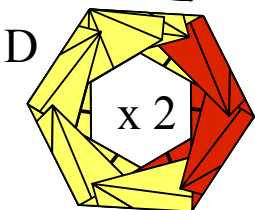
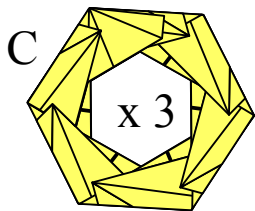
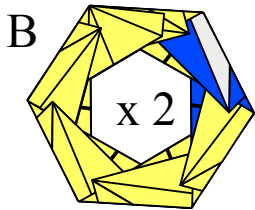
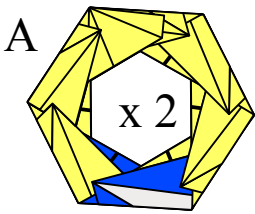
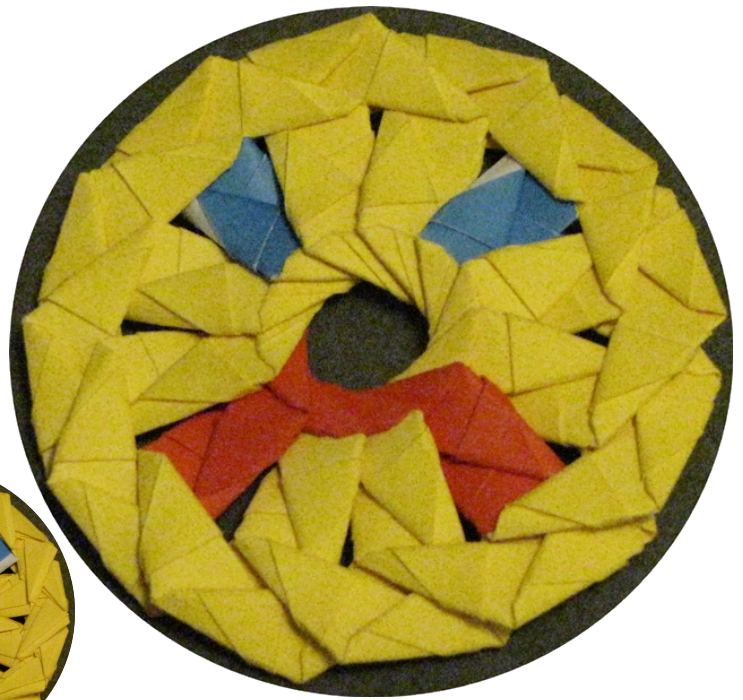
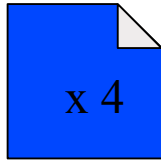
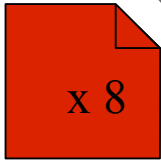
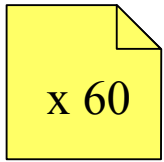




# Smiley Face

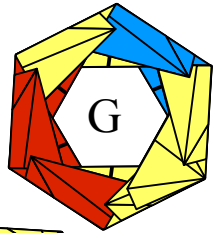
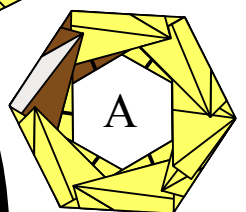
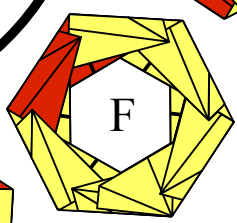
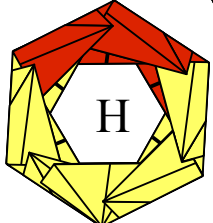
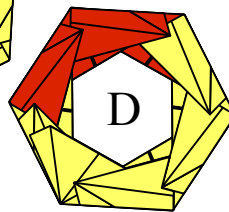
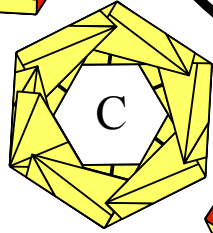
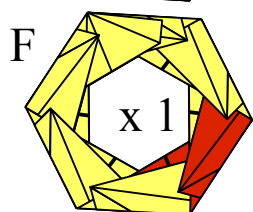
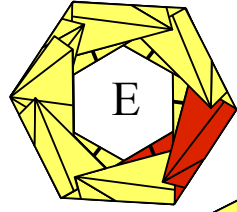
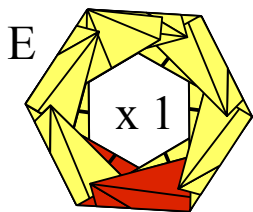
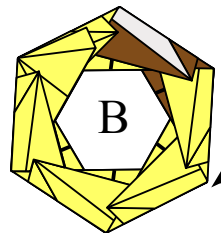
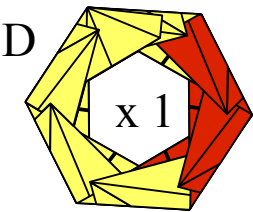
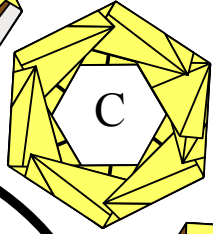
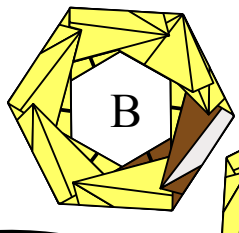
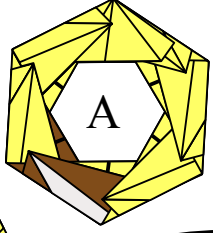
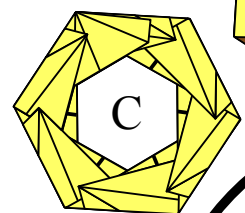
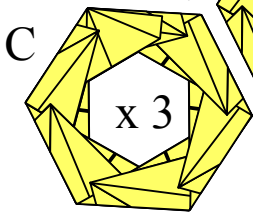
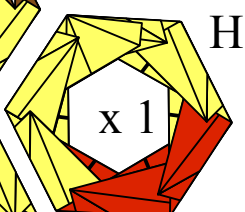
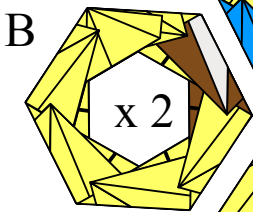
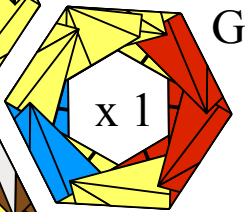
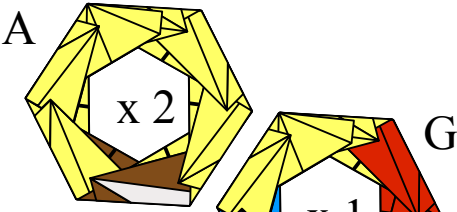
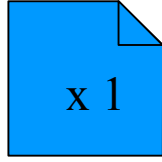
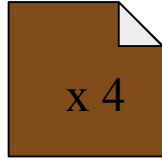
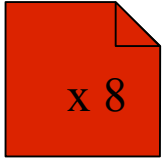
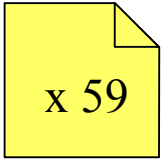


# FROWNY FACE

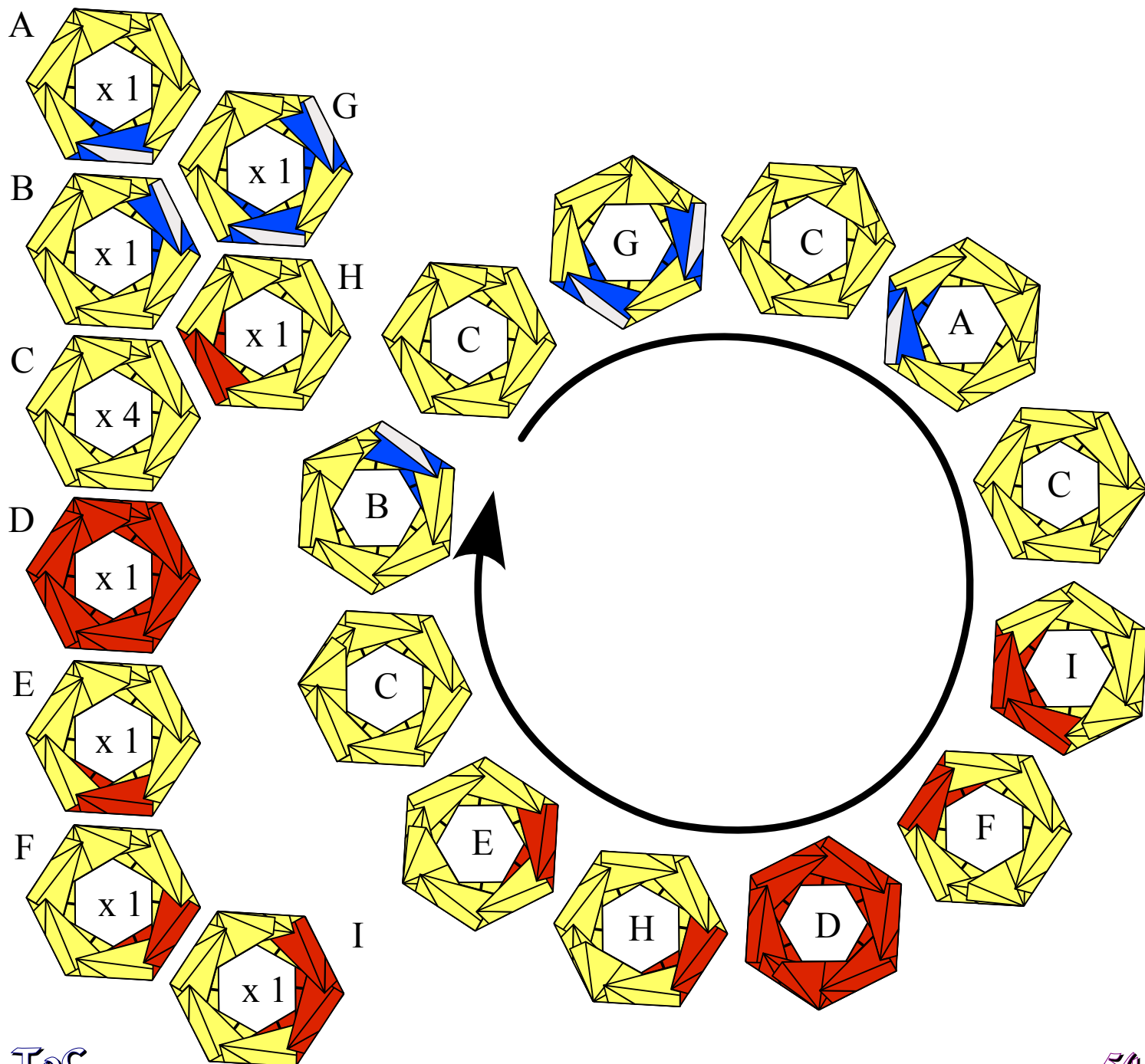
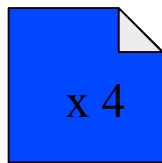
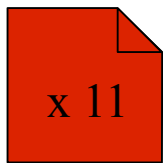
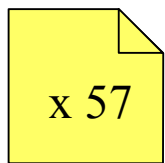




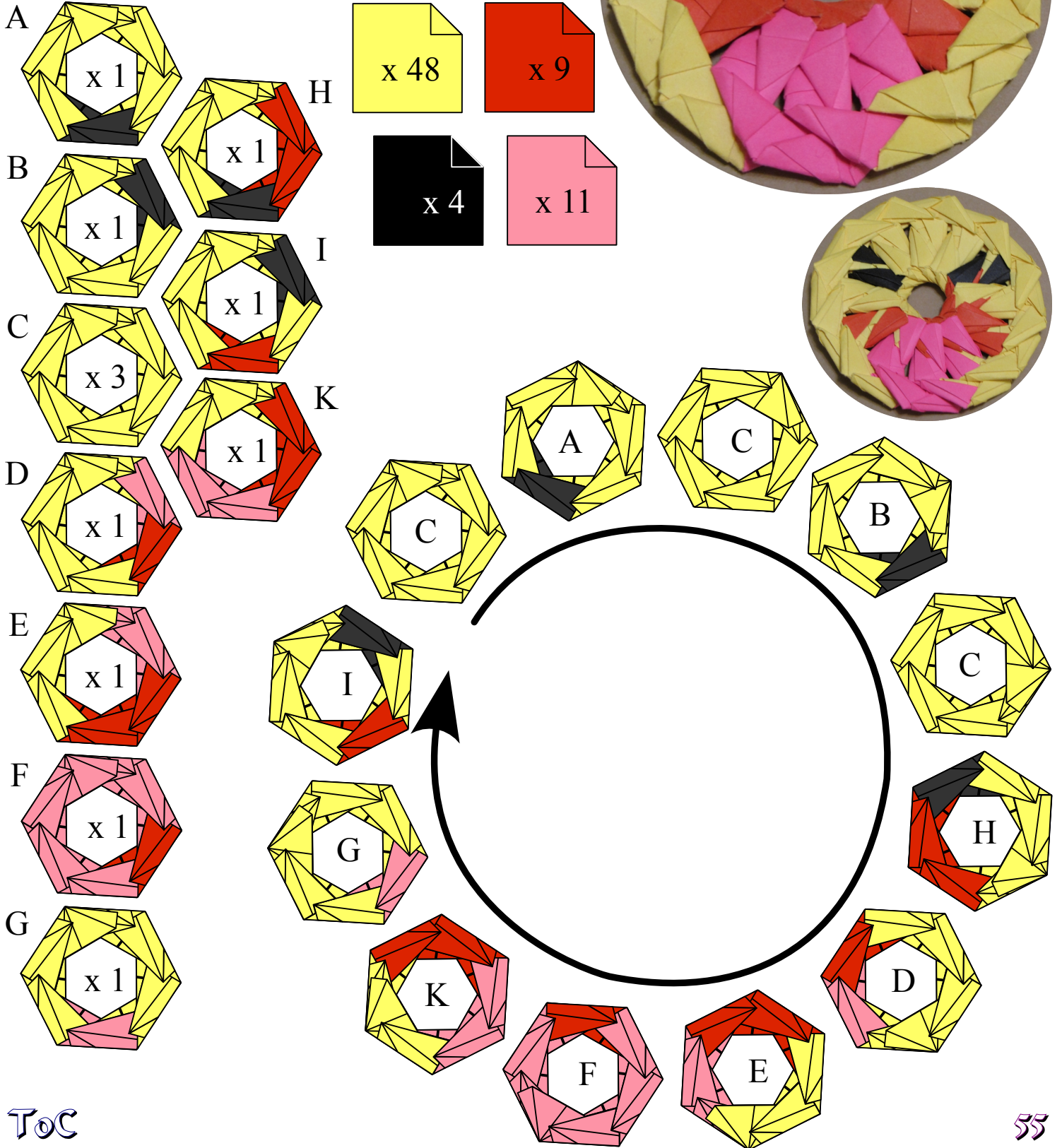
# Sad Face



# Surprise!

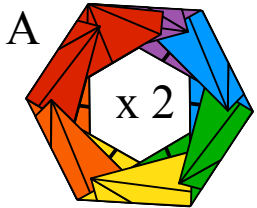
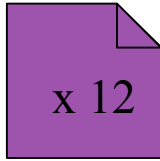
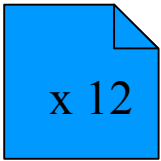
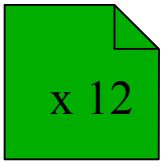
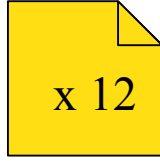
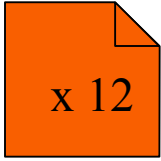
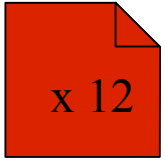


# YUKI!

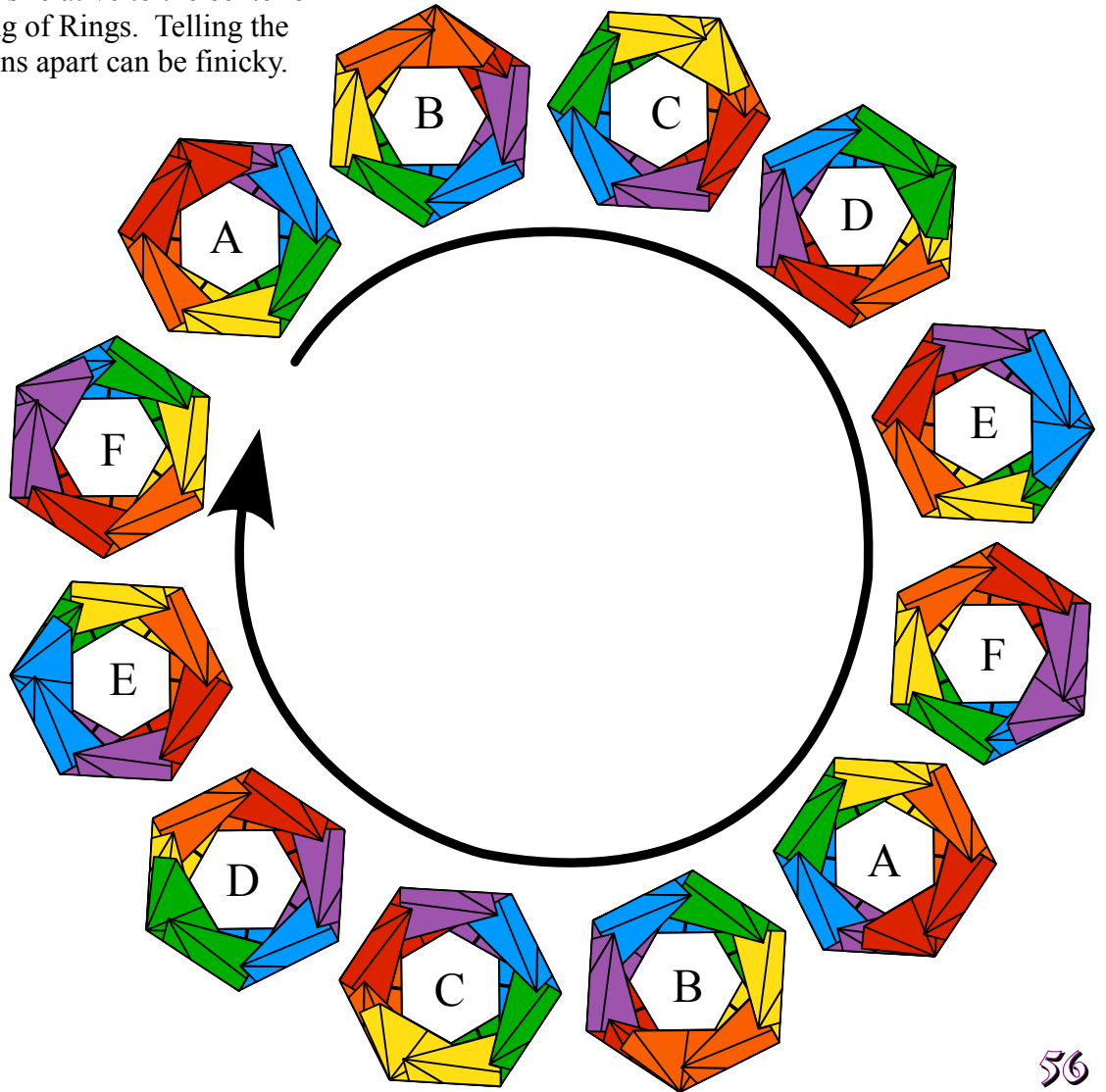
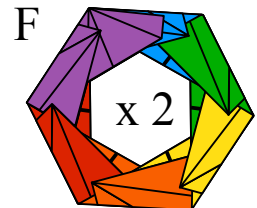
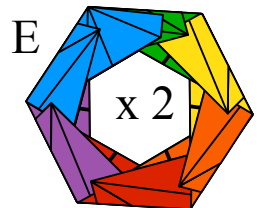
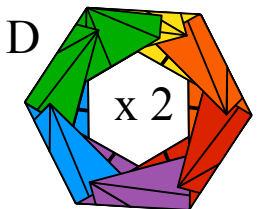
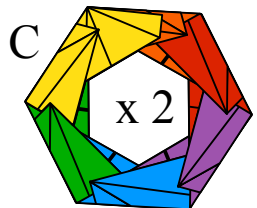
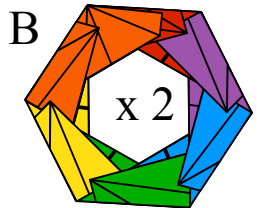




# Rainbow Eddy

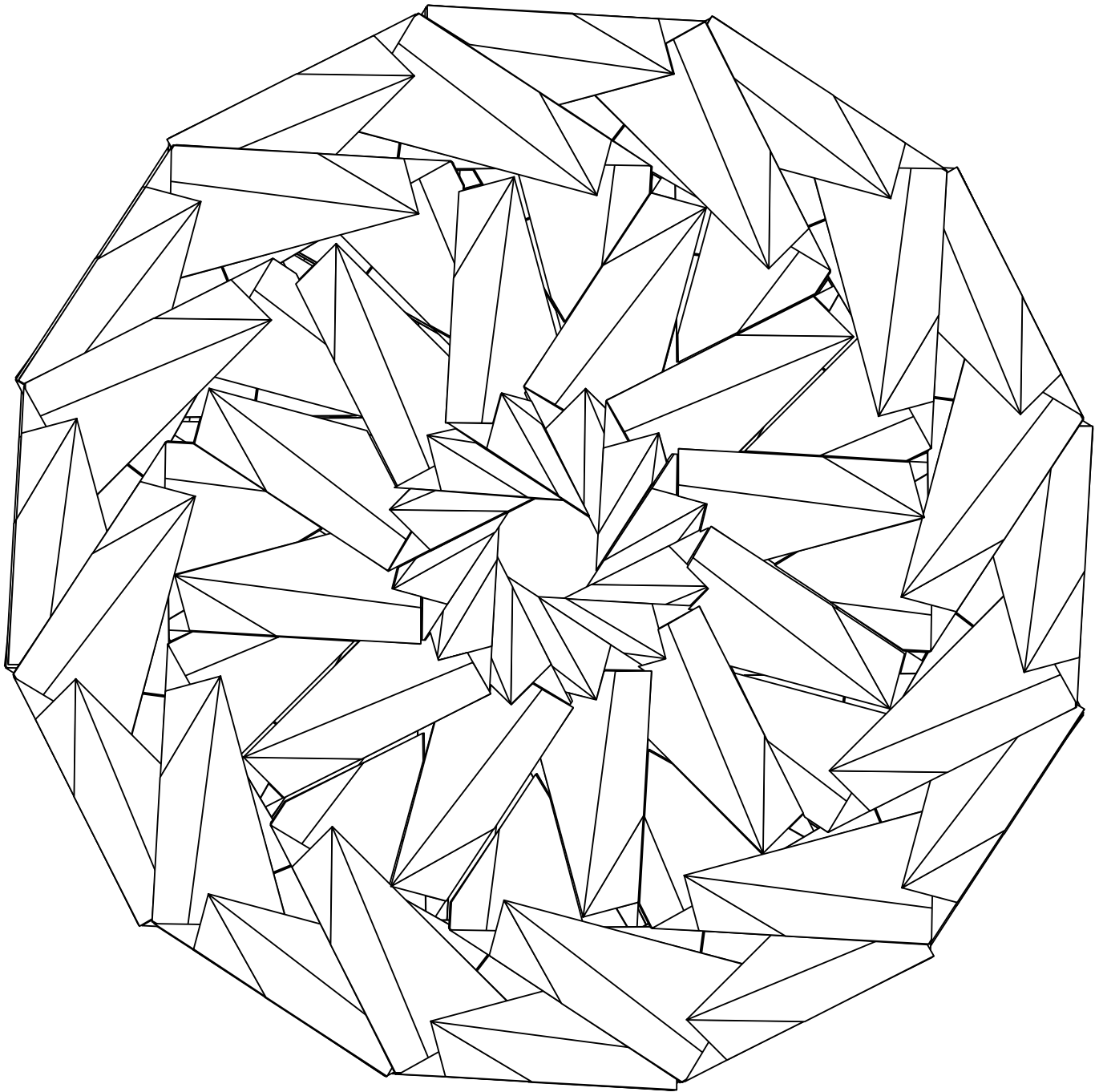


The colors are in the same order in each hexagon, but the opening is in different positions for different rotations relative to the center of the Ring of Rings. Telling the hexagons apart can be finicky.

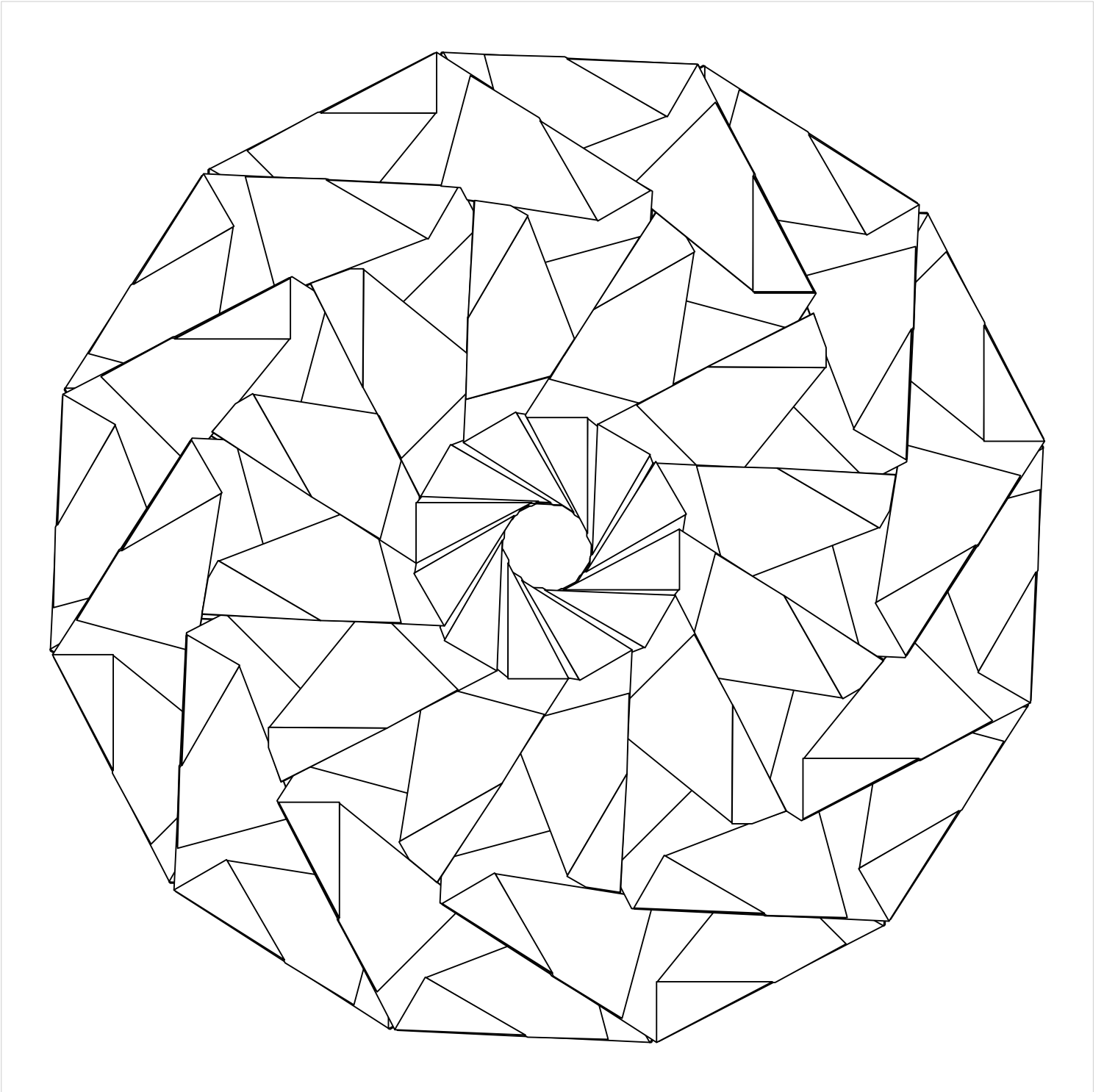




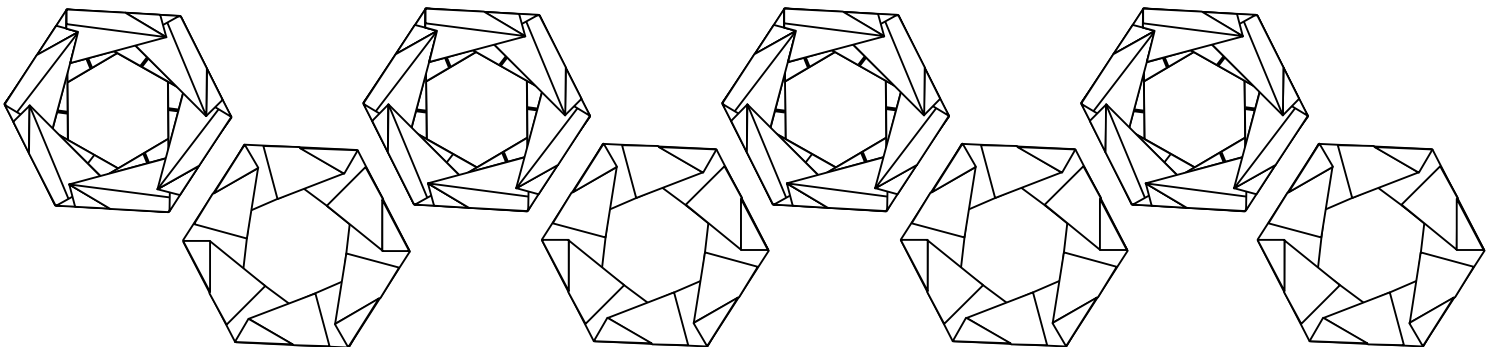
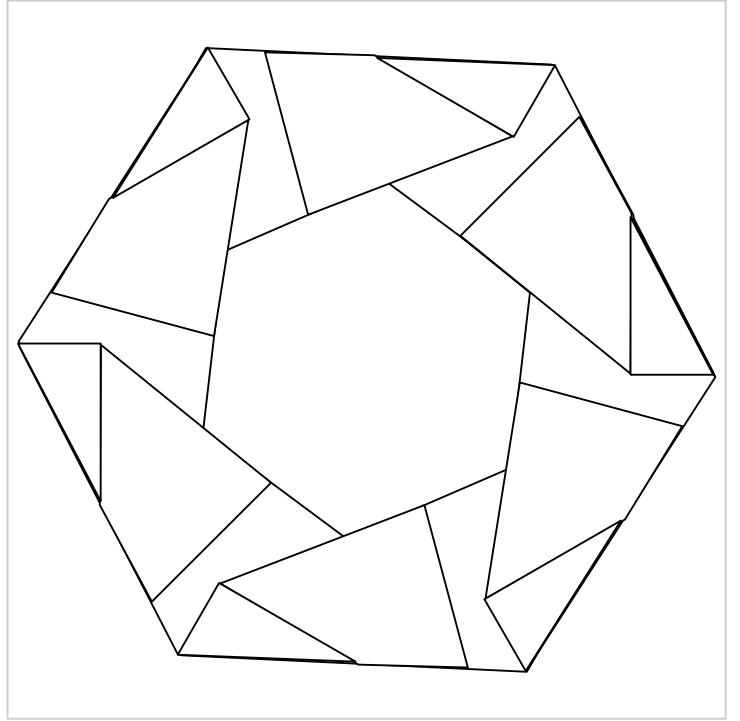
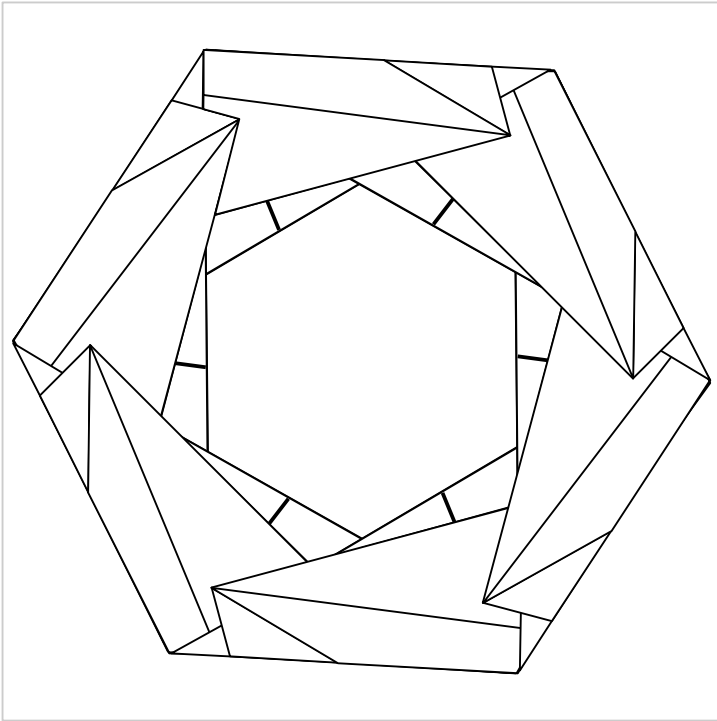
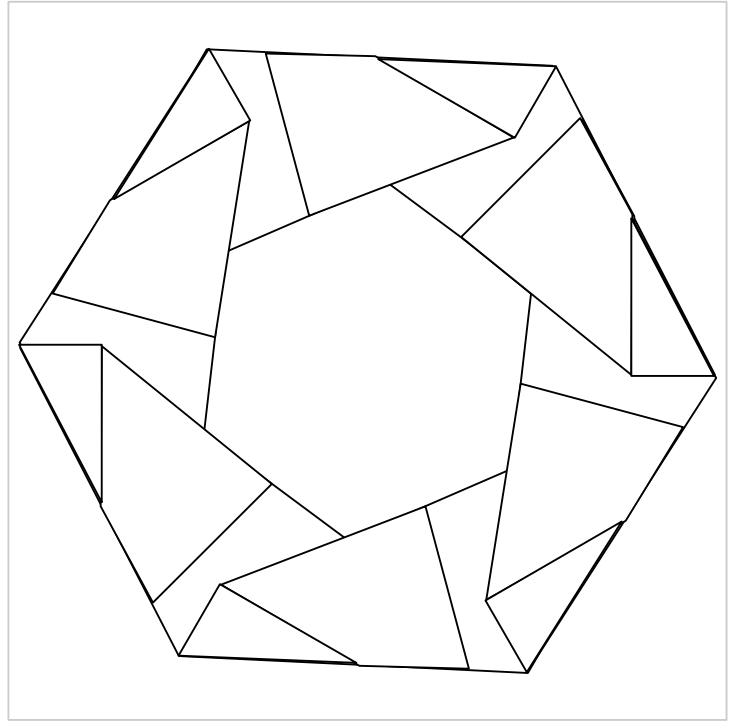
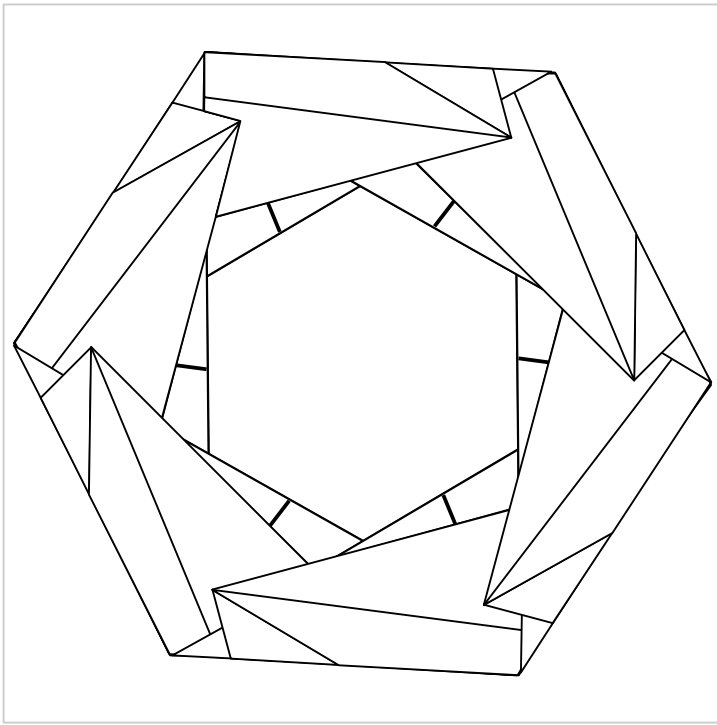
# Plan Your Own Patterns



Here's a blank Ring of Rings to print and color to figure out your own color patterns. Try to keep the constraints of the paper in mind. Afterward, the surrounding square makes it easy to turn your plan into a square for origami with the pattern centered.

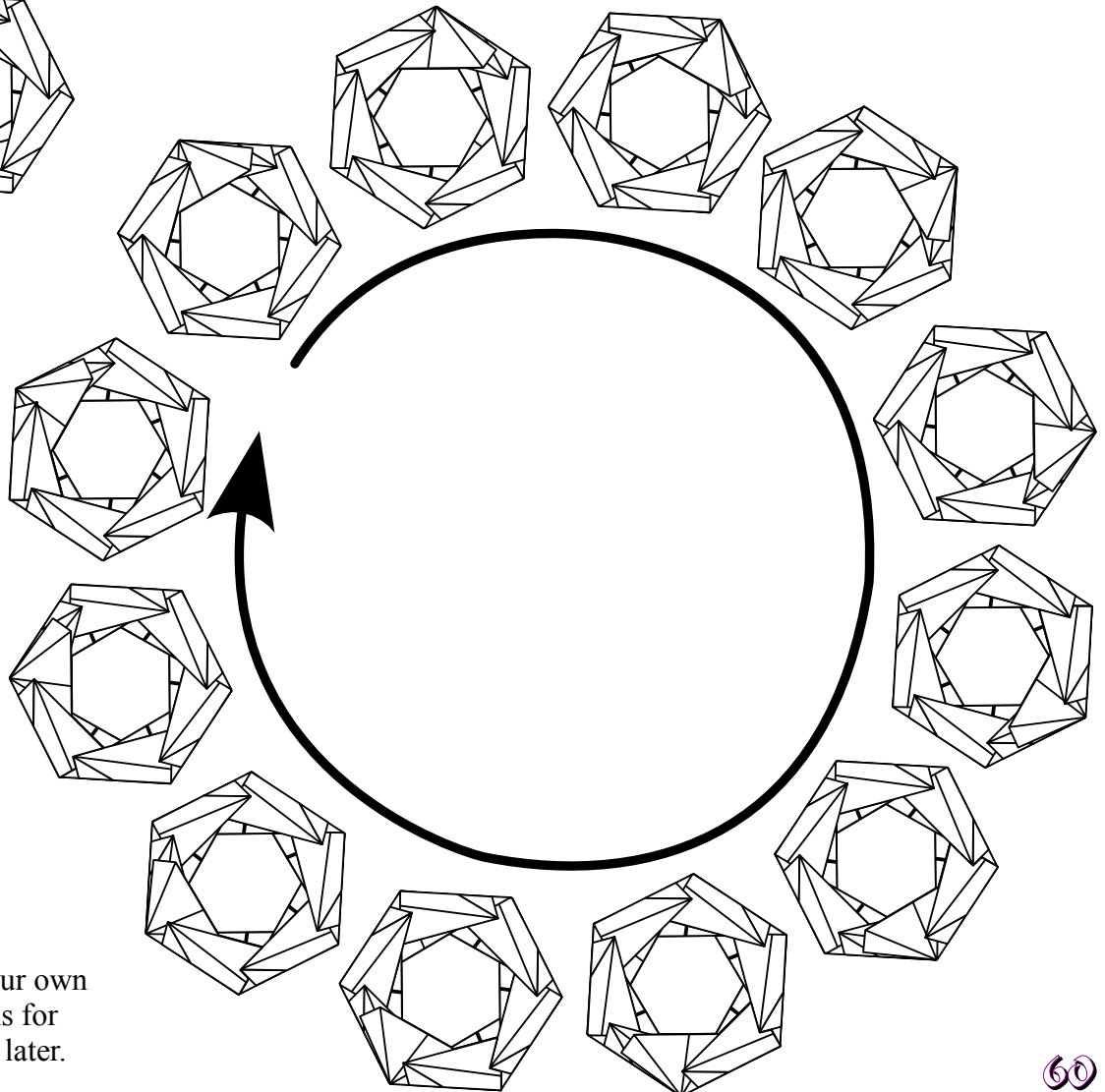
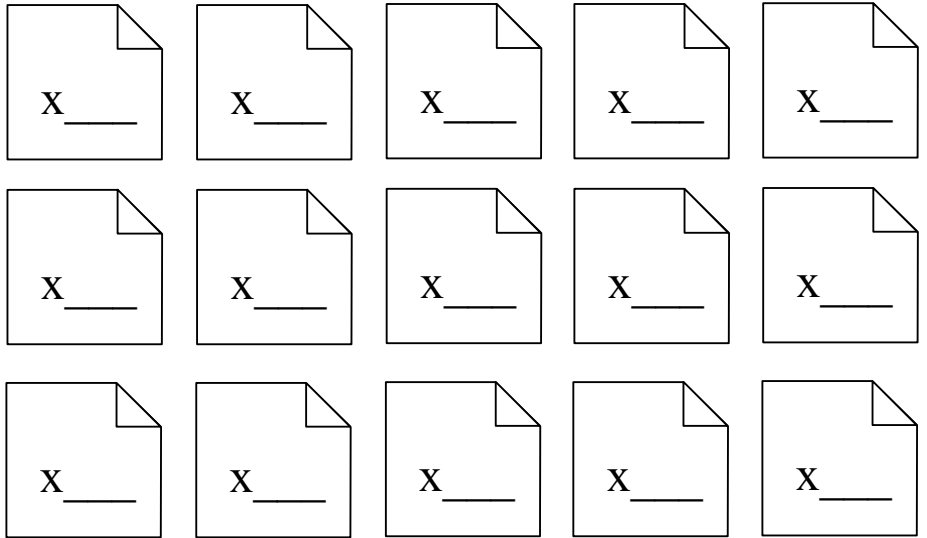
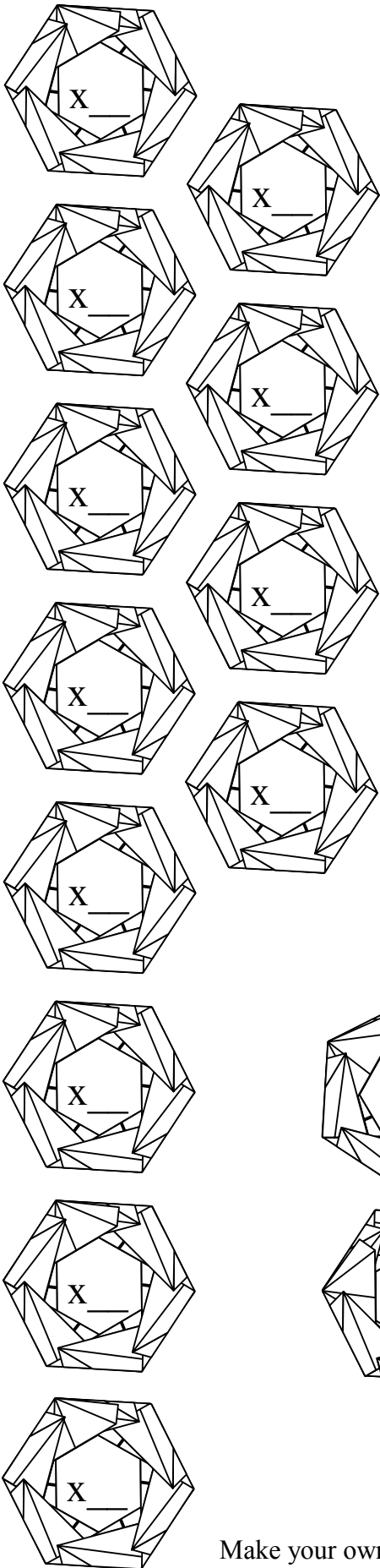


For some patterns, the reverse side becomes the favored front, so here's the back to color and work out new patterns. Cut out on the square to fold your worksheet afterward.



Title: \_\_\_\_\_

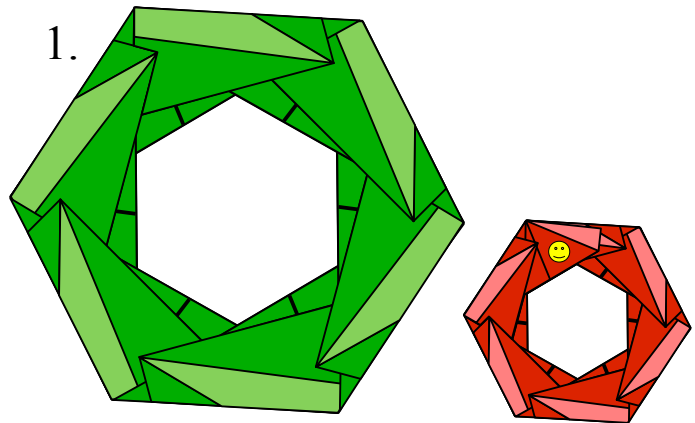
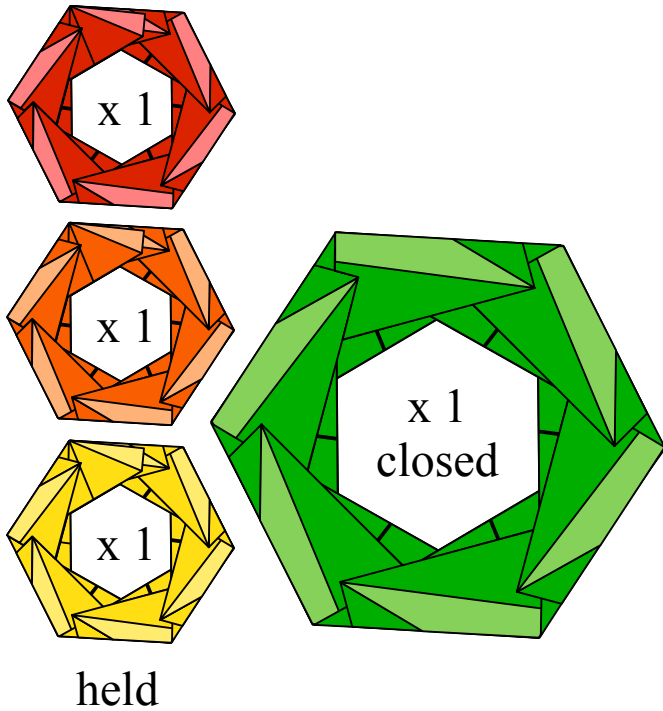
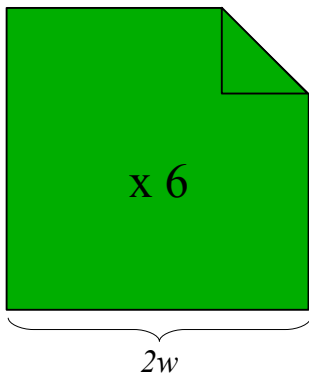
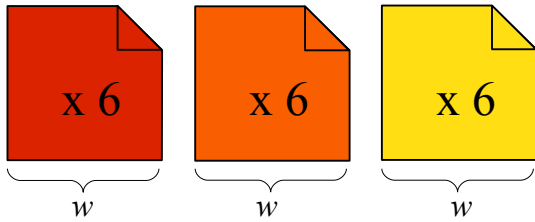
By: \_\_\_\_\_



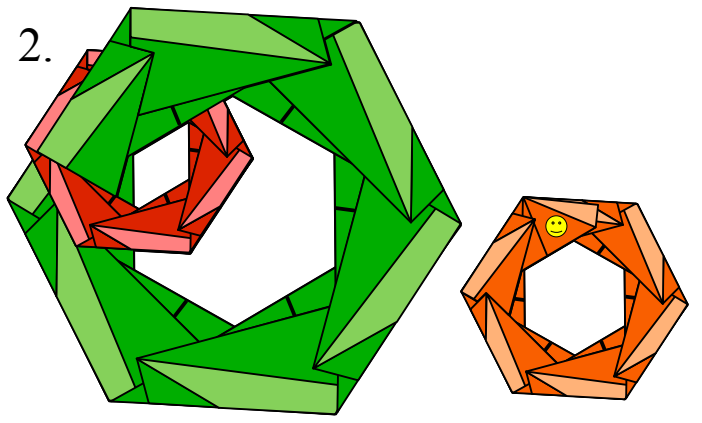
Make your own directions for now and later.



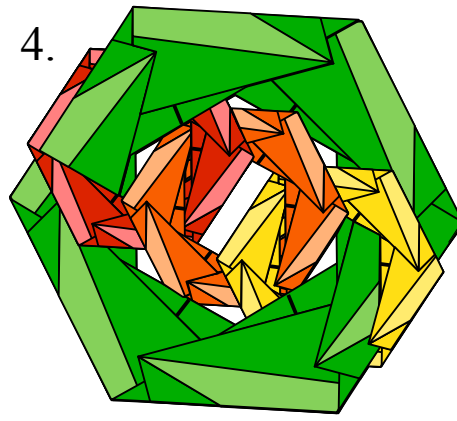
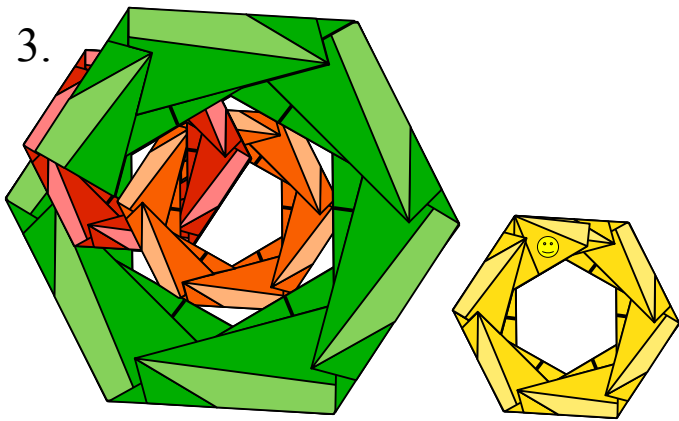
# Ringed Planet



1. Bring the marked end of the red hexagon up through the center of the green hexagon and close the red hexagon around the upper left side of the green hexagon.

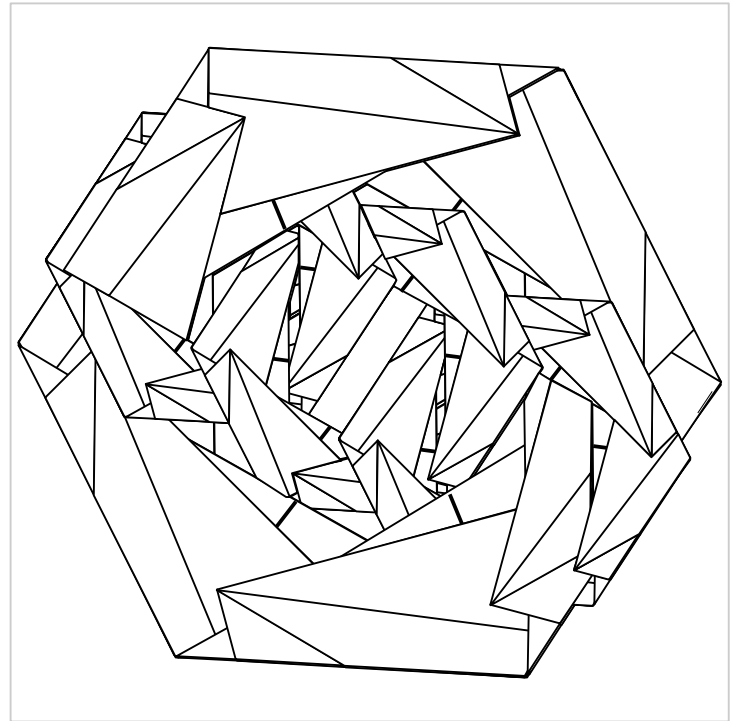


2. Bring the marked end of the orange hexagon down through the center of the red hexagon and close it.



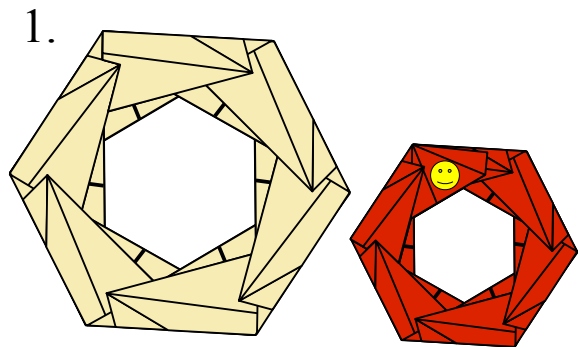
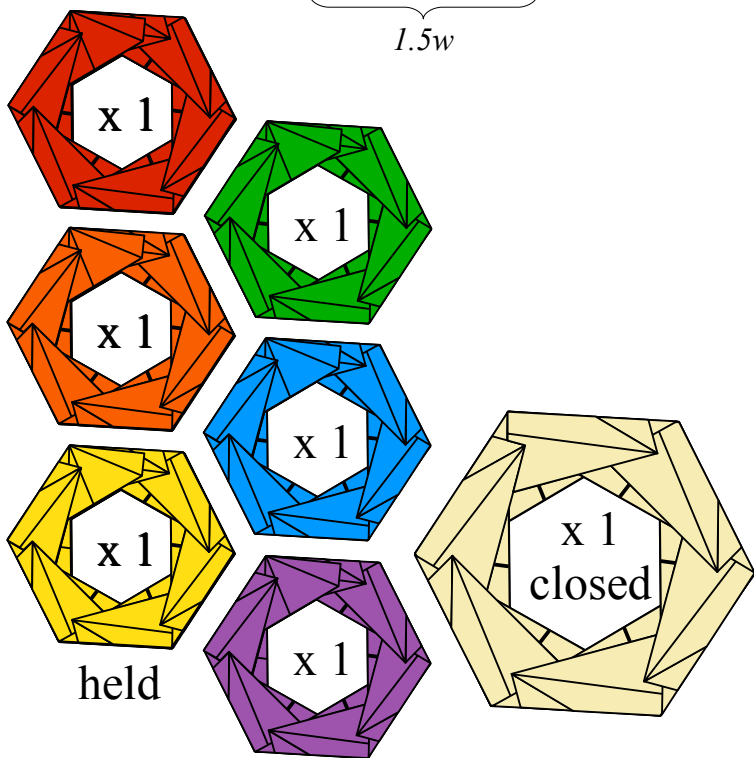
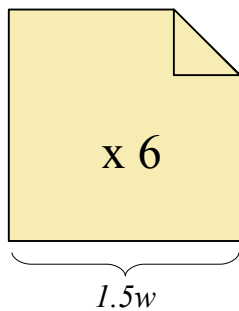
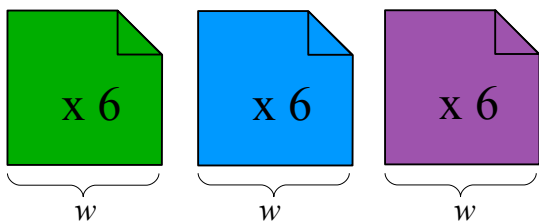
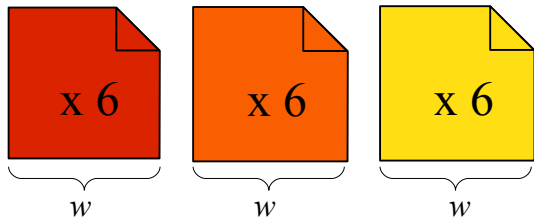
Done!

From behind the green hexagon, bring one unit of the marked end of the yellow hexagon down through the center of the orange hexagon and then up through and over the side of the green unit and close it. The links will retain only a little amount of play.

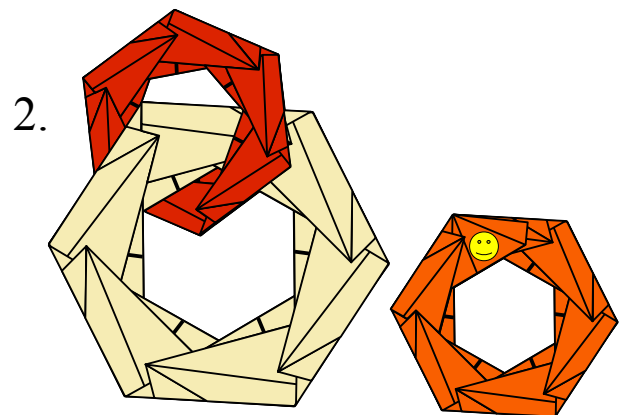


For planning purposes and folding afterward...

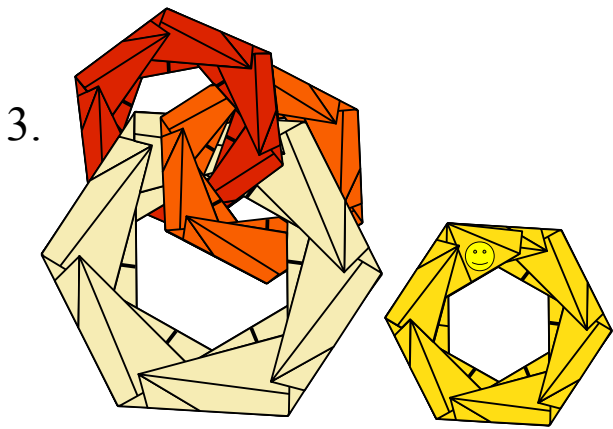
# Chaos Theory



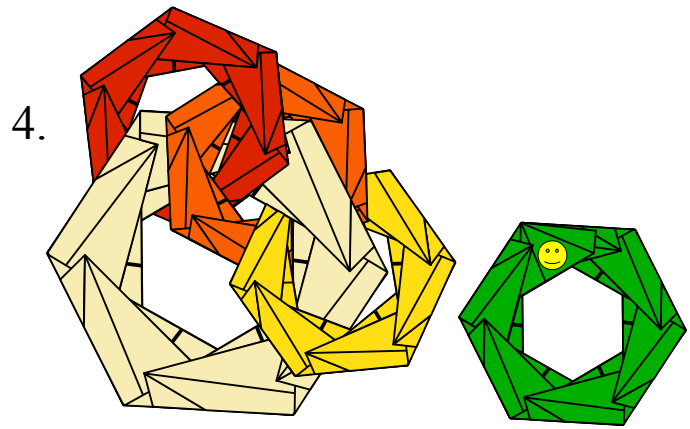
Bring the marked end of the red hexagon down through the center of the white hexagon and close the red hexagon.



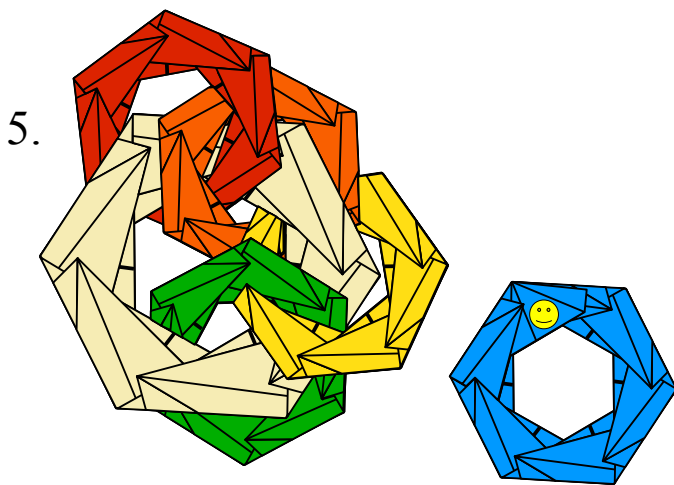
Bring the marked end of the orange hexagon up through the white hexagon and down through the red hexagon. Close the orange hexagon.



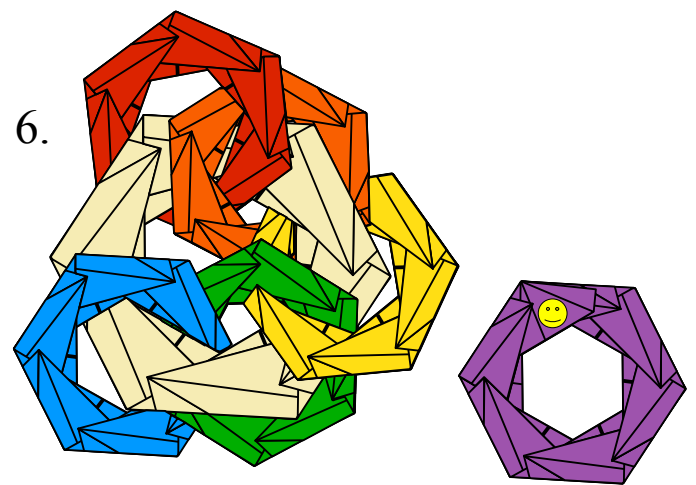
Bring the marked end of the yellow hexagon down through the white hexagon and orange hexagon simultaneously. Close the yellow hexagon.



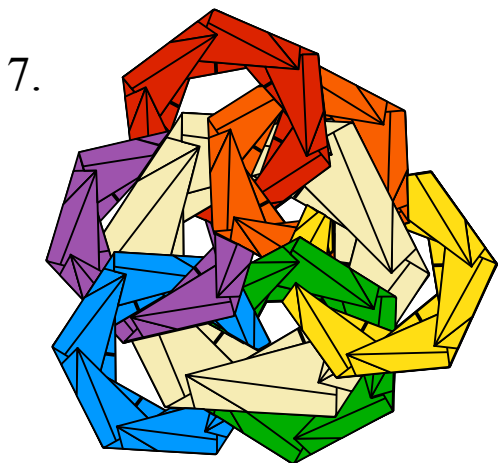
Bring the marked end of the green hexagon up through the white hexagon and down through the yellow hexagon. Close the green hexagon.



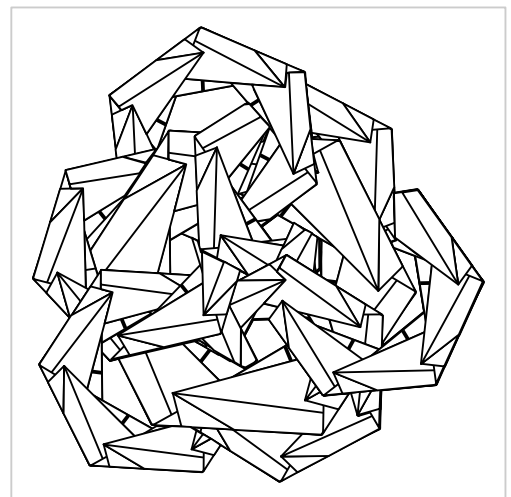
Bring the marked end of the blue hexagon down through the white hexagon and green hexagon simultaneously. Close the blue hexagon.



Bring the marked end of the purple hexagon up through the white hexagon and down through the blue hexagon. Bring the other end of the purple hexagon up through the red hexagon. It may be easier to remove one unit and replace it once the end is threaded through the red hexagon. Close the purple hexagon. Check all the joints and tighten any that have loosened and tweak the symmetry. The rings fit quite but not absolutely tightly.



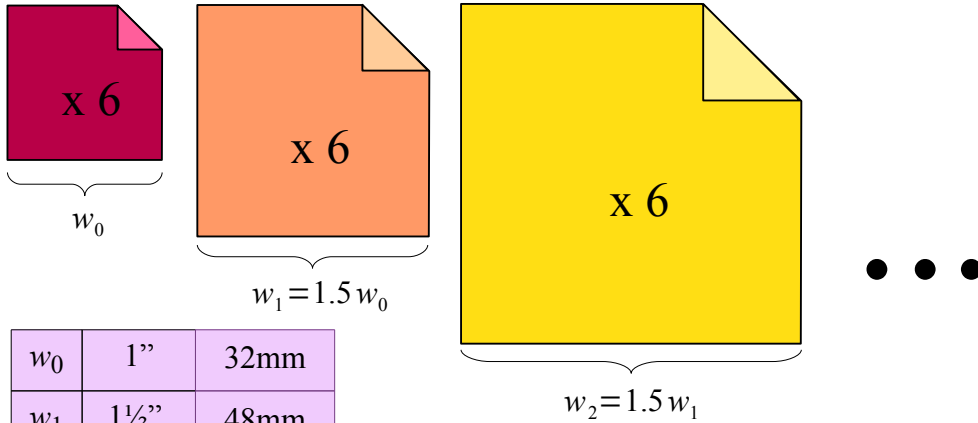
Done!



For planning purposes and folding afterward...



# Nestagon



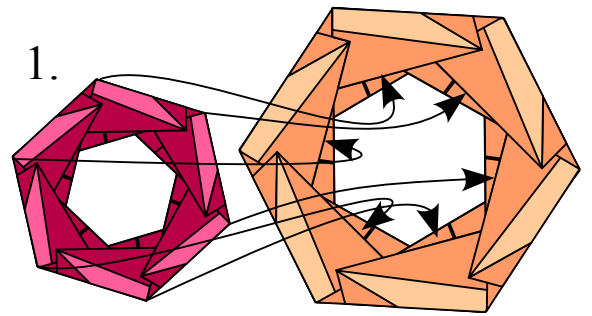
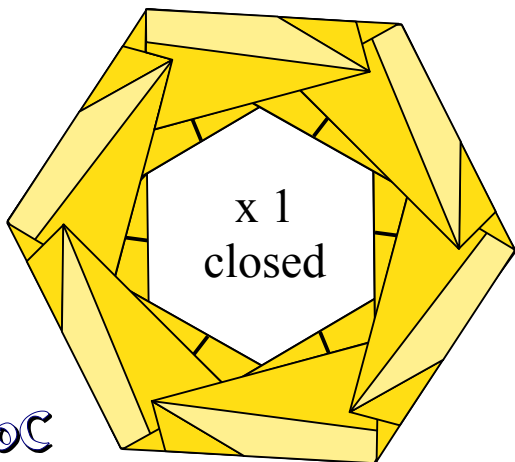
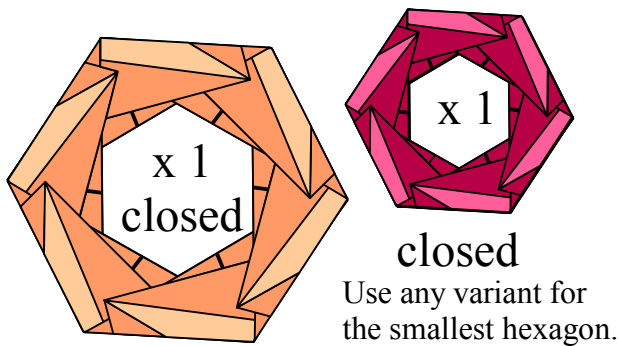
$w_0$	1"	32mm
$w_1$	1½"	48mm
$w_2$	2¼"	72mm
$w_3$	3 ⅜"	108mm
$w_4$	5 ⅙"	162mm
$w_5$	7 ⅒"	243mm

Example progressions

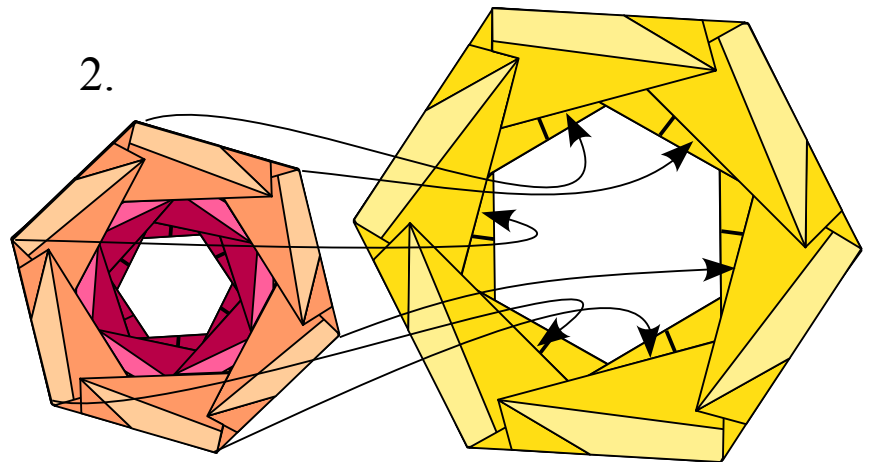
$$w_i = 1.5 w_{i-1} \forall i, 0 < i < n$$

$$w_i = 1.5^n w_0 \forall i, 0 \leq i < n$$

where  $n$  is the number of hexagons

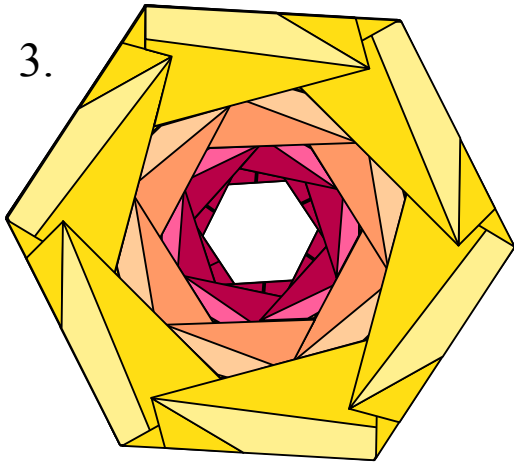


1. Attach the smallest hexagon inside the next smallest, tucking the corners into the pockets.

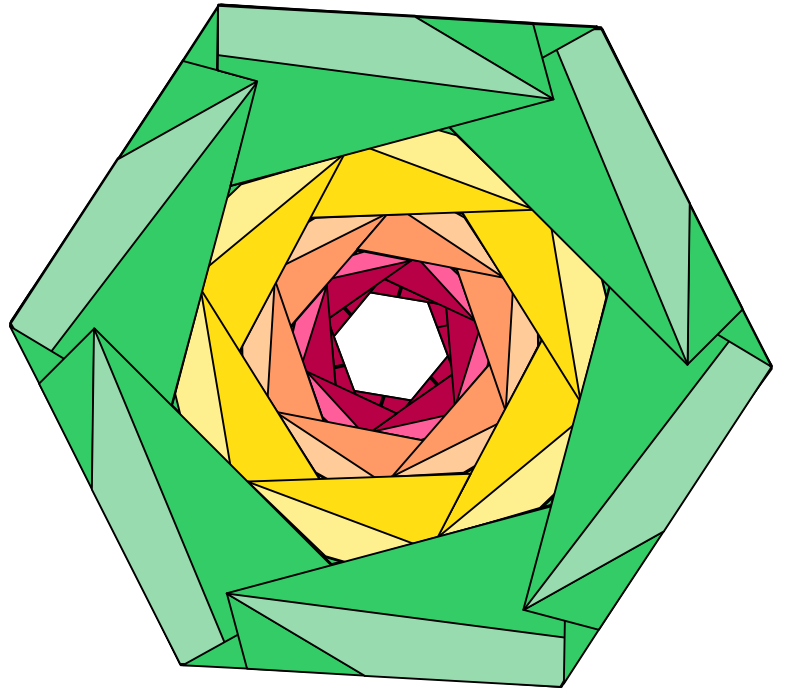


2. Attach the growing nest inside the next larger hexagon, tucking the corners into the pockets. Repeat for all hexagons to complete the nest.

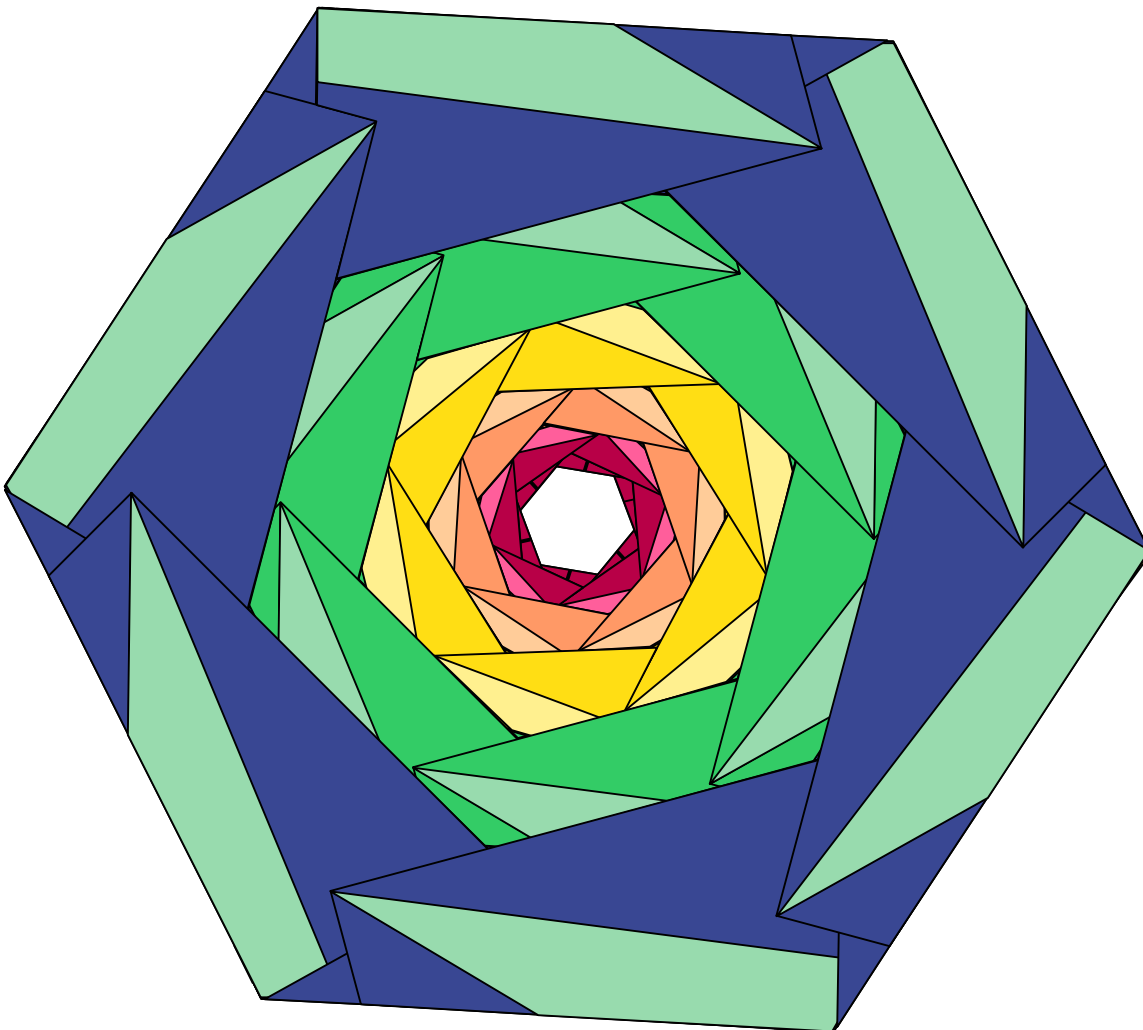
3.



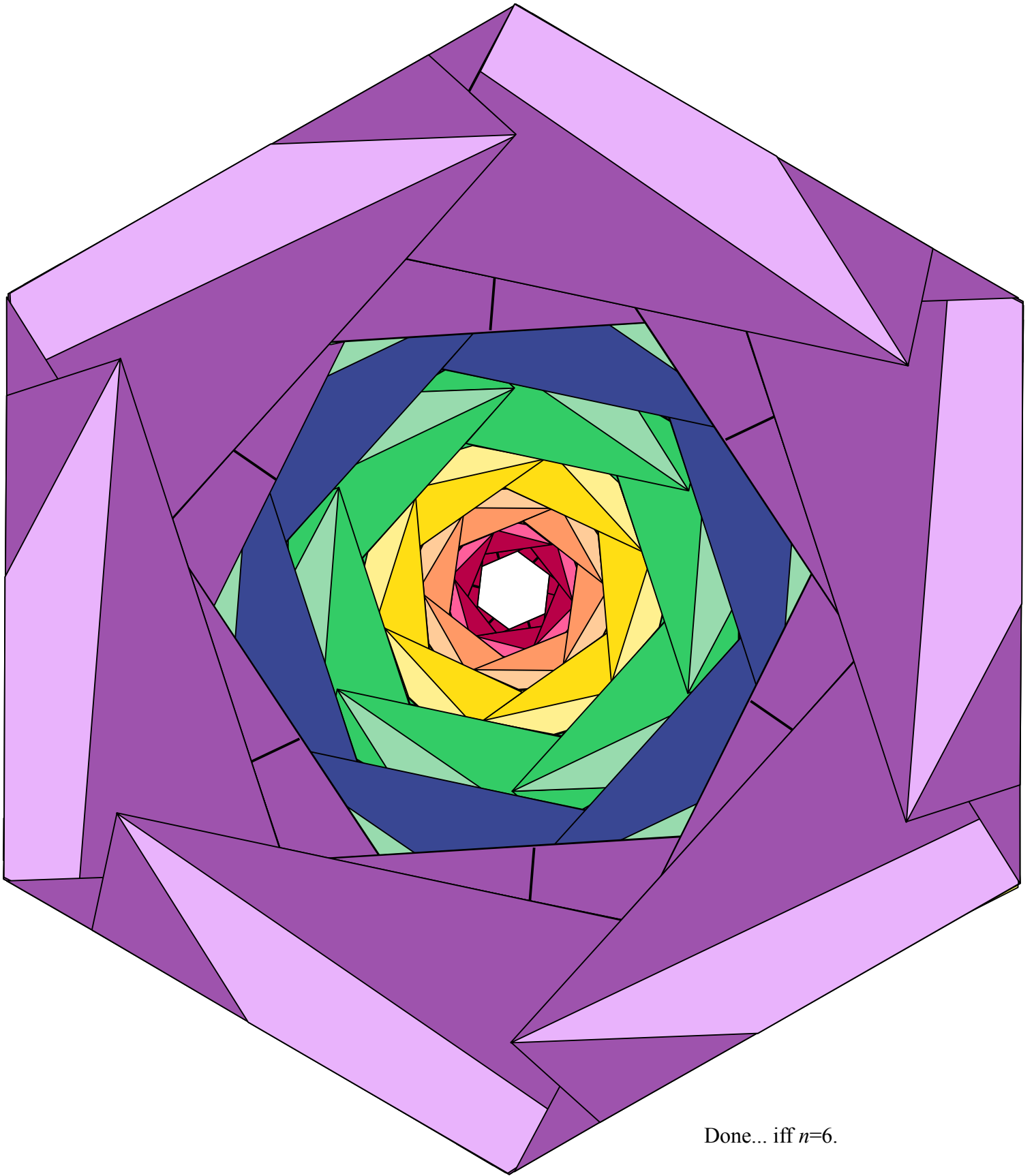
Done... iff  $n=3$ .



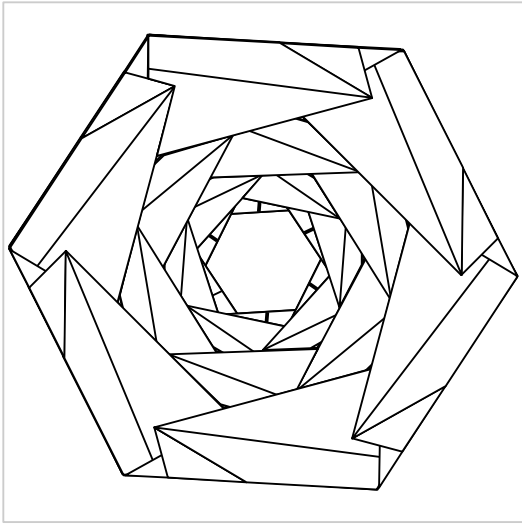
Done... iff  $n=4$ .



Done... iff  $n=5$ .

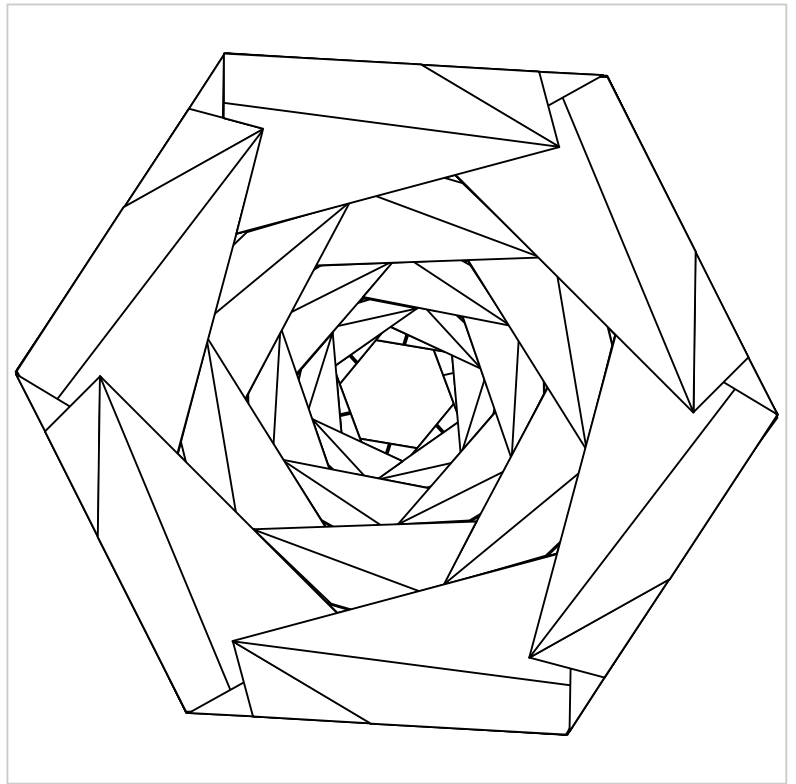


Done... iff  $n=6$ .

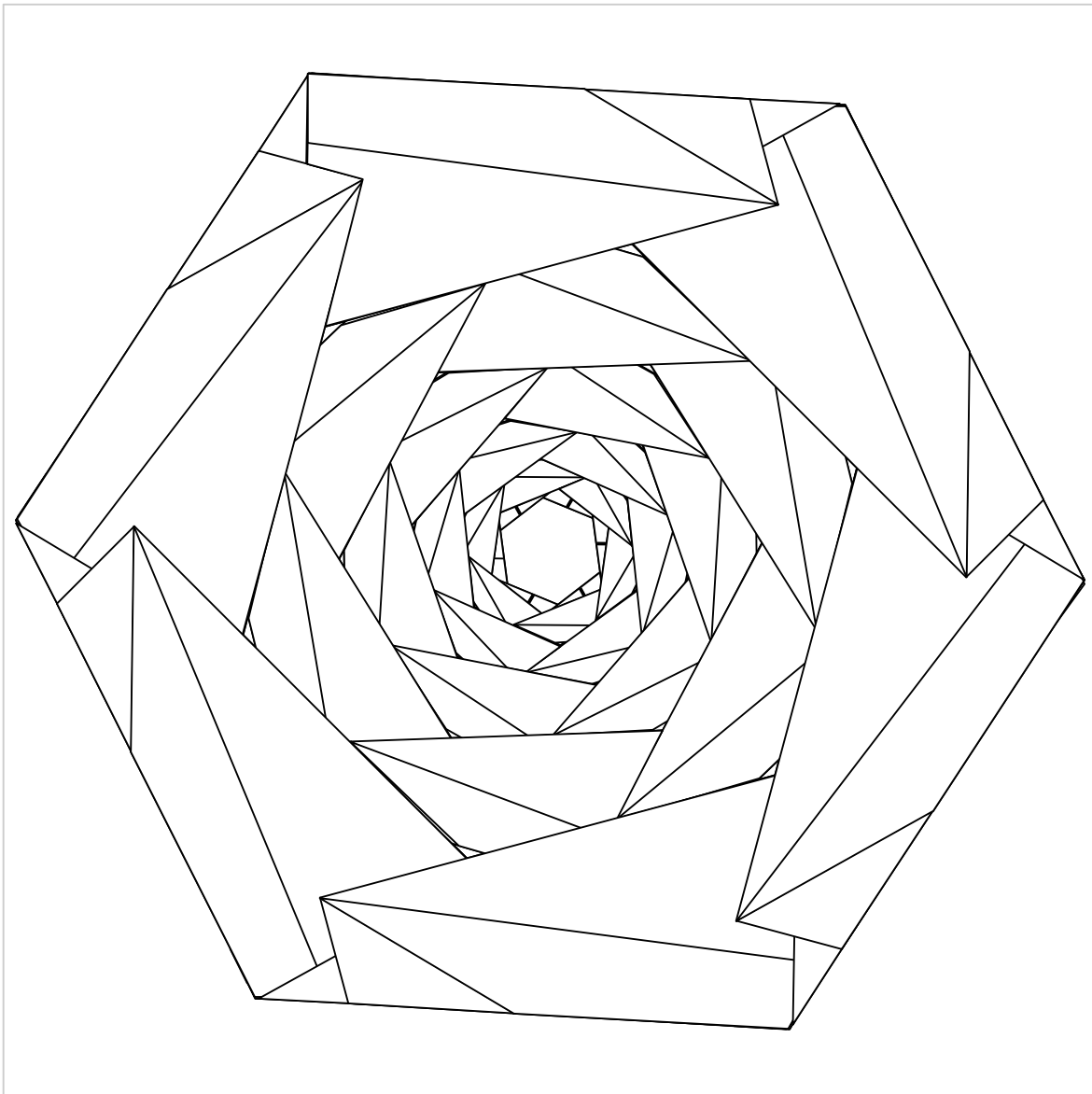


$n=3$

Plan your nests, then fold your expended plans afterward. The squares are centered on the hexagons for convenient cutting.

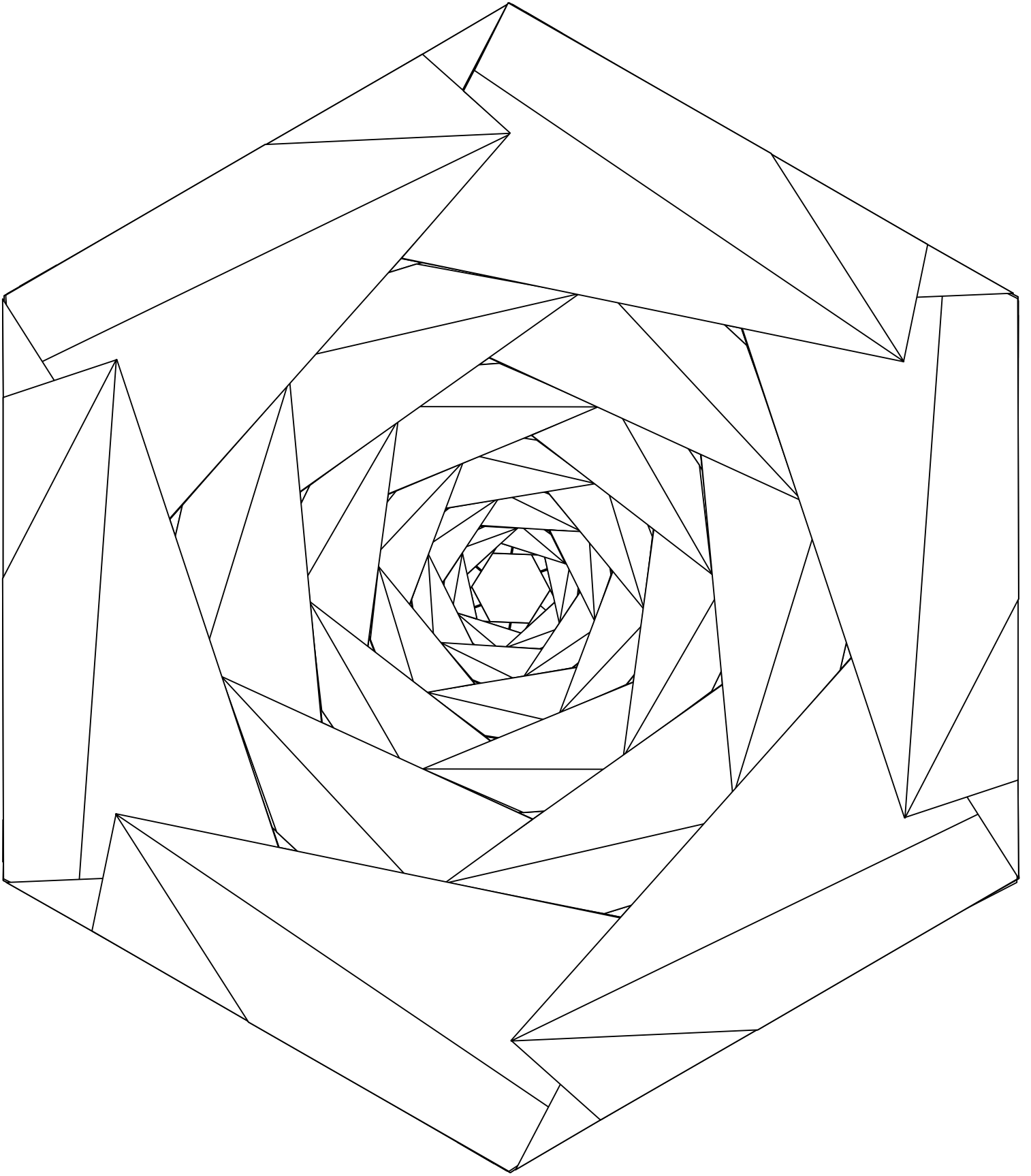


$n=4$



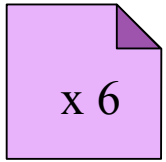
$n=5$





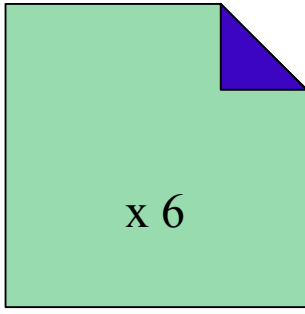
$n=6$

# Starry-Eyed Nestagon



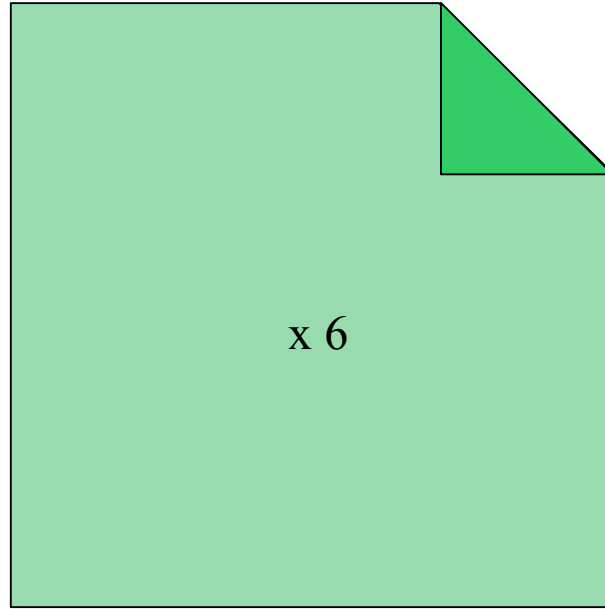
x 6

$w_0$



x 6

$w_1 = 2w_0$  or slightly less



x 6

$w_2 = 2w_1$  or slightly less



$w_0$	1"	1"	20mm
$w_1$	2"	$1\frac{7}{8}$ "	37mm
$w_2$	4"	$3\frac{1}{2}$ "	69mm
$w_3$	8"	$6\frac{1}{2}$ "	129mm
$w_4$	16"	$12\frac{1}{4}$ "	242mm
$w_5$	32"	23"	453mm

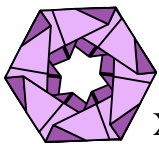
Example progressions

$w_i = 2w_{i-1}$  or slightly less  $\forall i, 0 < i < n$   
where  $n$  is the number of hexagons

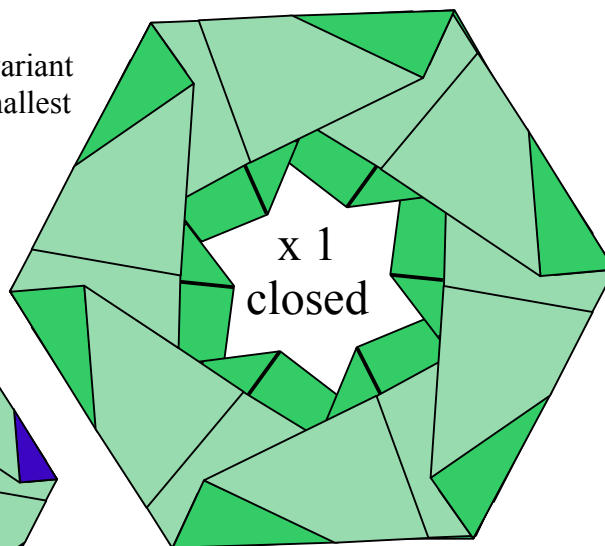
Exactly doubling the size of the squares produces hexagons that are the size of the inner hexagons they go into. Rotated, they catch, but using  $1\frac{7}{8}$  as the multiplier and the rounding slightly for more convenient measuring makes the connection more solid and the slower growth becomes significant and helpful for deeper (higher order) nests.

Hex Vortex, Triple Hex and other possible variants with the non-structural corner likewise flipped center-ward can next in exactly the same way.

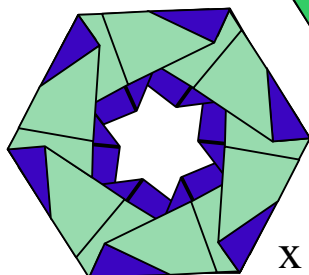
Use any variant for the smallest hexagon.



x 1  
closed

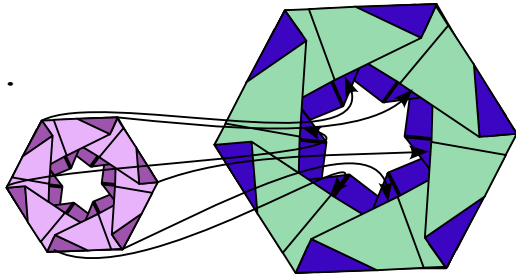


x 1  
closed



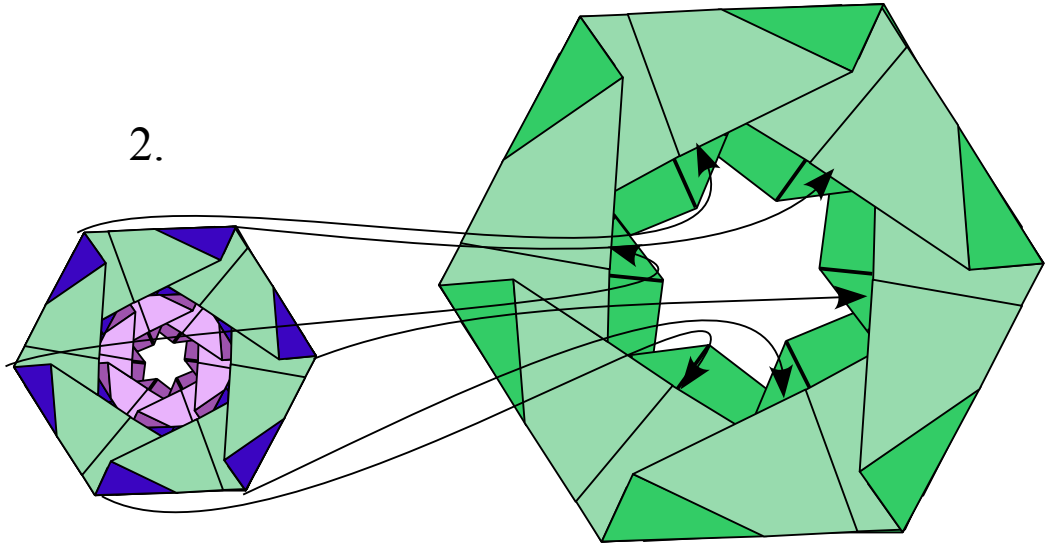
x 1  
closed

1.



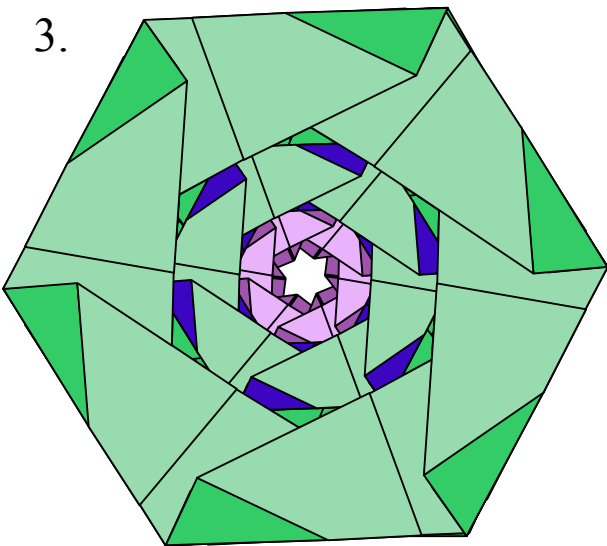
Attach the smallest hexagon inside the next smallest, tucking the corners into the pockets.

2.

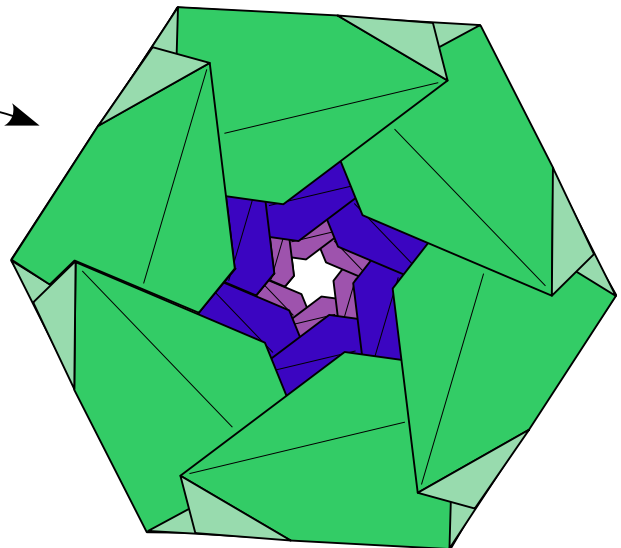
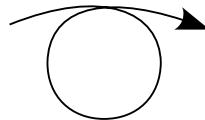


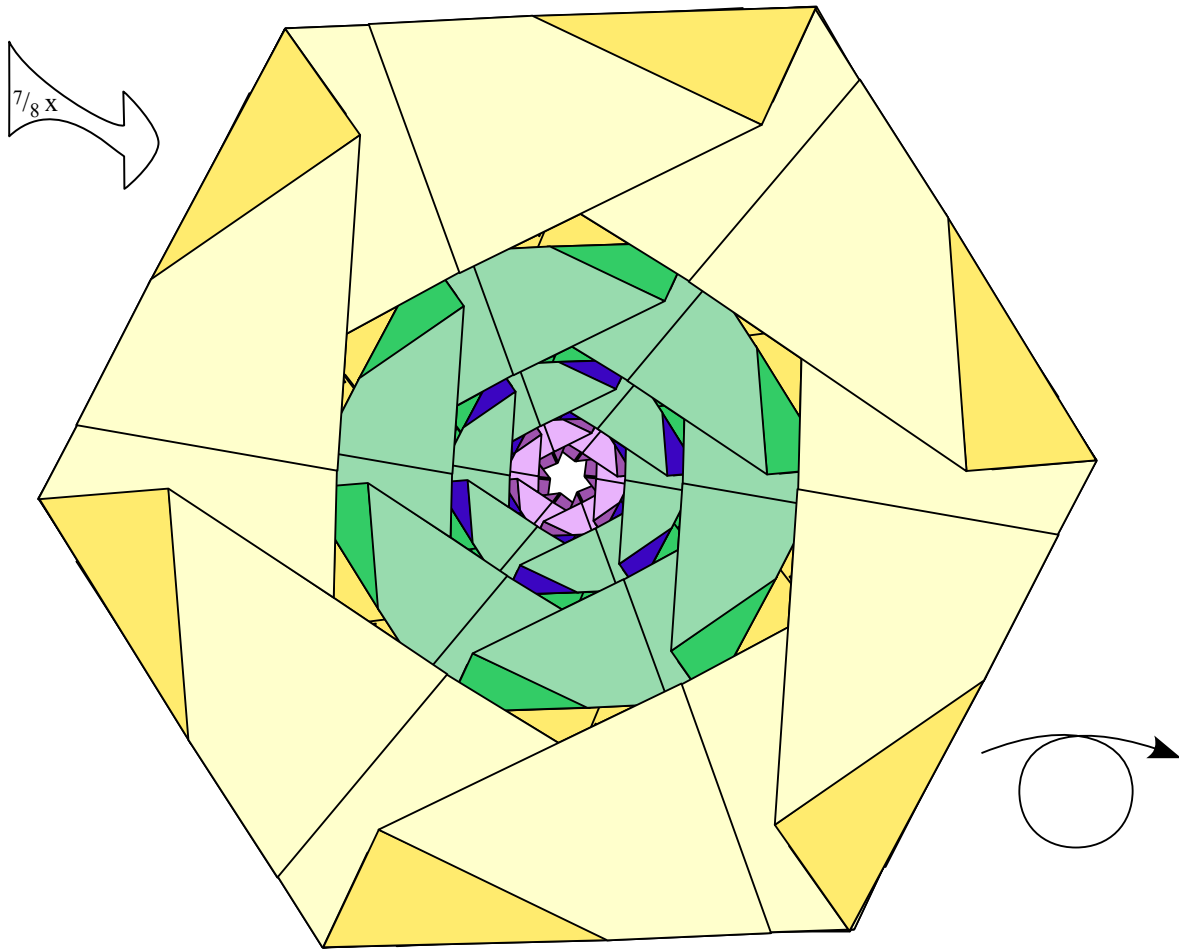
Attach the growing nest inside the next larger hexagon, tucking the corners into the pockets. Repeat for all hexagons to complete the nest.

3.

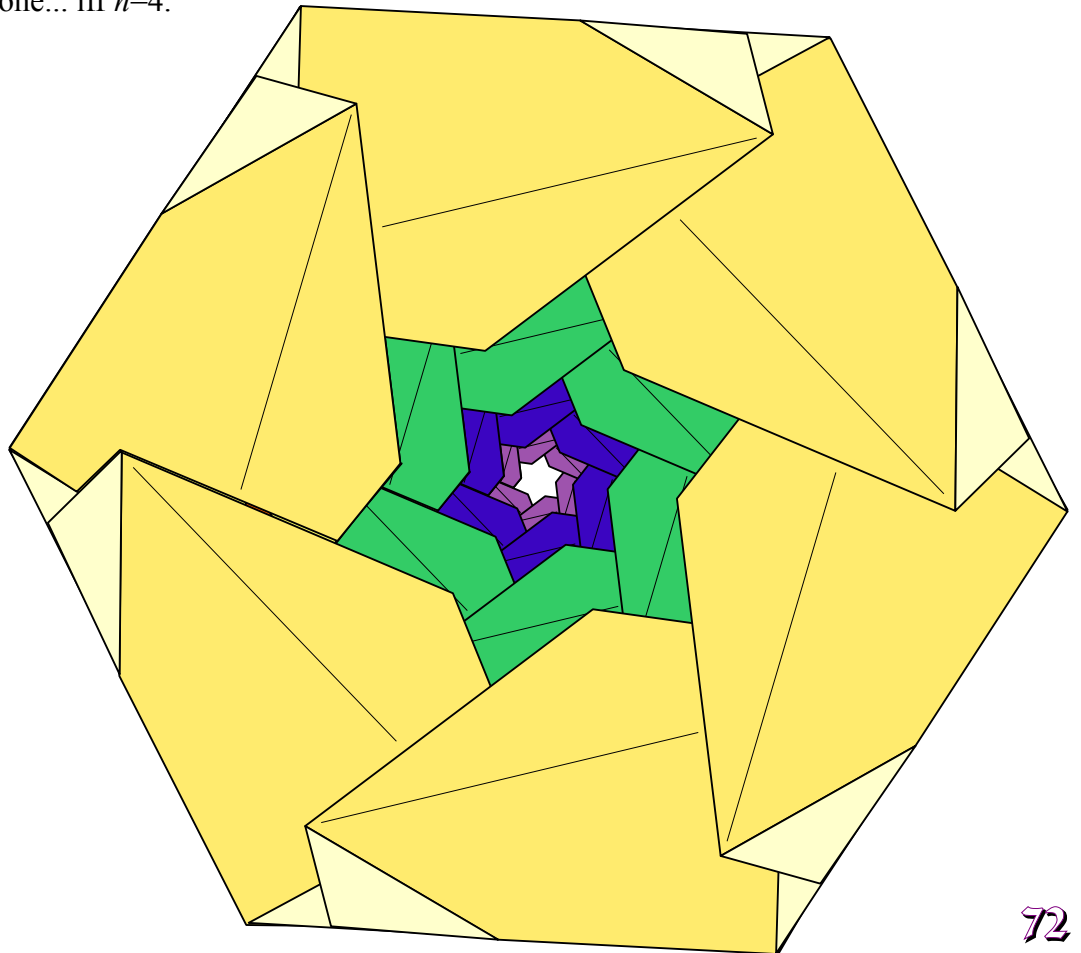


Done... iff  $n=3$ .

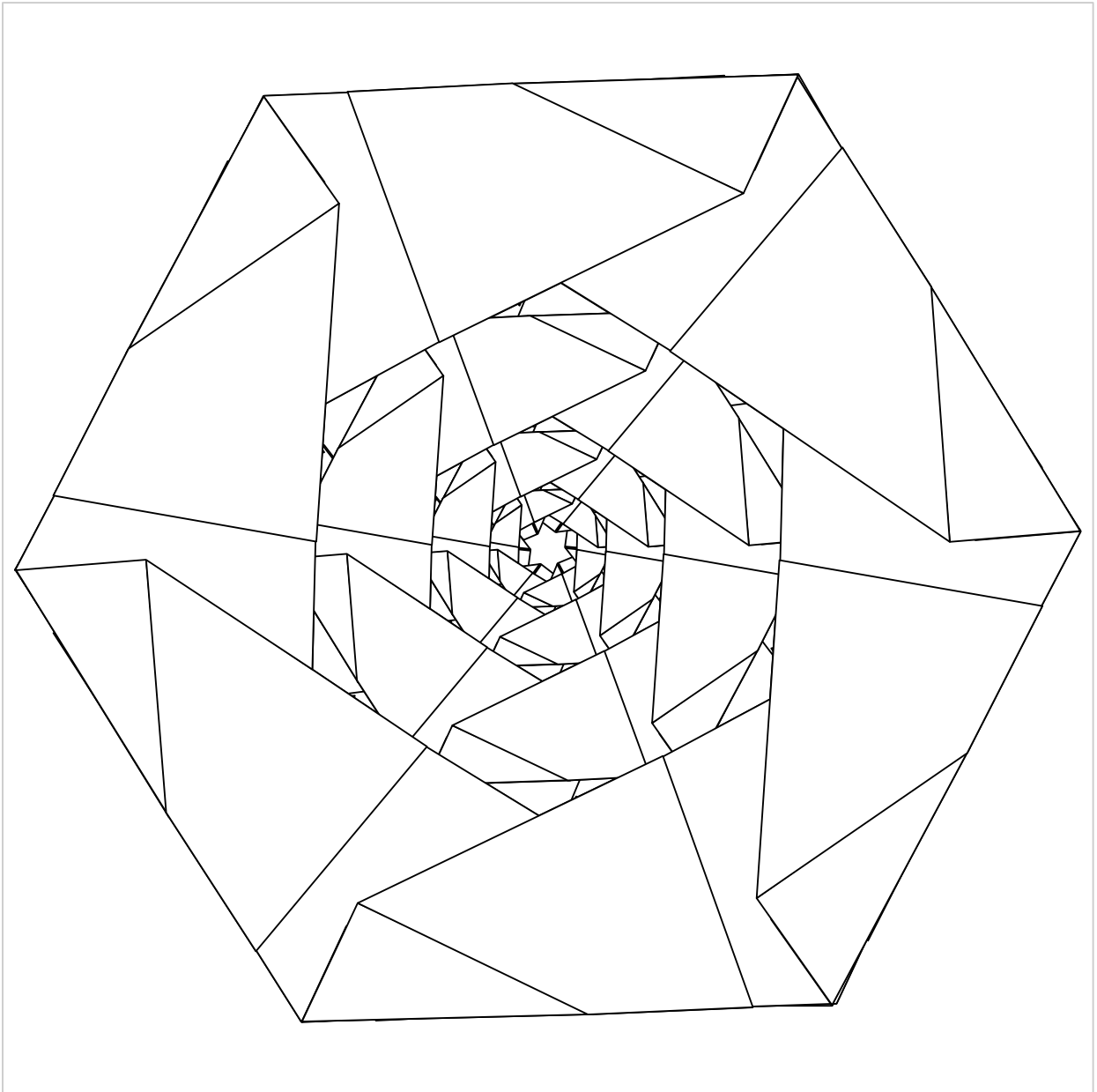
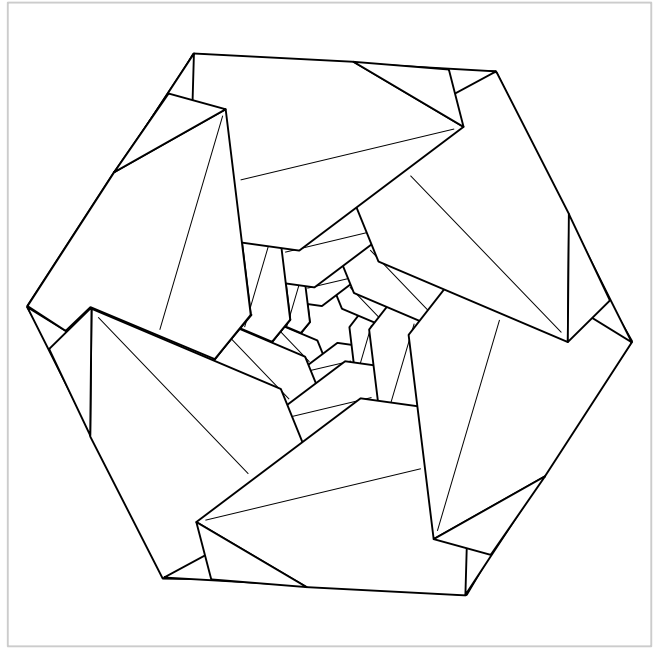
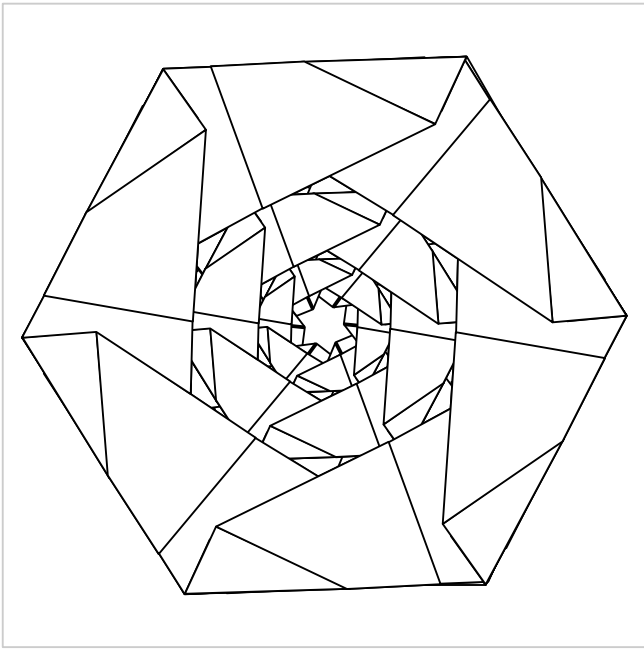


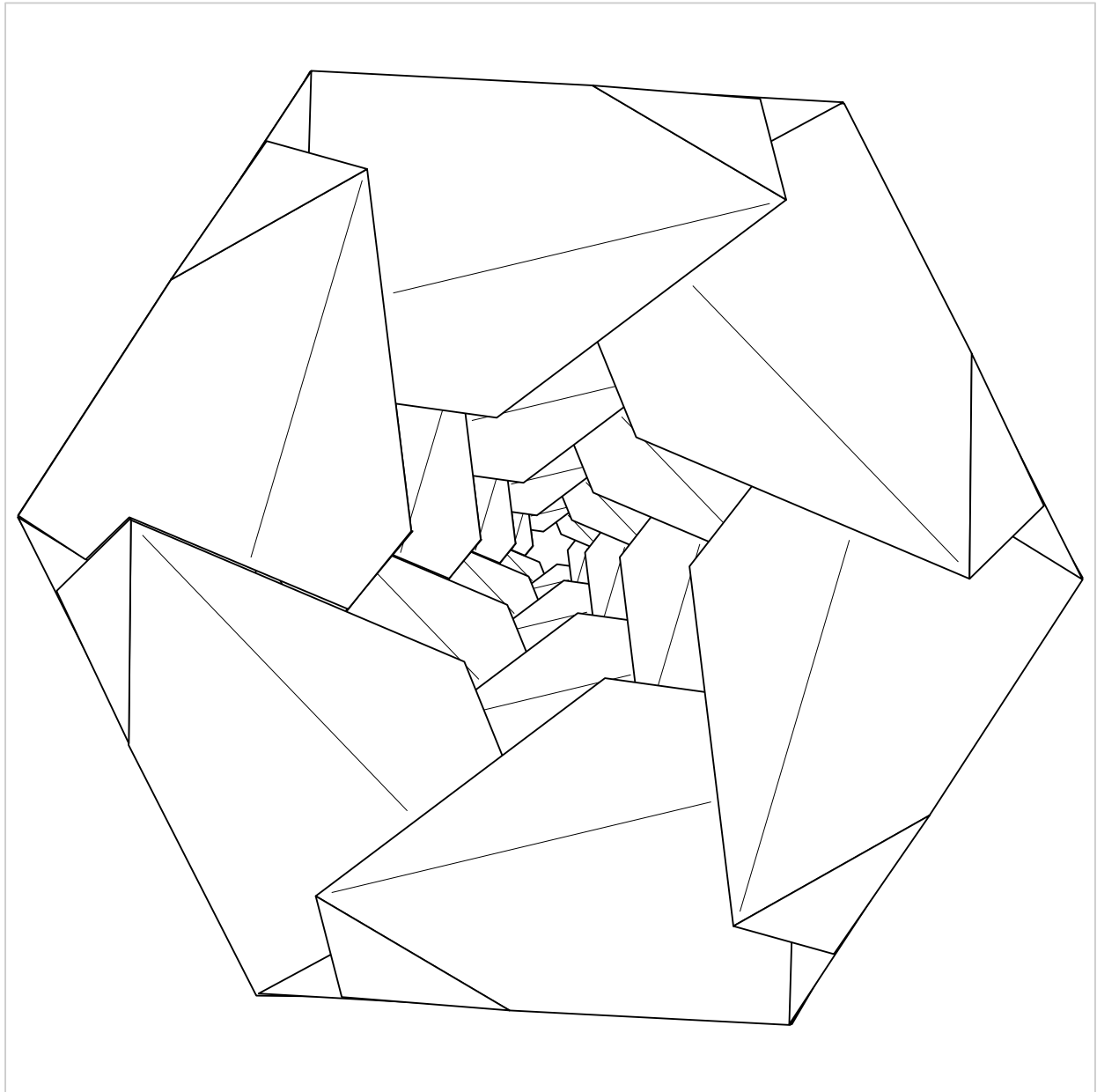


Done... iff  $n=4$ .









These two pages of blank Starry-Eyed Nestagons to help you figure out your own color patterns. Print, color, and afterward the surrounding square makes it easy to re-purpose your plan as a square of origami paper with the pattern centered. The hexagons suggest themselves as a paper shape, too

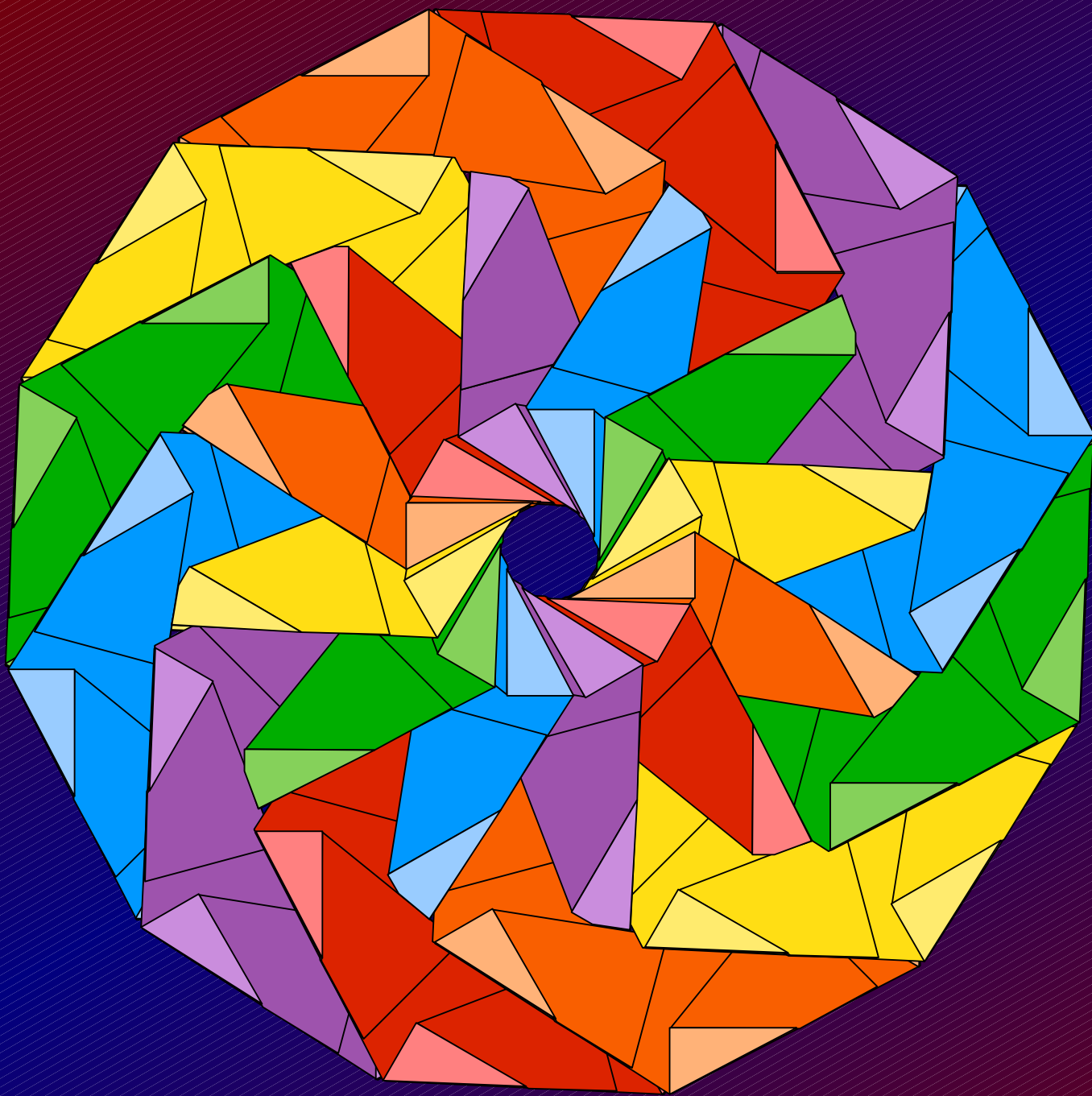
# Extreme Nestagons

## Mix & Match

The Nestagon and the Starry-Eyed Nestagon can use any version of the hexagon at the center even though they use different inner edges to trap the next smaller hexagon. These inner edge hexagons differ in size if not usefulness and calculating the size of paper for the nest larger hexagon differs accordingly *depending only on the type of the entrapping hexagon* and the size of the hexagon to grip but *not* on the type of any smaller hexagon. Therefore, it is possible to mix and match the types of hexagons at each level of a single nest. Just remember to calculate the size with the appropriate formula.

The Starry-Eyed Nestagon includes a comment that Hex Vortex and Triple Hex would build nests the same way as Starry Space. The essential difference goes back to the non-structural corner which is so very useful for decorative variation. The corner is either flipped toward the outer edge of the hexagon or towards its center. This is a binary decision so any hexagon ring that uses units that are all in one category or the other – innie or outie – will have one of these hexagonal pockets and can therefore be used at any level of a nest. These units are mix and match, so some hexagonal rings could use units of both types. Such mongrel rings can always be the center ring. If every second ring is an innie or an outie, the hexagon may still be able to grip a smaller hexagon by three non-adjacent corners.

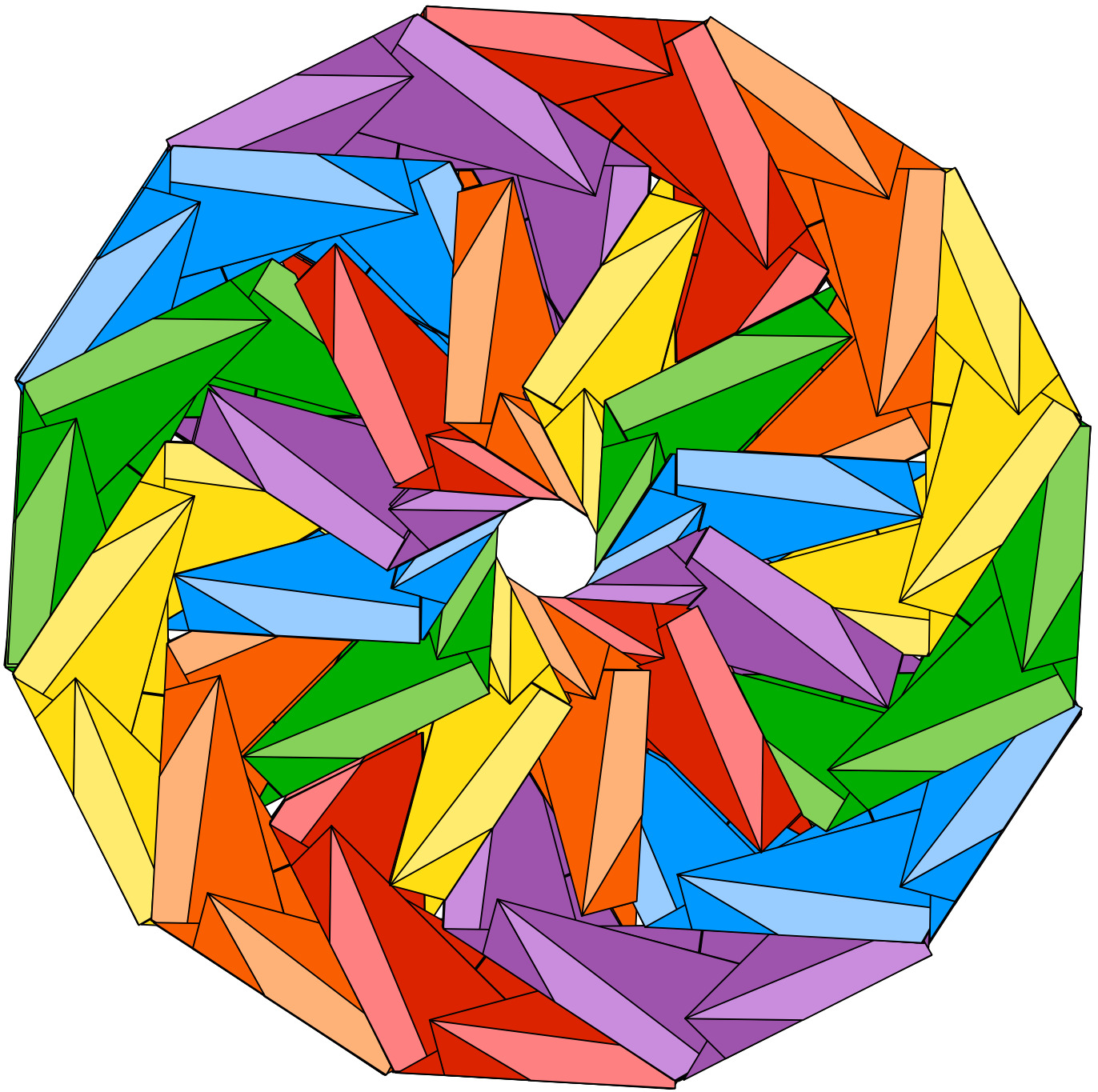
So much to explore...

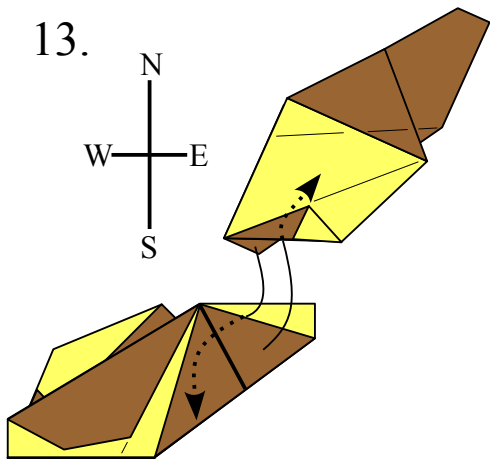


The End

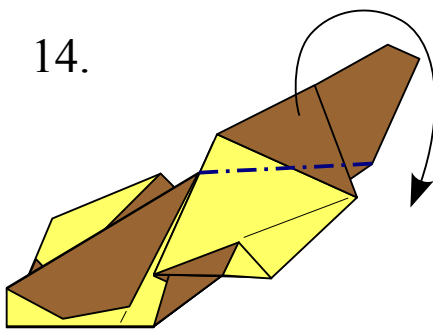




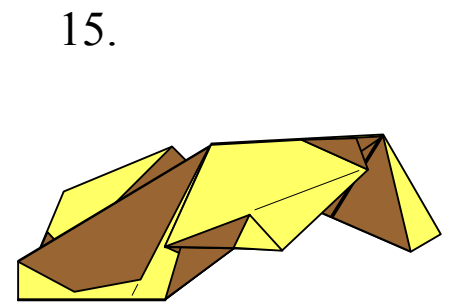




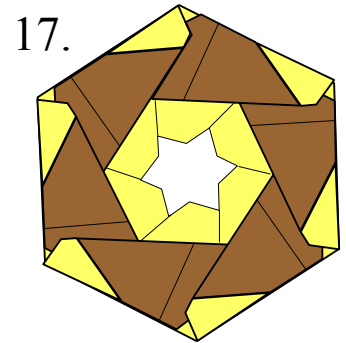
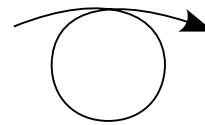
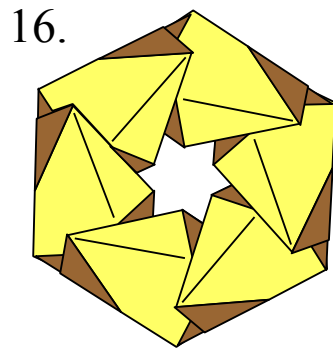
Slide the units into each other, interleaving the layers of paper with the top layer of the northern unit on top



Mountain fold with the existing crease from step 4.



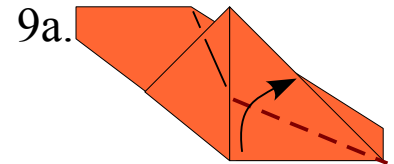
Turn over and continue adding units counterclockwise. Temporarily opening step 14 will let you work clockwise instead.



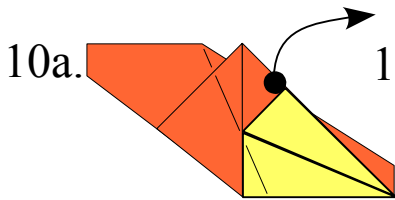
# Triple Hex

and Other Variants

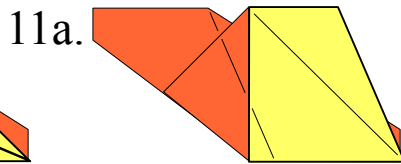
Steps 9-12 provide decoration independent of structure. *Many* variations are possible. Here are a few to get you started. Assemble them the same way as Starry Space. Mix or match in each hexagon.



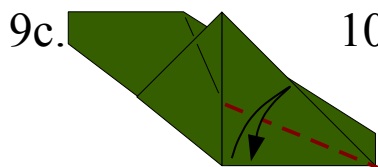
Bisect the angle.



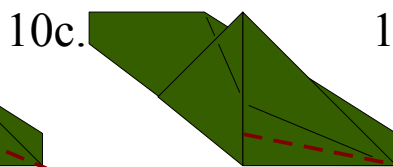
Unfold one crease.



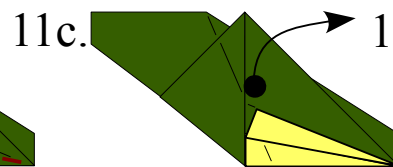
The Triple Hex unit. Fold 6 and assemble like Starry Space.



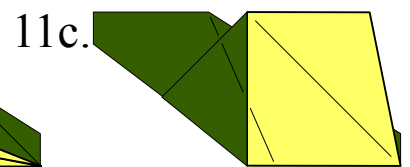
Bisect the angle.



Bisect the new angle.

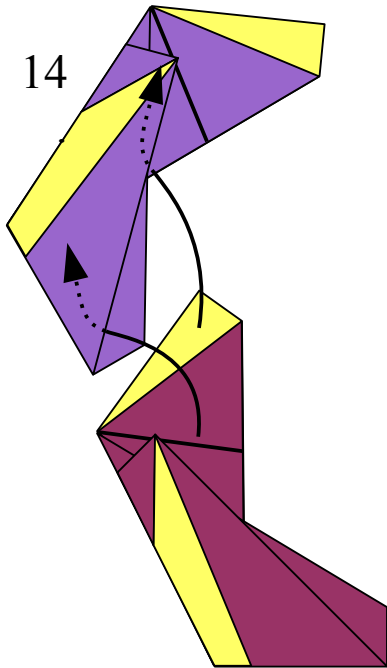


Unfold one crease.

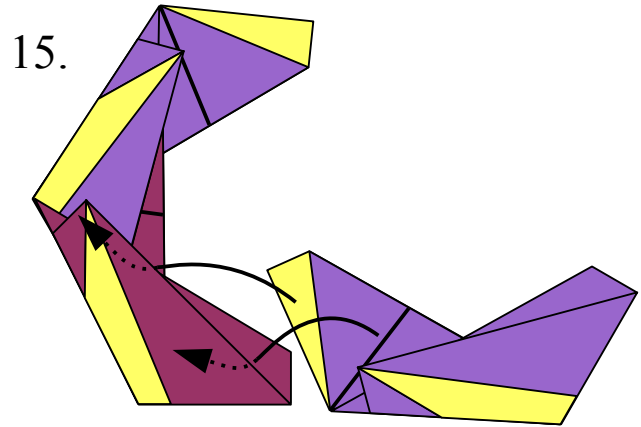


The 4<sup>th</sup> variant. Now create your own!

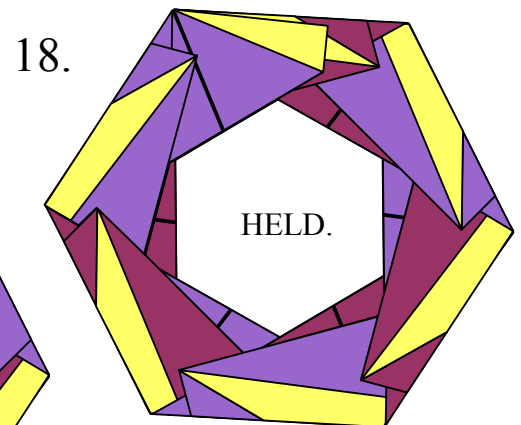
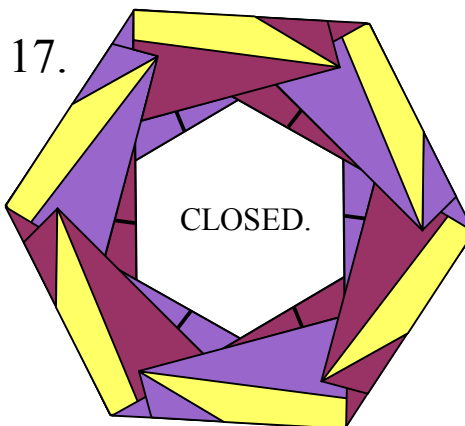
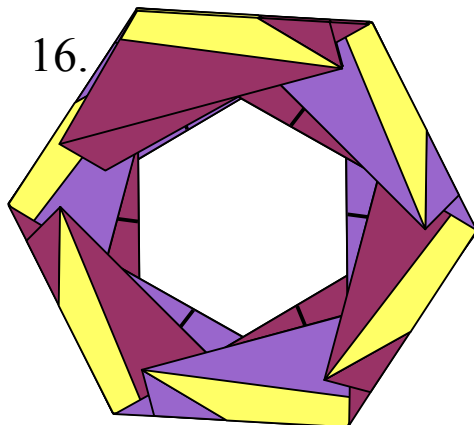
# Assembly



Slide the units into each other, interleaving the layers of paper. The mauve flap with the colorful square corner which is sandwiched between layers of its own flap goes into the pocket of the violet unit. The back flap of the violet unit goes behind the mauve unit. It doesn't quite fit right if you put it in front of the yellow square corner showing on the mauve unit.



The new violet unit overlaps the other violet unit and should land on top of it. Add the other three (3) units in the same manner. If you are making a single ring, also close the ring in the same way. For a Ring of Rings, leave each individual ring open to link it with other rings, but it likes to spring and fall apart, so push the top end behind the other end so tension holds it temporarily.



To make a lone ring, close the ring in the same way. For a Ring of Rings, leave each individual ring open for now, but tuck the top end behind the other end for a temporary hold.