



**Outside-theLines Lesson Designs®**

**Scott Cummins**

[www.outside-the-lines.com](http://www.outside-the-lines.com)

# Teacher's Resource

## Tessellating Design

### Objectives:

Students will experiment with tessellation and create a finished design using tessellating shapes they have created.

### Materials:

- Handouts
- pencil
- scissors
- transparent tape
- straightedge (optional)
- felt marker
- colored pencil
- Other colored media (optional)

### Instructions:

Discuss the concept of tessellation. Perhaps showing some examples of different artworks and artists featuring tessellation. Here are some points to include:

- Tessellation is a design composed of shapes which repeat in pattern. The shapes are special in that they fit together with no gaps or overlaps.
- A simple example of tessellation is the checkerboard pattern created by ceiling or floor tiles. The word "tessella" means "tile".
- Strictly speaking, tessellations are very rigid but some artists design their tiles to gradually change as they repeat across the surface.

Make copies of the page 3" **Tessellation Squares** for the students to use. Copying these to heavy paper is ideal but regular paper will work as well. Each sheet can be cut into six squares. Stress the importance of being very precise when cutting the squares. Younger students may benefit from using precut sheets. I also suggest one provide copies of the **Tessellation Sketch** and the **Creative Tile Worksheet** handouts.

Go over, or preferably, demonstration as many of the tile cutting and assembling techniques as possible. Use transparent tape to assemble the tiles. I usually make a booklet of pages 7-26 and provide one for each student or each table. For less experienced students, one may choose to

leave some of the more advanced techniques out and concentrate on translation or the lettering variations. More advanced or older classes will benefit from trying all the techniques.

Later, when it is time to choose a shape and develop it, the more tiles a student has to choose from, the better.

With my 7th and 8th grade students, I usually insist that each student create at least one tile using each of the methods described. A significant part of the creation of this design is luck. Except in the case of the most advanced students, it may be best if students don't waste time trying to create a certain object but rather, just create as many random tiles as possible to increase the chance of success.

- **Translation**
- **Rotation**
- **Reflection**
- **Single-cut Translation**
- **Modified Translation**
- **Translation/Reflection**
- **4-Square Method**
- **Symmetrical**
- **Lettering Tile**

When they have most, if not all, of these, begin directing the students to start the process of choosing a tile to develop for their design.

This is the most challenging part of the process for most students.

## Instructions:

Suggest that the students lay out all their tiles and begin looking for recognizable shapes and objects suggested by the random shapes. Remind them to flip and rotate the tiles and look at them from every possible angle. One has to be flexible and willing to recognize very abstract versions of objects. One strategy is to have students complete the **Creative Tile Worksheet** handout before proceeding as an exercise in creativity. I usually run these pages front-to-back to make a single sheet.

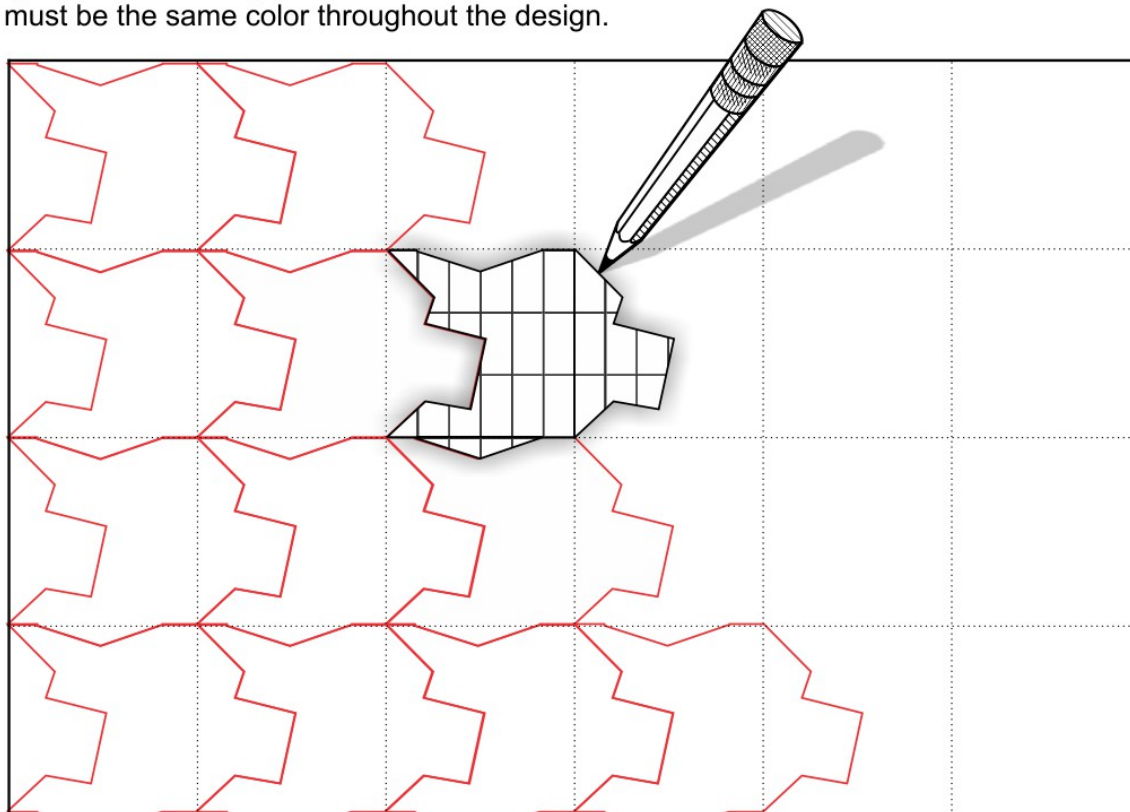
Students may need to be reminded that they can't trim away the parts they don't want.

This is a good time to explore the **Interpreting a Tessellation Tile** handouts. There are many strategies suggested for coming up with ideas for the tiles. Encourage your students come up with a recognizable subject matter if possible. As a last resort, a non-objective design could be created in the tile. In other words, just a design. Another alternative are the lettering tiles. For example, a tessellation of the student's name. Or even more than one word from the same shape. A student's first name and then their last name upside down in the adjacent tile, etc. When sketching ideas, students should trace their tile to a sheet of paper and avoid drawing directly on the tile.

Once a design is settled on, students will begin to layout the pattern on a background sheet. I use 12x18 white paper in my class. Students should create a 3x3" grid on the paper (horizontal or vertical). There are many ways to execute the design. In my classes, I prefer to have the students trace/draw to the paper and color it with some kind of alternating color scheme in a combination of marker and colored pencil. Another way would be to actually cut the tiles from colored paper and then assemble it and add the details with marker. Either way, stress the importance of making a grid and assembling the tiles aligned with the grid. **Students will be tempted to simply trace the piece and attempt to just stack the traced shapes one against the other. This is not the best way to get consistent results. The tiles will gradually move more and more out of place unless the grid is used as a guide.**

I also prefer to have the students create a border around the edge of their paper and color it solid black to give it a finished look.

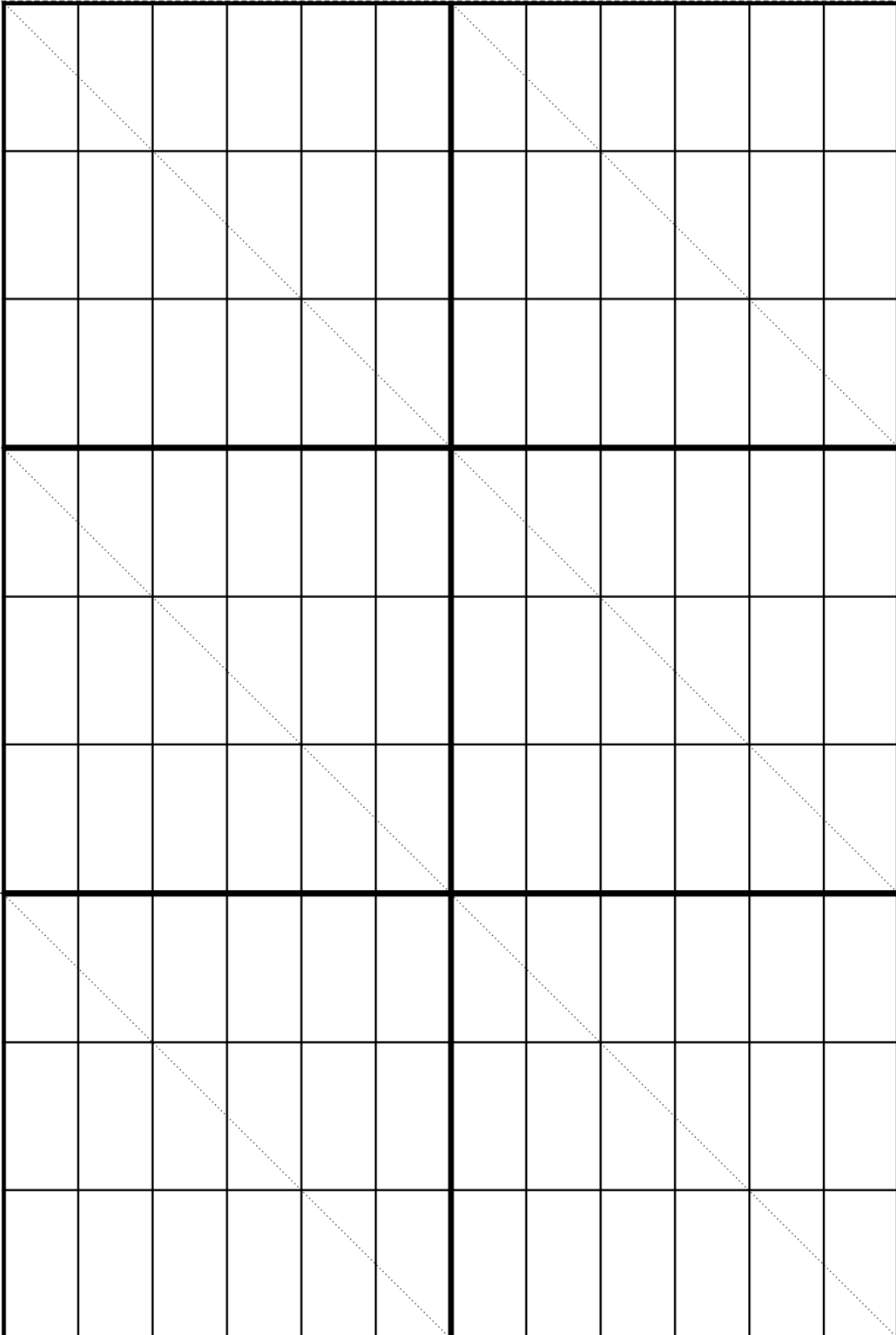
Encourage the students to give careful consideration to their color scheme. There is no reason why the images must be the same color throughout the design.



# 3" TESSELLATION SQUARES

Use the 6 gridded squares here to cut into tiles.

Cut on the bold lines to separate six individual squares.



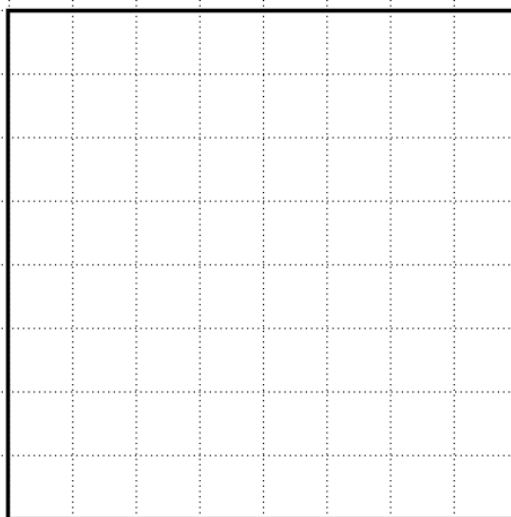
Printing this sheet on cardstock or heavy paper is ideal for cutting and assembling sturdy tile templates.

Outside-the-Lines Lesson Designs



# ***TESSELLATION SKETCH***

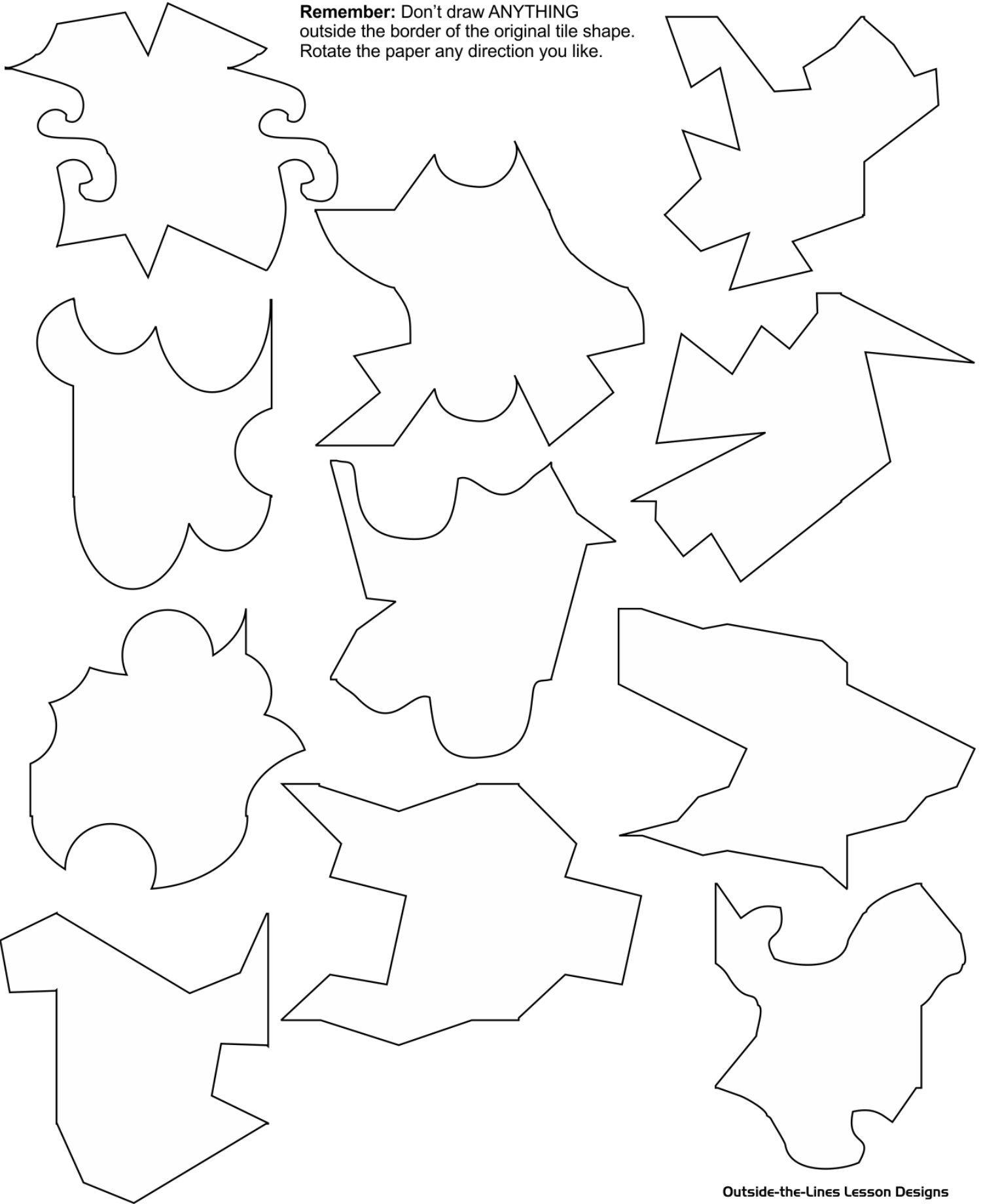
Use this sheet to sketch a tile idea. This sheet is not intended for actual cutting. This handout may also be used to trace a created tile in its pattern to be certain that it functions correctly.



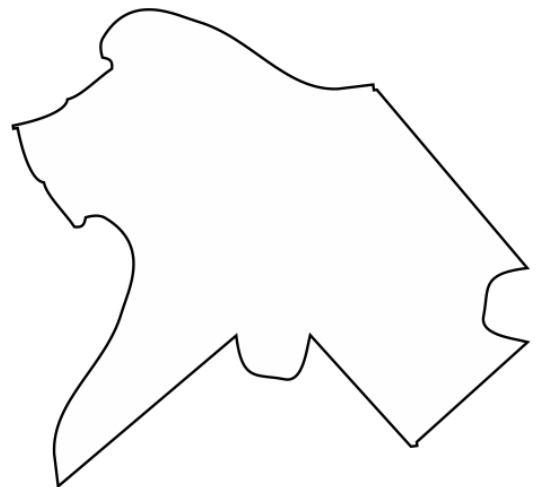
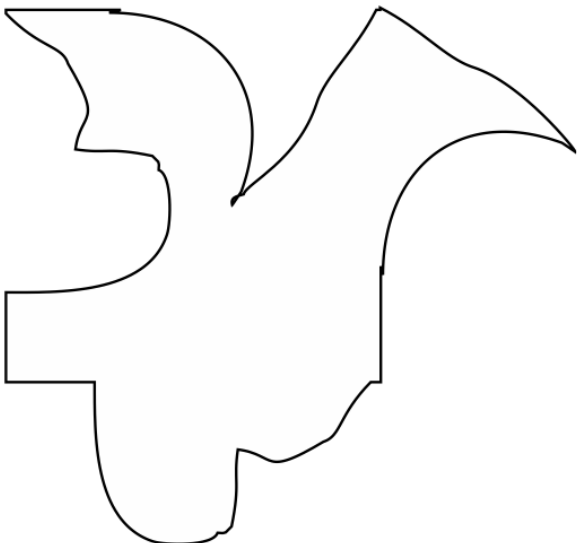
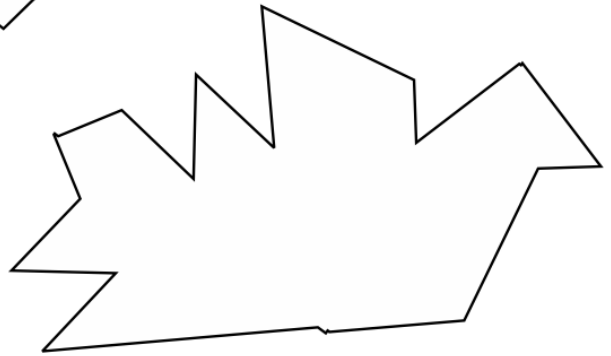
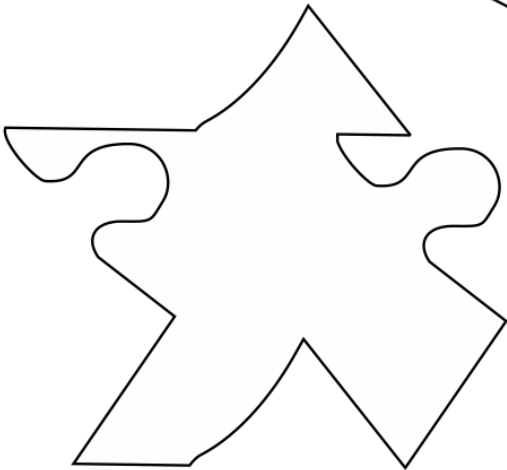
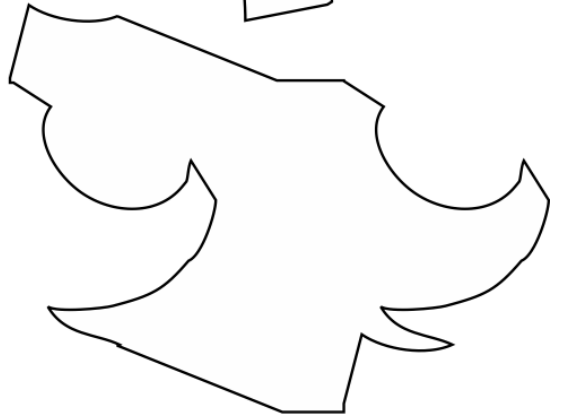
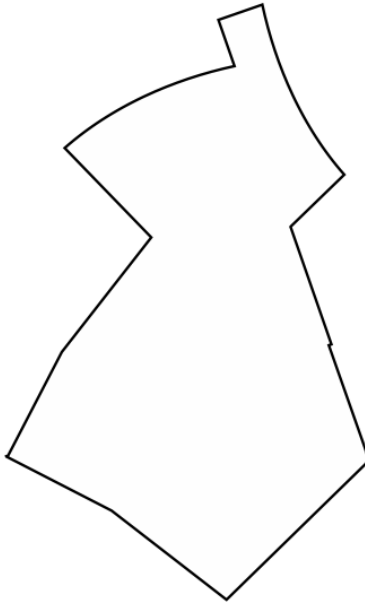
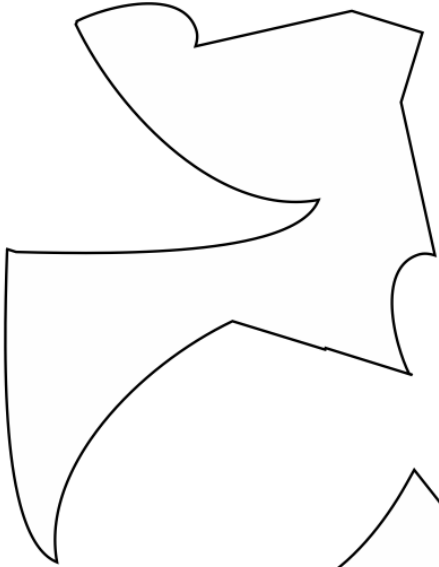
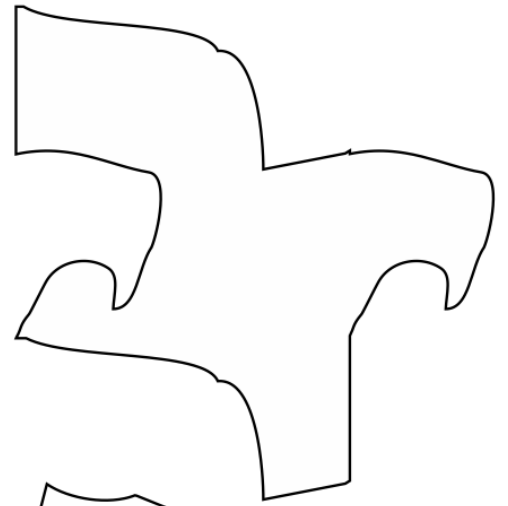
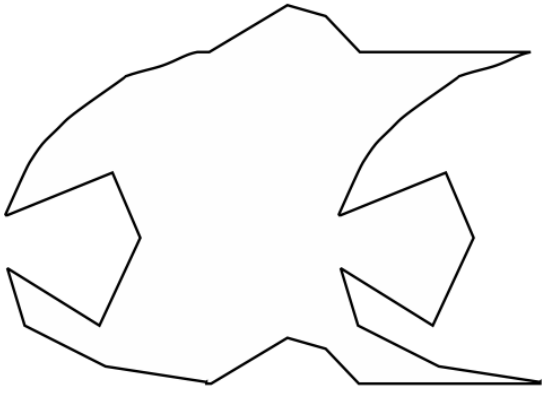
## CREATIVE TILE WORKSHEET

Before creating your own design, it helps to exercise your brain in creating objects from the unusual shapes that can occur. Below are some tiles that tessellate. Use your imagination to turn as many as you can into recognizable objects. If one object is too difficult, it may be easier to turn a shape into two or more objects grouped together.

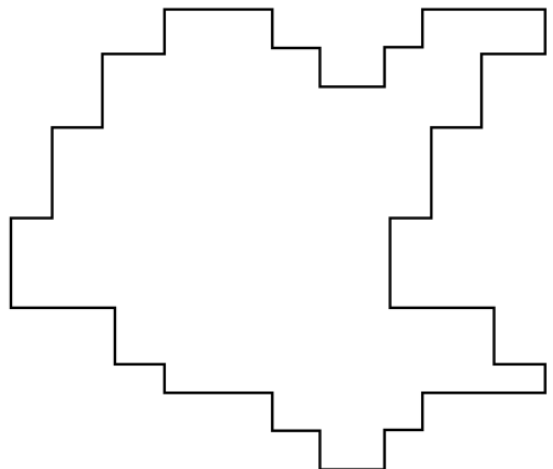
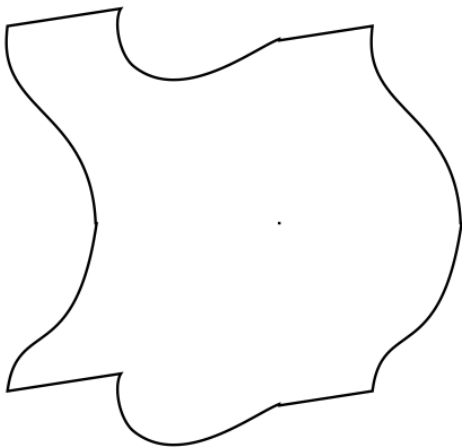
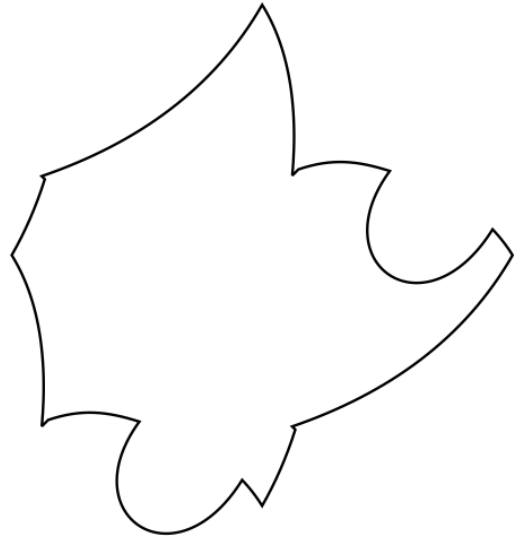
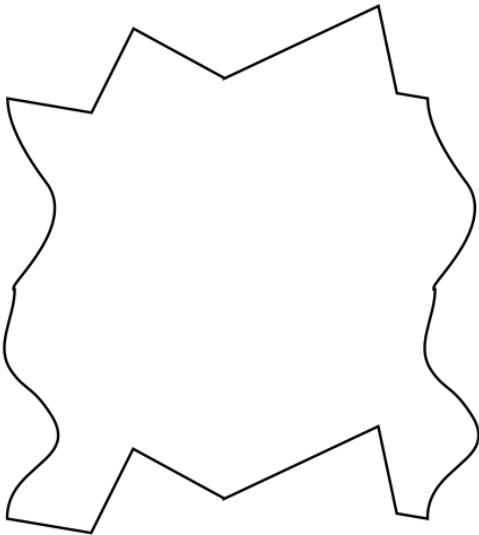
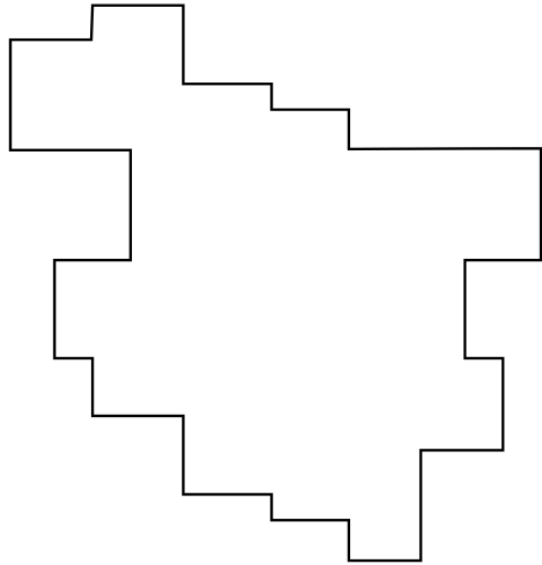
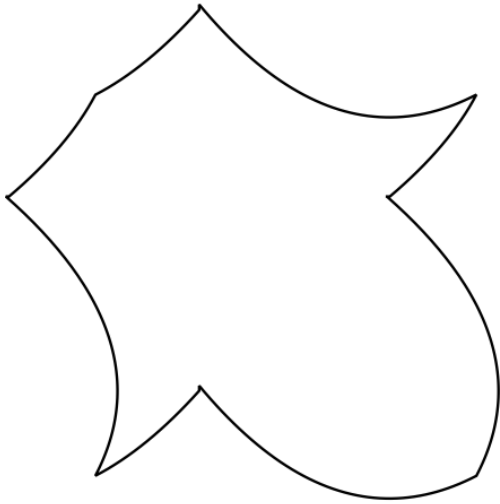
**Remember:** Don't draw ANYTHING outside the border of the original tile shape. Rotate the paper any direction you like.



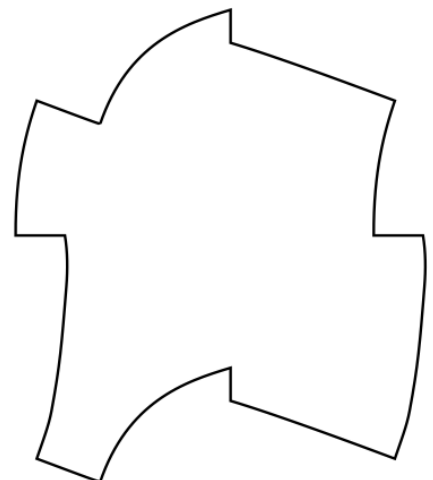
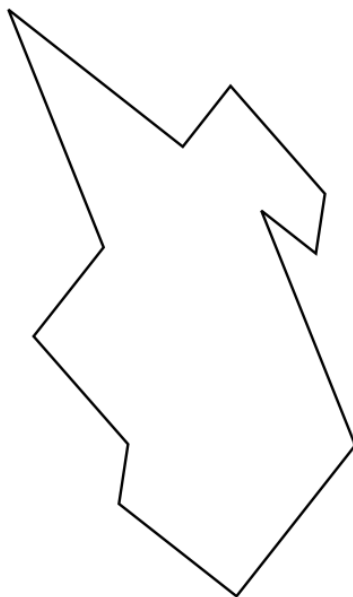
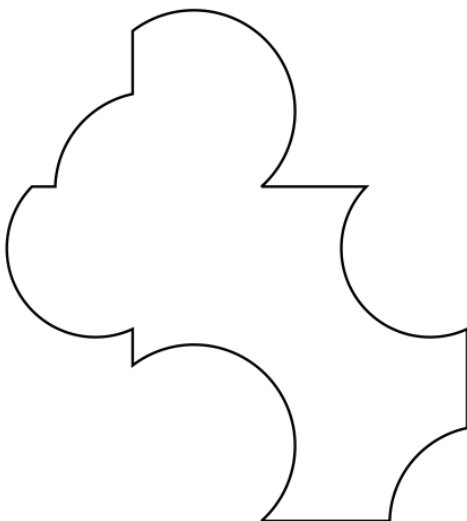
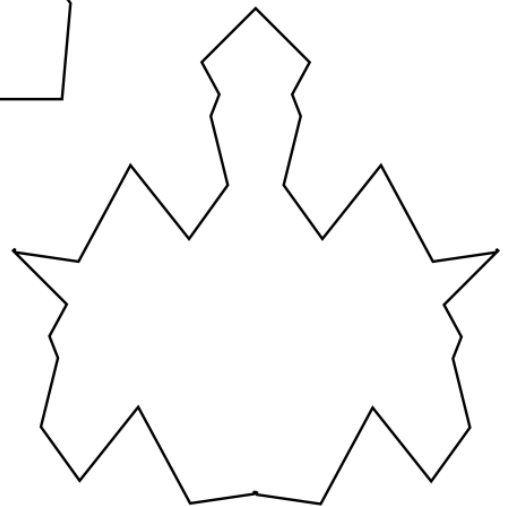
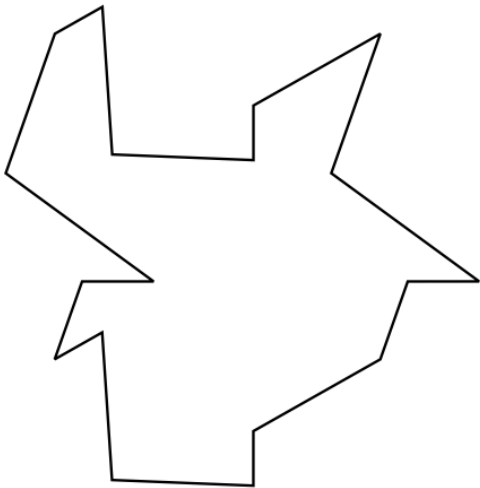
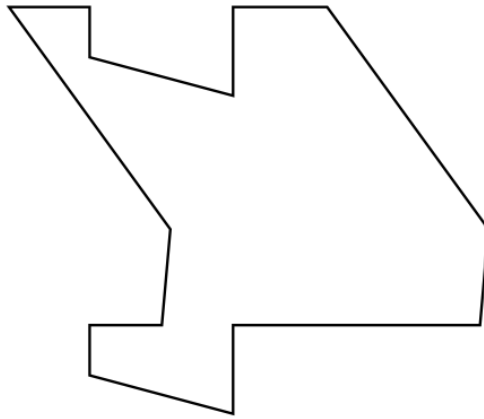
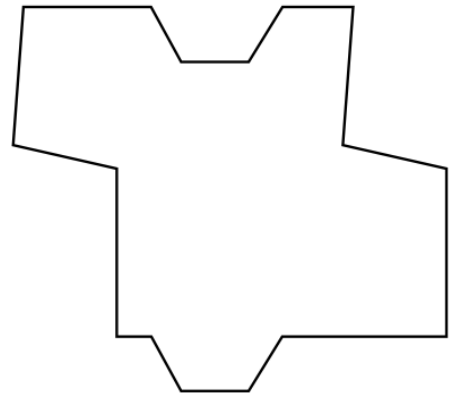
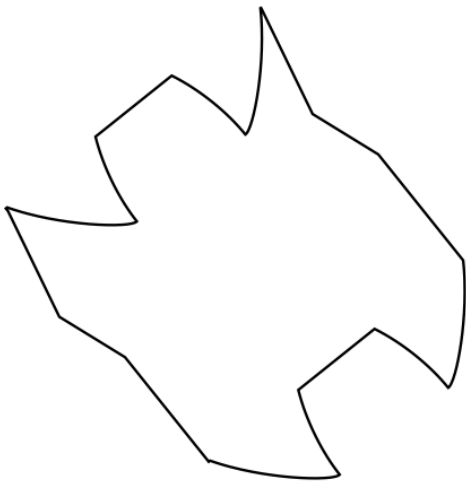
# CREATIVE TILE WORKSHEET PAGE 2



# CREATIVE TILE WORKSHEET PAGE 3

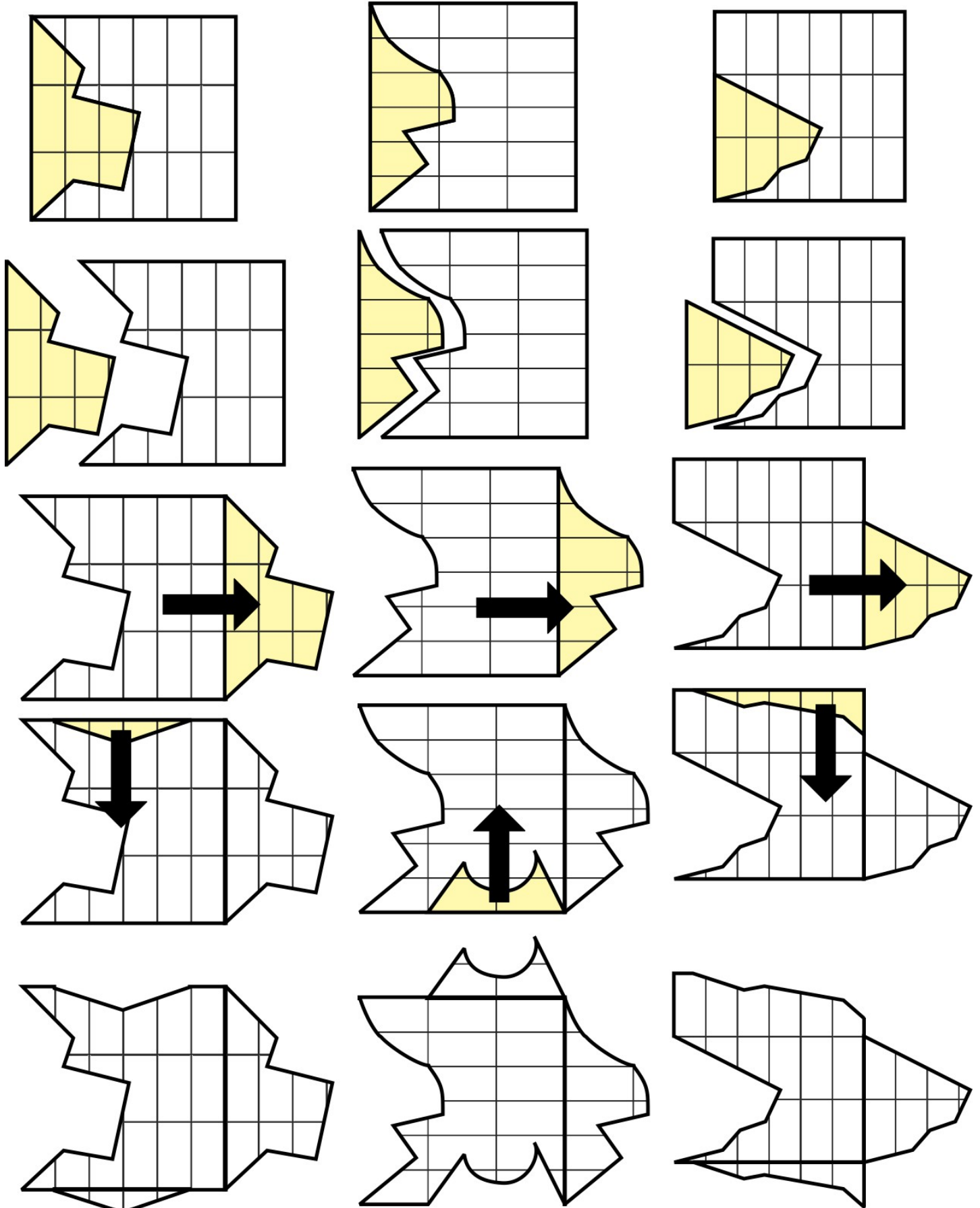






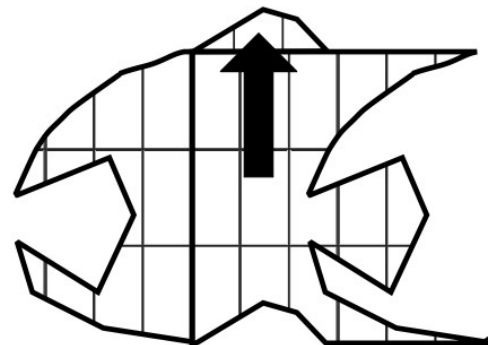
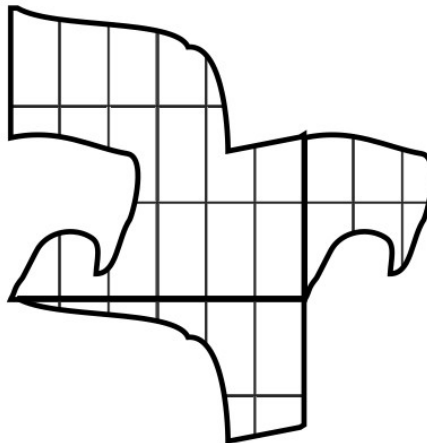
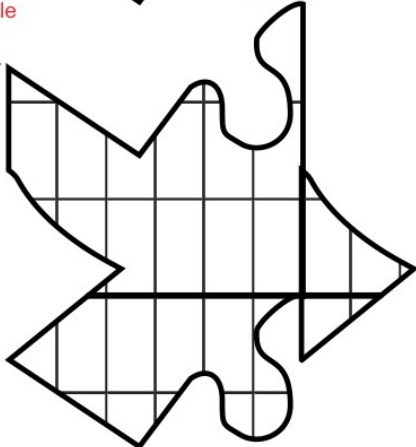
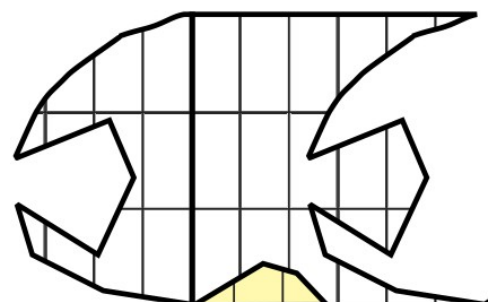
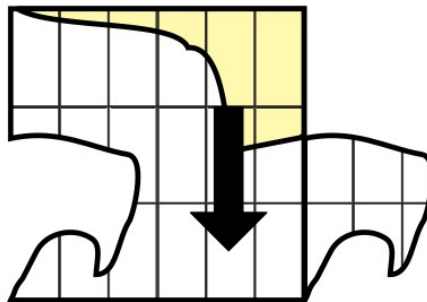
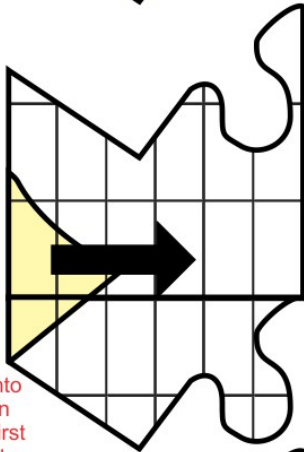
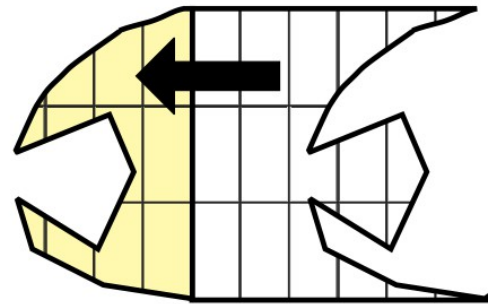
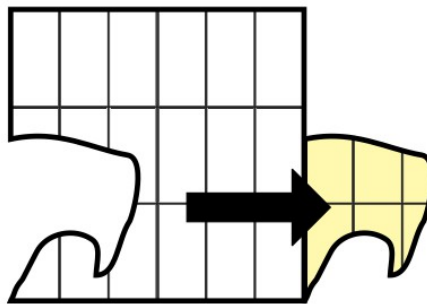
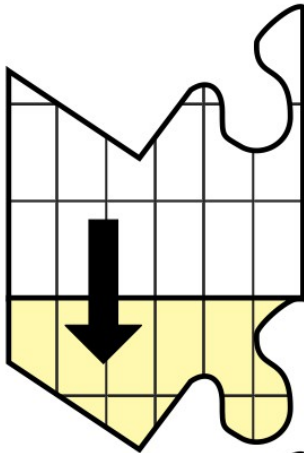
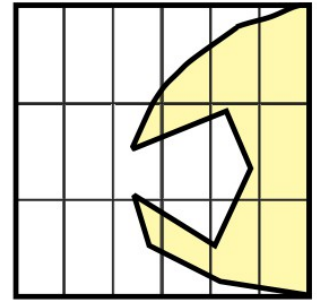
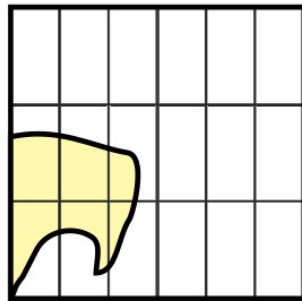
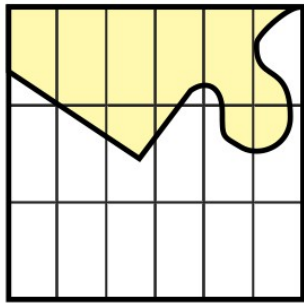
# TRANSLATION EXAMPLES

The simplest tile is created by translation. Trim from one side and slide the piece to the opposite side. Take care to line up the grid lines when assembling.



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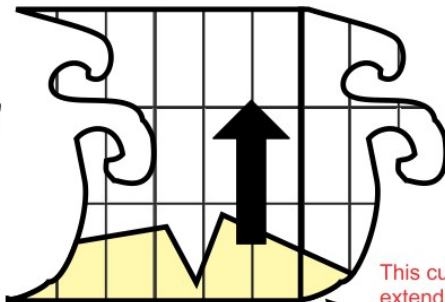
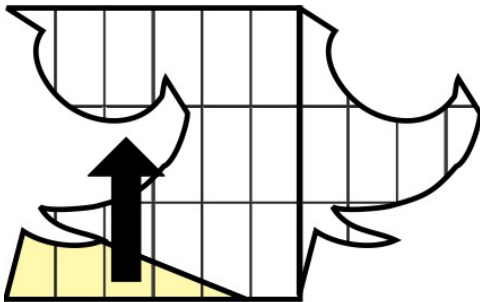
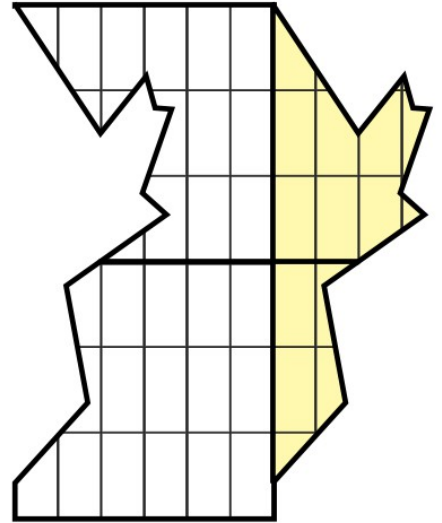
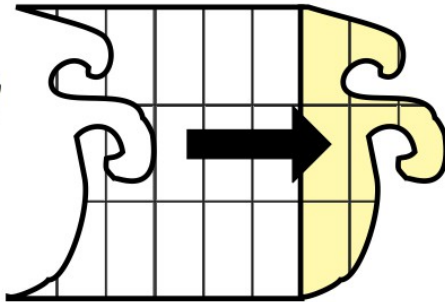
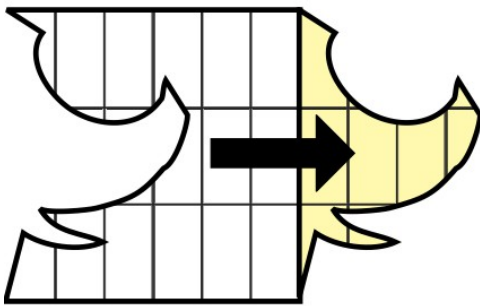
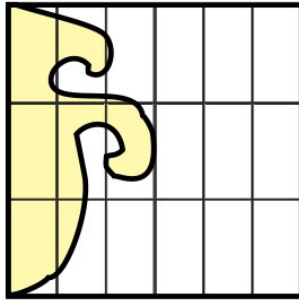
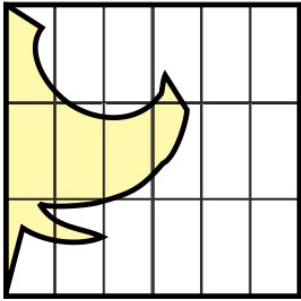


This cut extends into the section from the first cut. The tile will still tessellate.

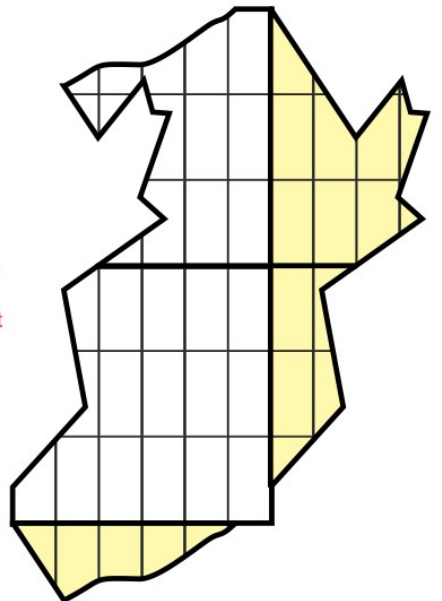
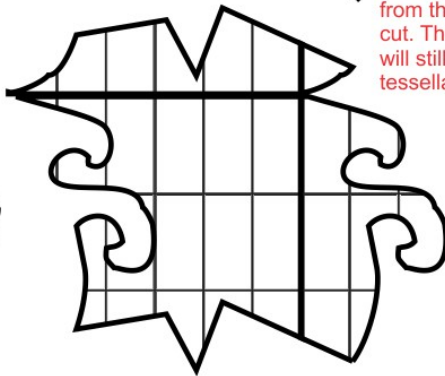
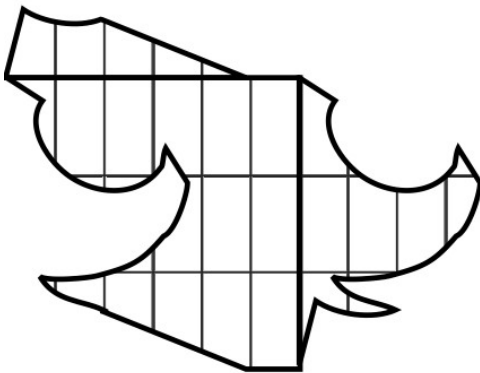
# TRANSLATION EXAMPLES

The simplest tile is created by translation. Trim from one side and slide the piece to the opposite side. Take care to line up the grid lines when assembling.

The original tile doesn't necessarily have to be square. A rectangular tile will work the same way. One can leave two tiles connected to create their custom tile.



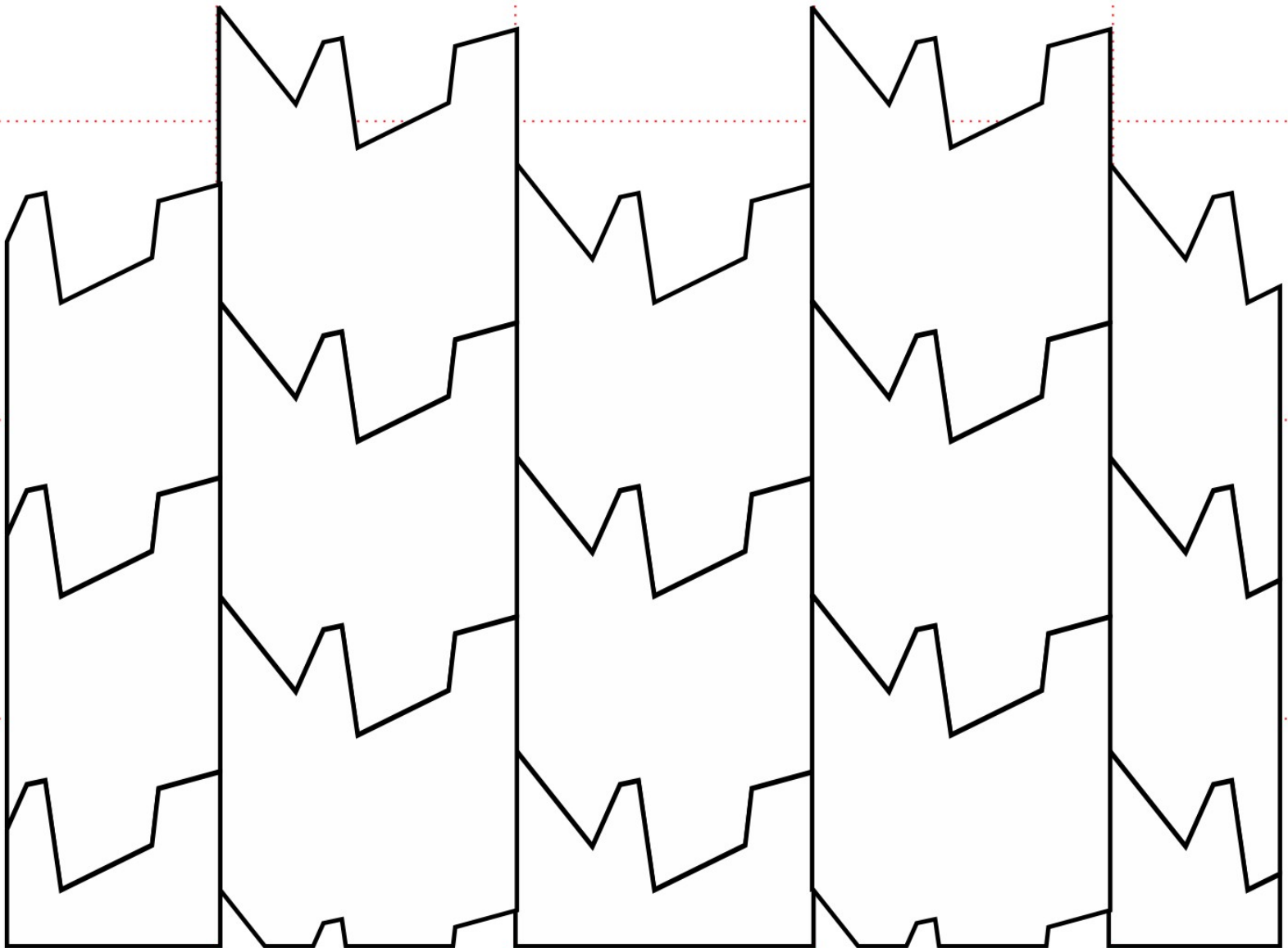
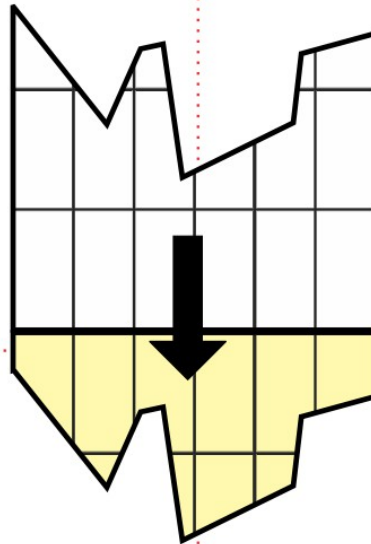
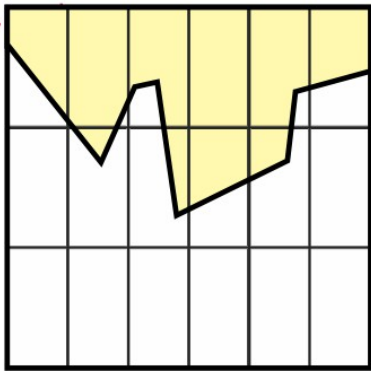
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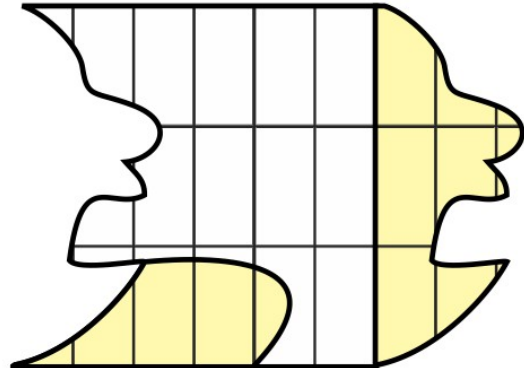
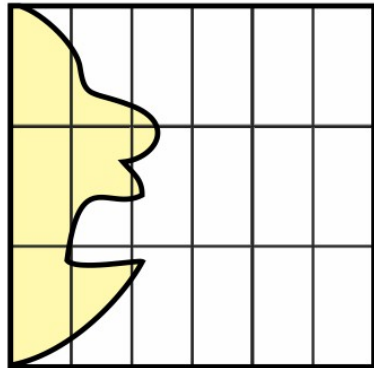
# SINGLE CUT TRANSLATION

In this variation, the first cut is made from one side, then moved to the opposite side. No second cut is made. The only benefit of this type of technique is that the uncut sides allow the tiles to be shifted up or down in adjacent columns to give a staggered effect.



# MODIFIED TRANSLATION

This variation is created like a regular translation. A cut is made on one side and shifted to the opposite side.

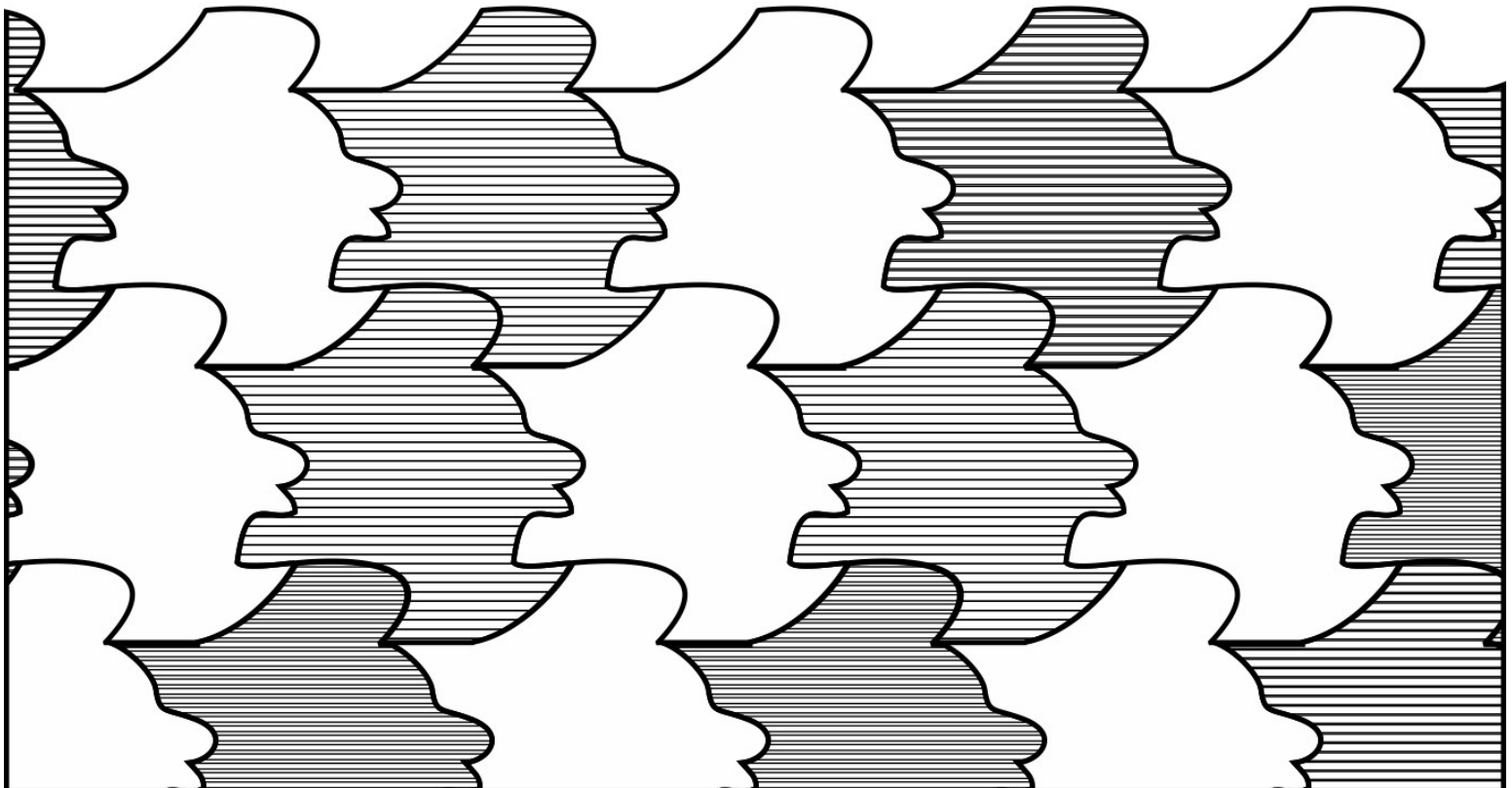
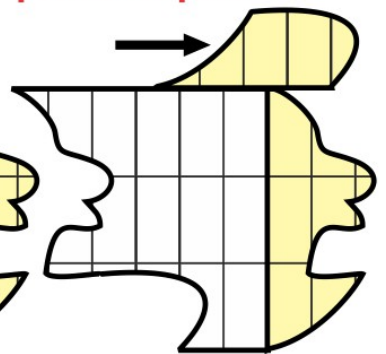
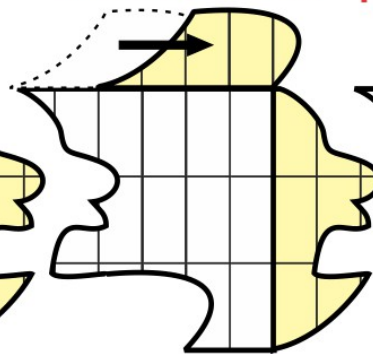
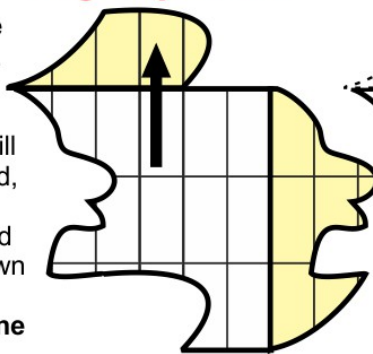


**Original position.**

**Modified position.**

**An even more extreme position is possible.**

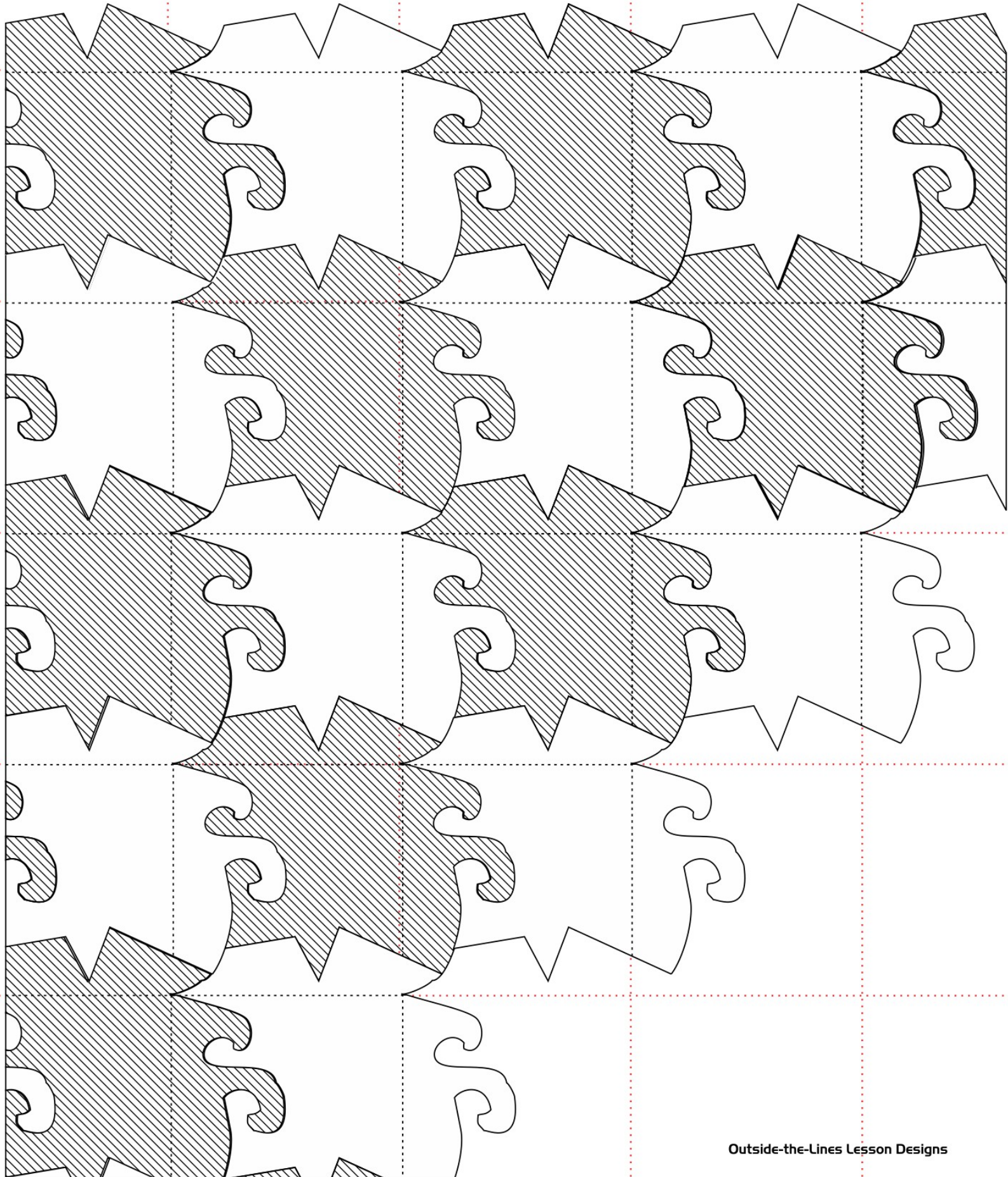
Normally, the tile would slide to the opposite side in the same position. However, a variation would be to move the piece to a new position along the new edge. The design will still tessellate but, when assembled, each new row will shift over to accommodate the new position and create a staggered pattern as shown below. **This only works with translation and then only with one of the cuts...not both.**





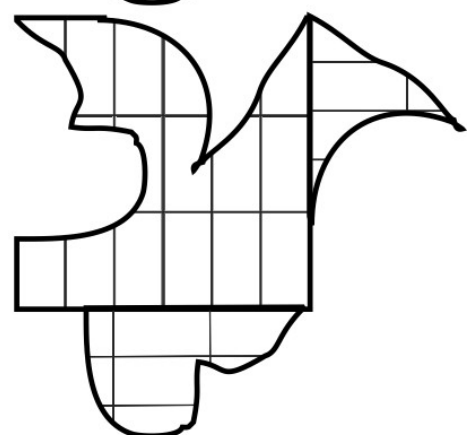
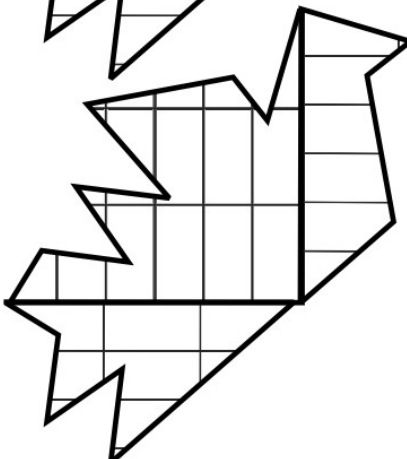
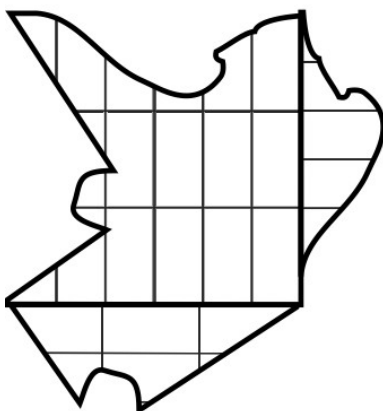
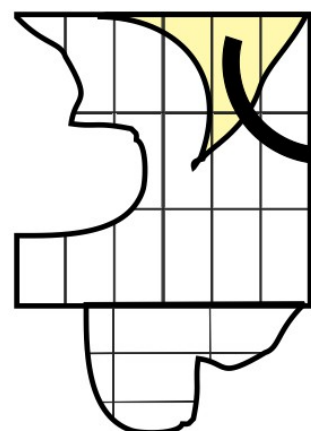
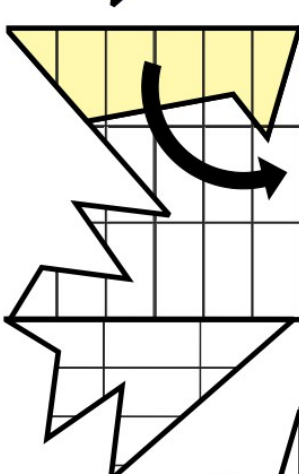
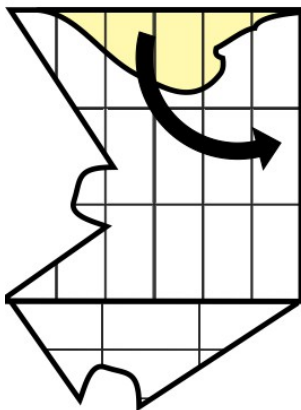
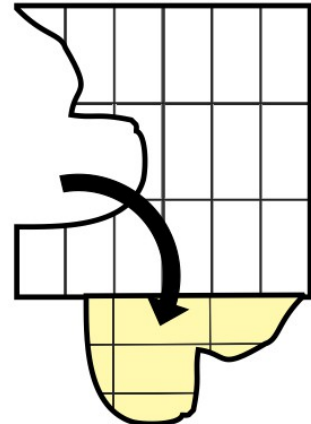
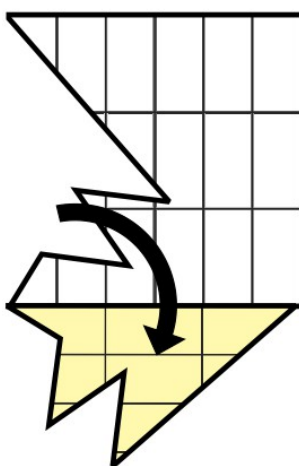
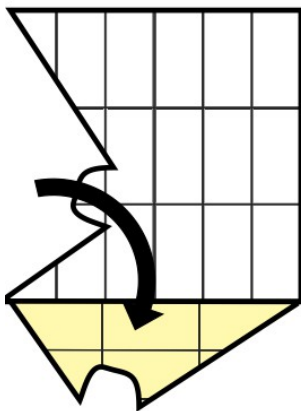
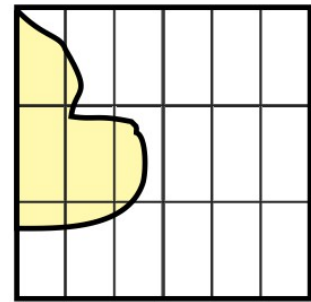
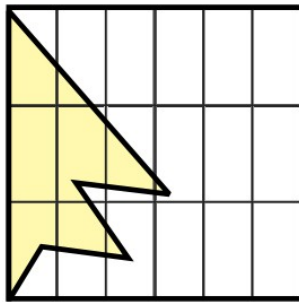
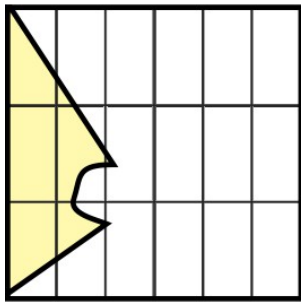
# TRANSLATION TILING TECHNIQUE

Create a grid on the background sheet lightly in pencil. The grid squares must be the same size as your original square pattern. The seams where your tile pieces are assembled are lined up with this grid. Always use the grid to place tiles rather than just attempting to fit the edges. Trace the tile template in a repeating pattern.



# ROTATION EXAMPLES

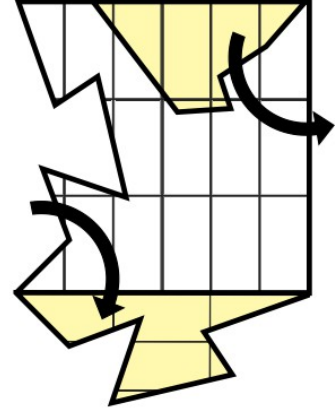
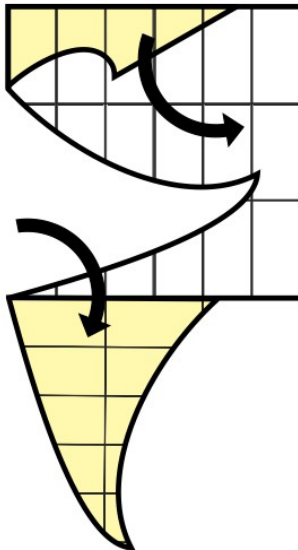
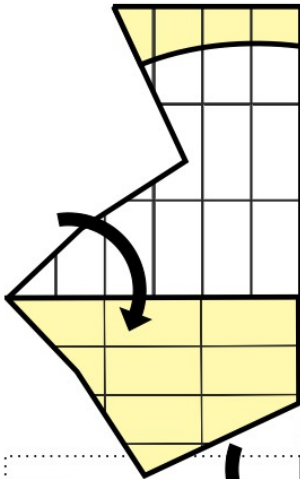
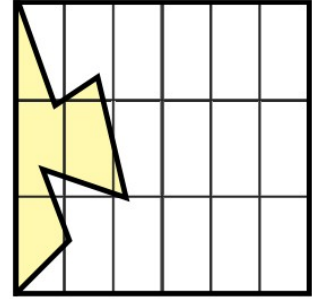
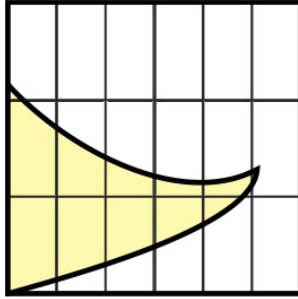
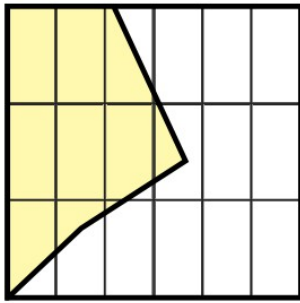
Rotation is only slightly more advanced than translation. Trim from the left side as on the translation technique. Next, rotate the piece down to the bottom. Take care to line up the grid lines when assembling. Notice that the rectangular grid that was vertical is now horizontal in the trimmed shape. Trim a second shape from the top then rotate on the right corner to the right side. Line up the grid as before.



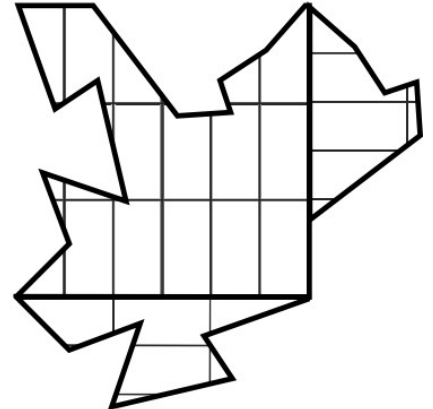
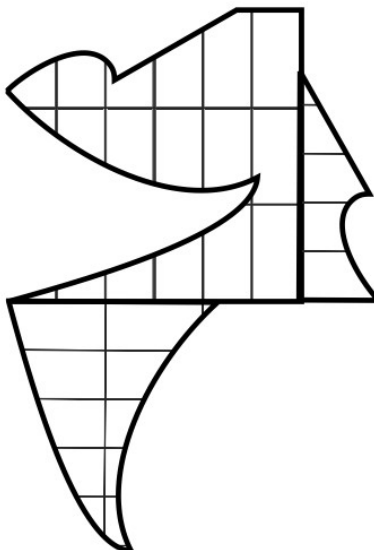
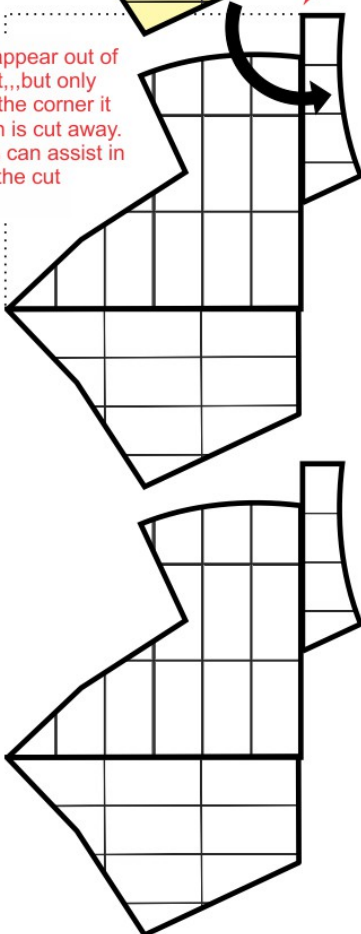


# ROTATION EXAMPLES

Rotation is only slightly more advanced than translation. Trim from the left side as on the translation technique. Next, rotate the piece down to the bottom. Take care to line up the grid lines when assembling. Notice that the rectangular grid that was vertical is now horizontal in the trimmed shape. Trim a second shape from the top then rotate on the right corner to the right side. Line up the grid as before.

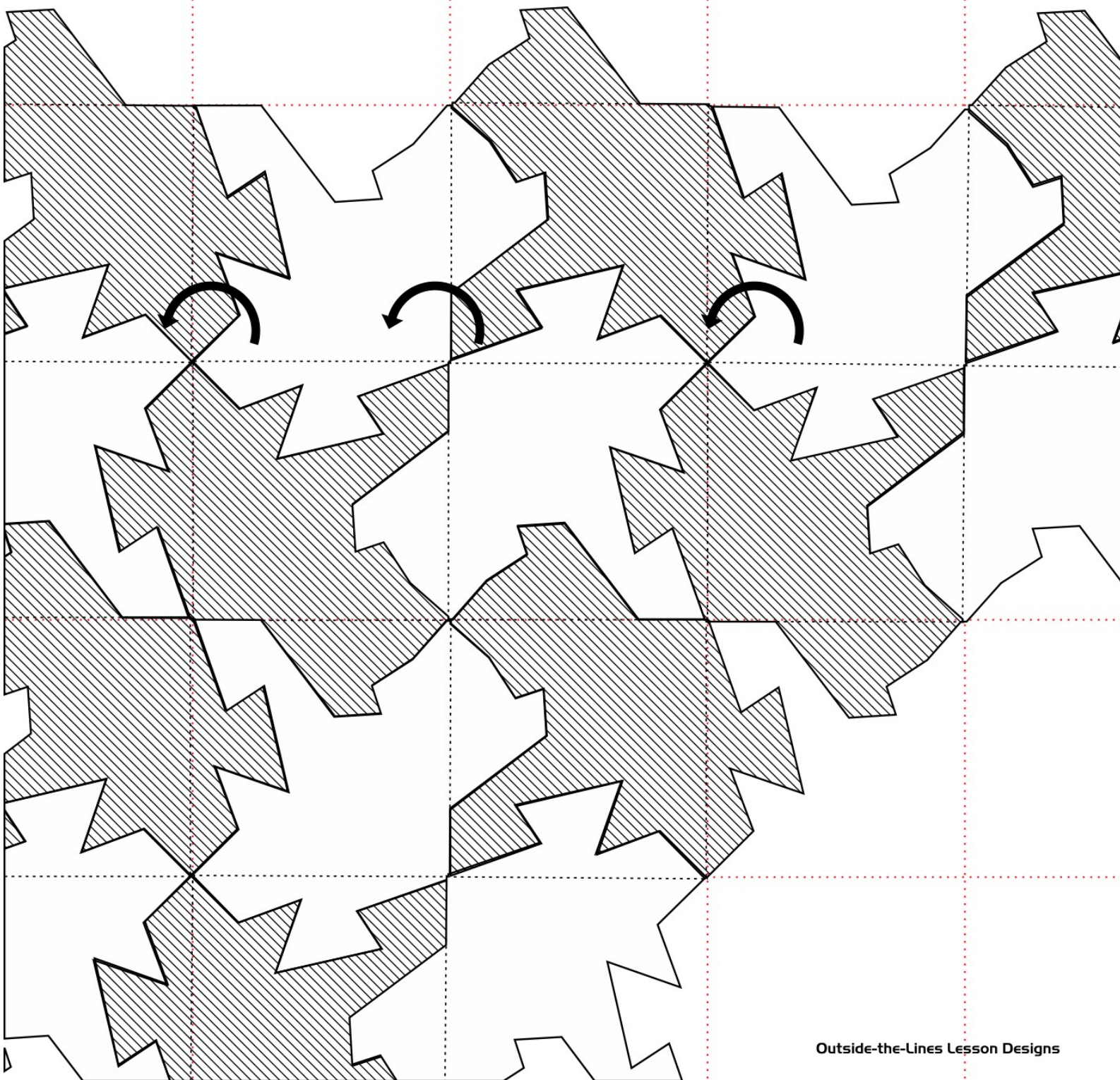


This cut appear out of alignment,,but only because the corner it rotates on is cut away. Grid lines can assist in lining up the cut pieces.



# ROTATION TILING TECHNIQUE

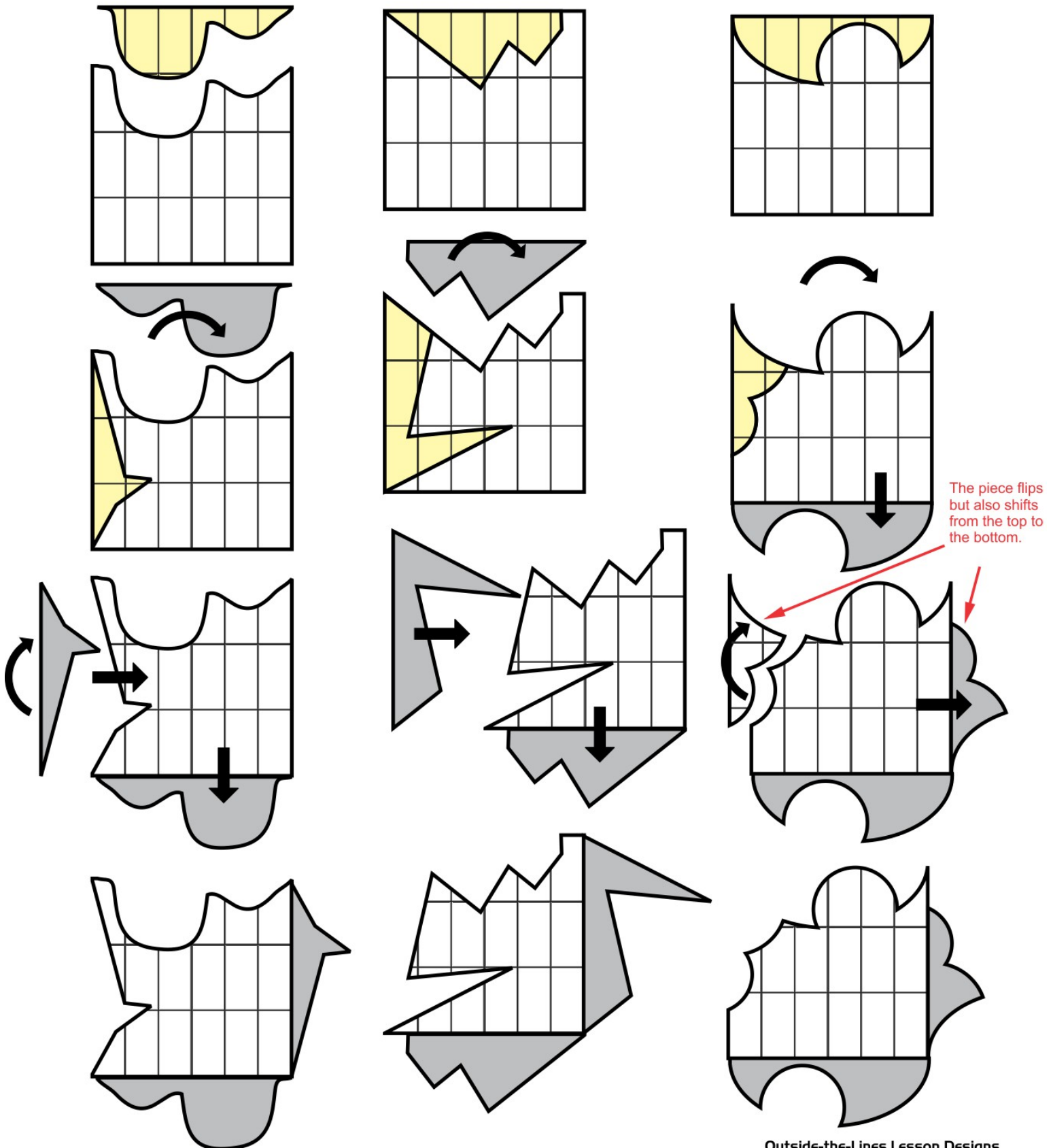
Create a grid on the background sheet lightly in pencil. The grid squares must be the same size as your original square pattern. The seams where your tile pieces are assembled are lined up with this grid. Always use the grid to place tiles rather than just attempting to fit the edges. Trace the tile template in a repeating pattern. In rotation, each piece must be rotated one quarter turn back and forth as they repeat.





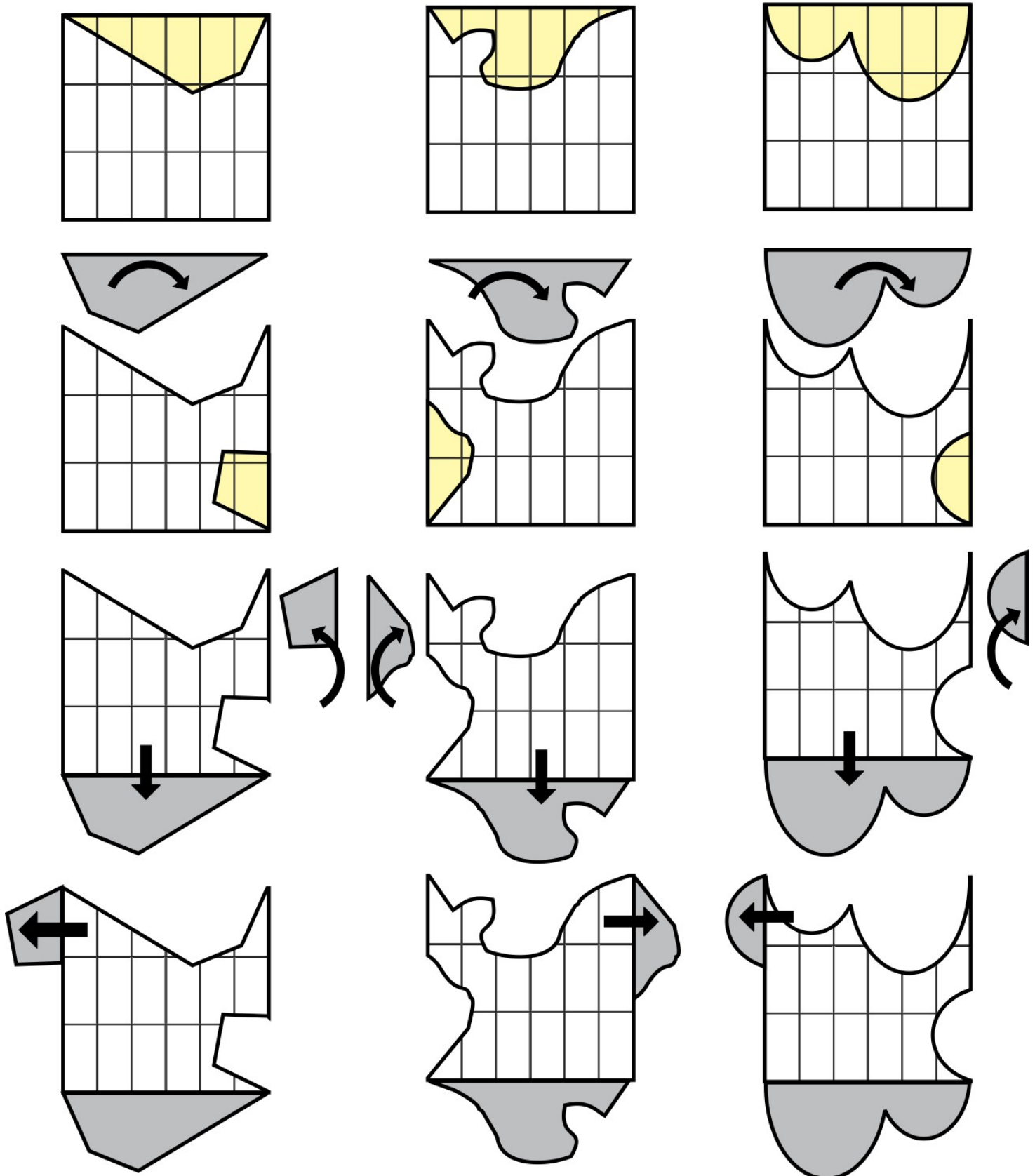
# REFLECTION EXAMPLES

For a reflection technique, trim from the top as on the translation technique. This time, flip the piece over so that the printed grid lines are now on the back. Then slide the piece to the bottom just like in translation. Complete the shape by trimming from the side, flipping, then sliding to the opposite side. Take care to assemble correctly as the grid lines will not be visible to line up as before.



# REFLECTION EXAMPLES

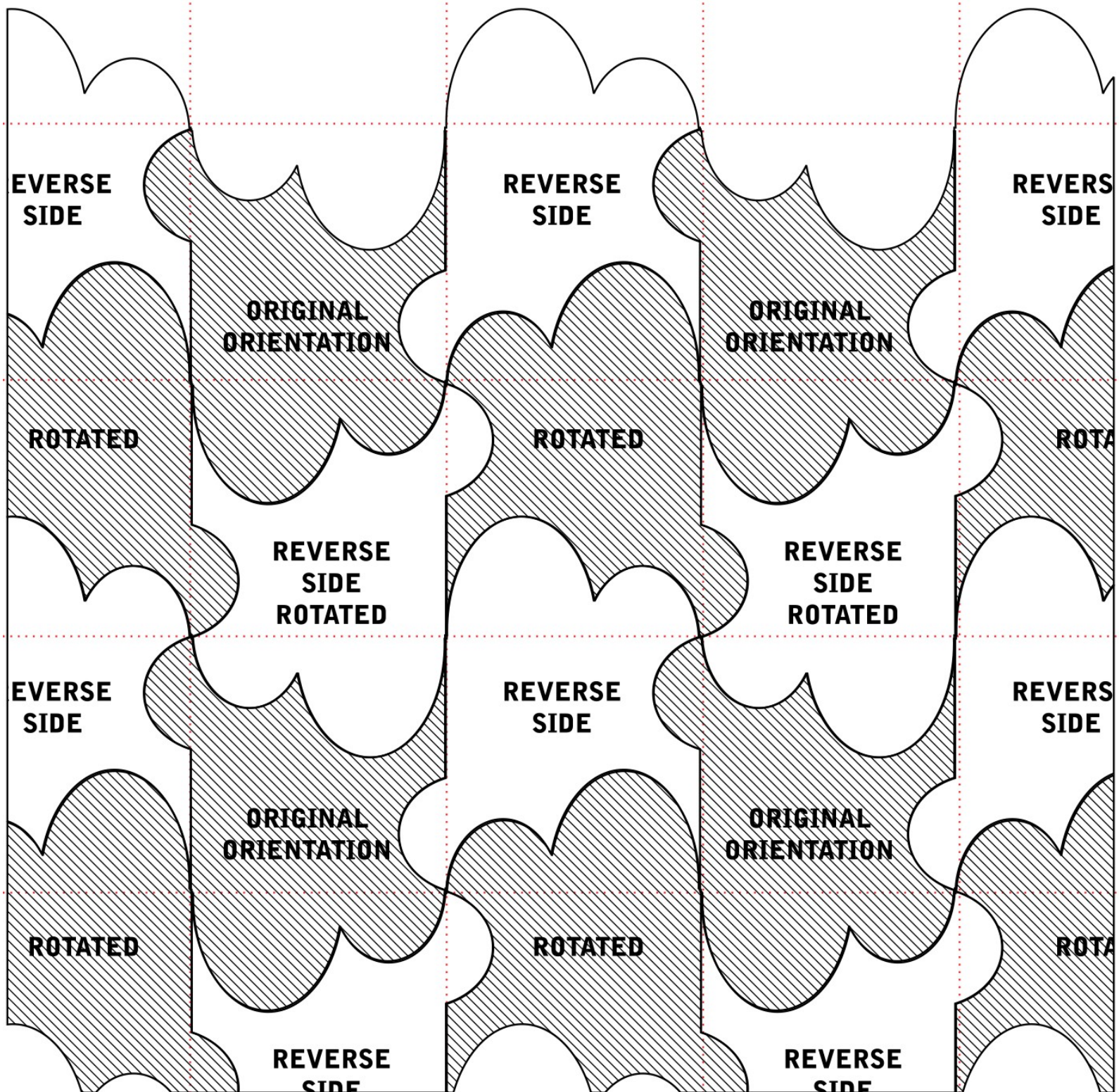
For a reflection technique, trim from the top as on the translation technique. This time, flip the piece over so that the printed grid lines are now on the back. Then slide the piece to the bottom just like in translation. Complete the shape by trimming from the side, flipping, then sliding to the opposite side. Take care to assemble correctly as the grid lines will not be visible to line up as before.





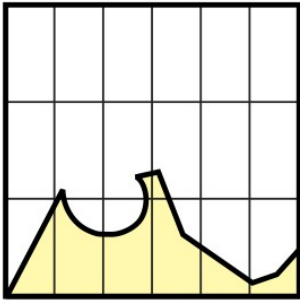
# REFLECTION TILING TECHNIQUE

Create a grid on the background sheet lightly in pencil. The grid squares must be the same size as your original square pattern. The seams where your tile pieces are assembled are lined up with this grid. Always use the grid to place tiles rather than just attempting to fit the edges. Trace the tile template in a repeating pattern. This time, in order to fit the tiles, every other tile is reverse so that the back of the pattern tile is up. On the next row, the tiles are rotated 180 degrees. Don't let the directions confuse you. Just start with your first tile and then flip and rotate until it fits to create a pattern.

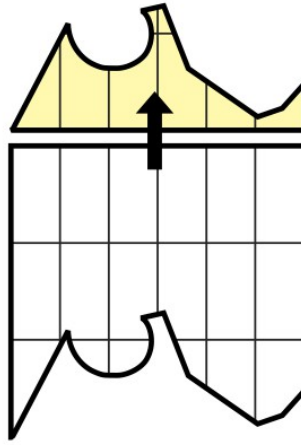




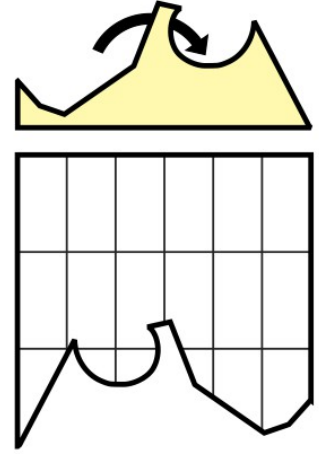
# TRANSLATION & REFLECTION COMBINED



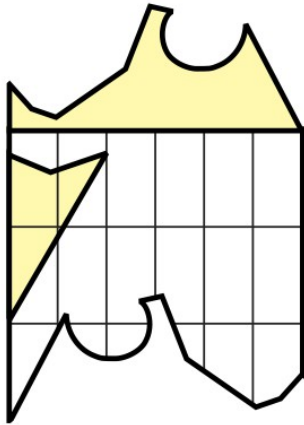
It is also possible to combine translation with reflection. Cut a shape from one side...



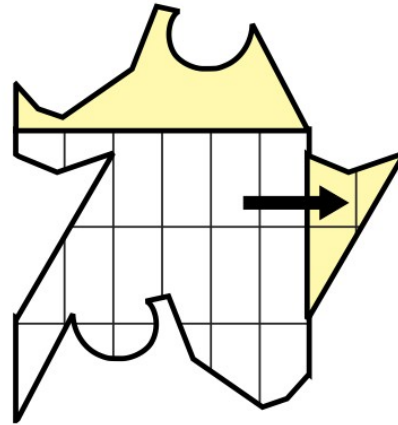
...Then slide it to the opposite side.



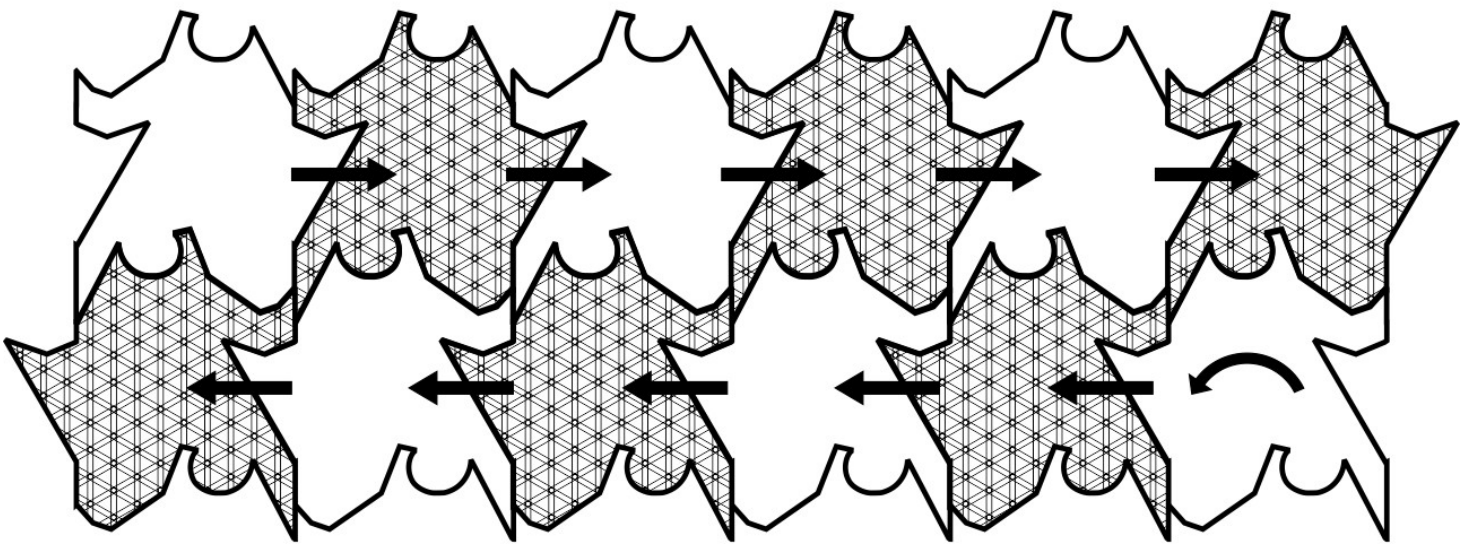
Flip this piece so that the back of the tile is face up and attach to the new edge.



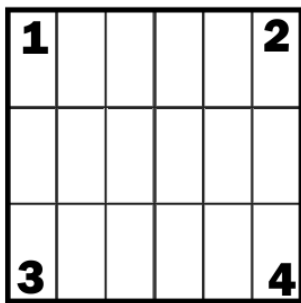
Clip a second piece from one of the remaining sides.



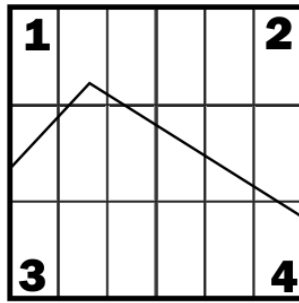
Slide this piece to the opposite side. This time, do not flip the piece but leave the grid side facing up. When assembling the tiles, the shape will need to be reversed in one direction but not in the other direction.



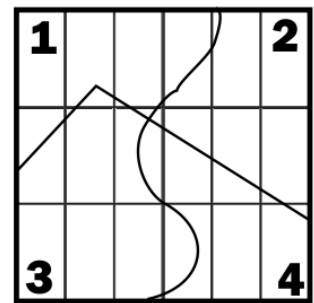
# 4-SQUARE TILE TECHNIQUE



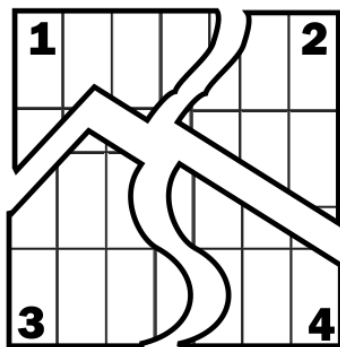
Another technique is the 4-square cut. Number the corners of the tile 1,2,3,4 beginning in the upper left corner as shown above.



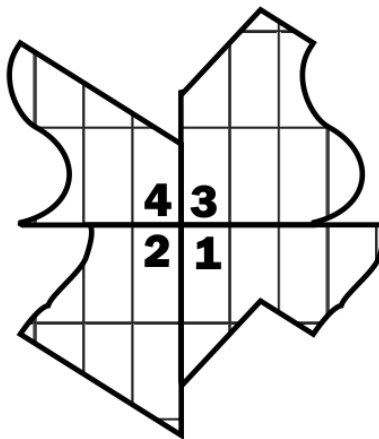
Draw a line across the tile. It can be anywhere but needs to go across the tile from side to side.



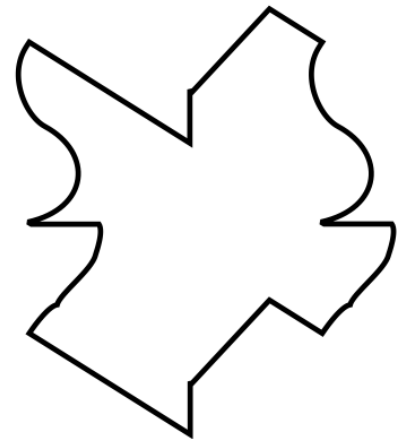
Draw a second line from the top of the tile down to the bottom. This line will intersect the first line.



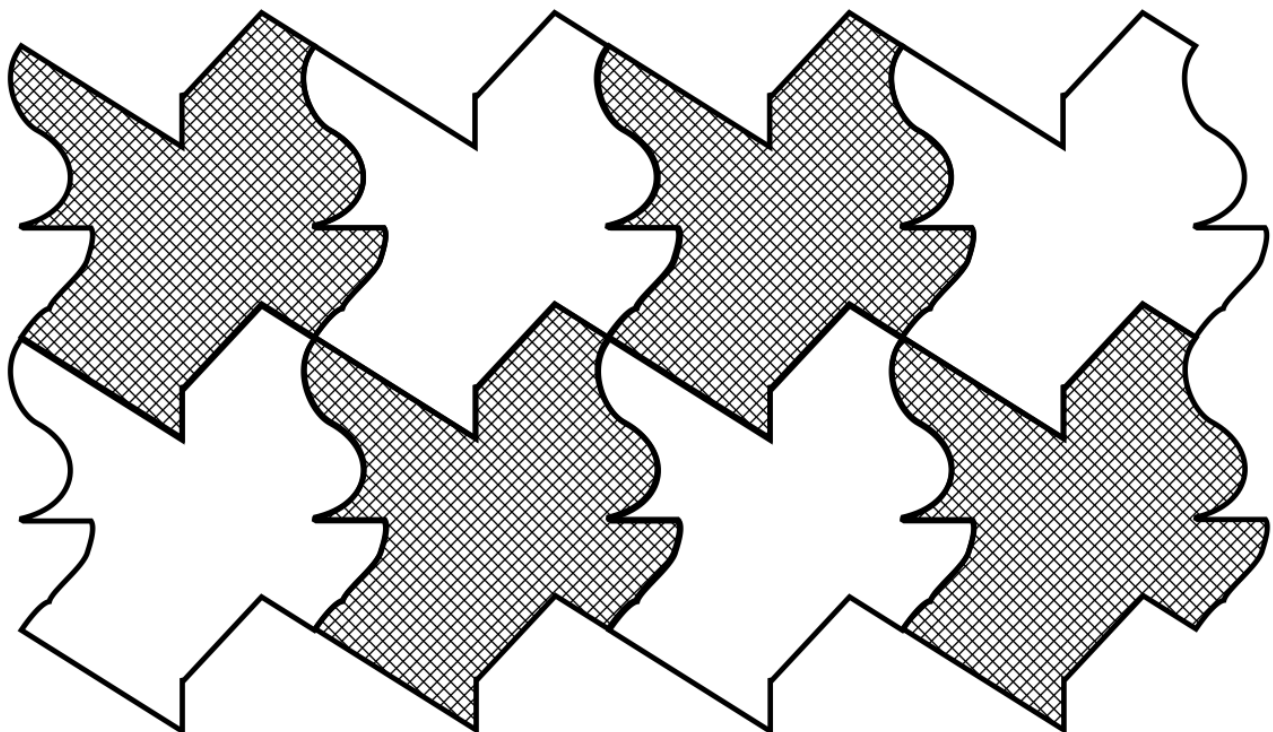
Cut both of these lines. There will be four pieces as shown above.



Reassemble the tile with the straight sides next to one another and the numbers in reverse order as shown above. ( 4,3,2,1) The grid lines can help assist in lining up the pieces.

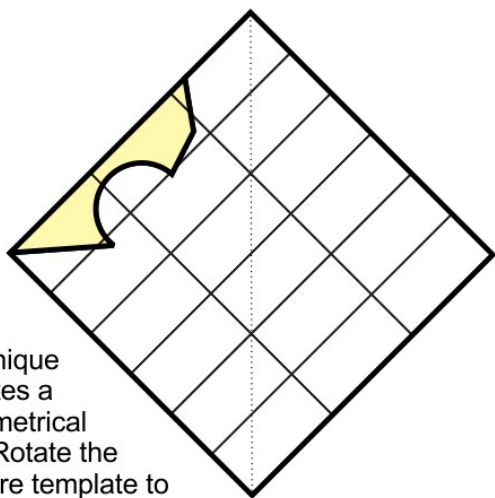


Attach the pieces with transparent tape. This tile will tessellate like the translation tiles. No flipping or rotation is required.

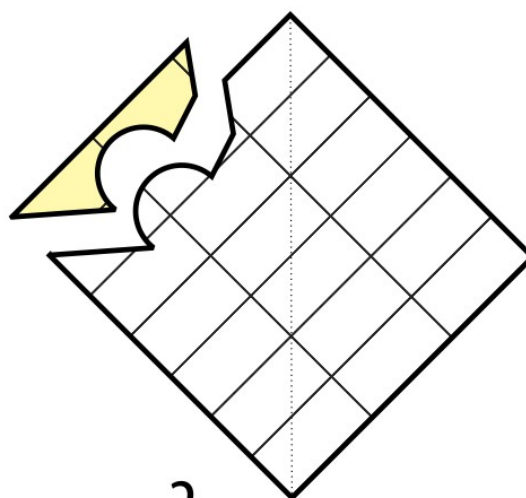


# SYMMETRICAL TESSELLATION

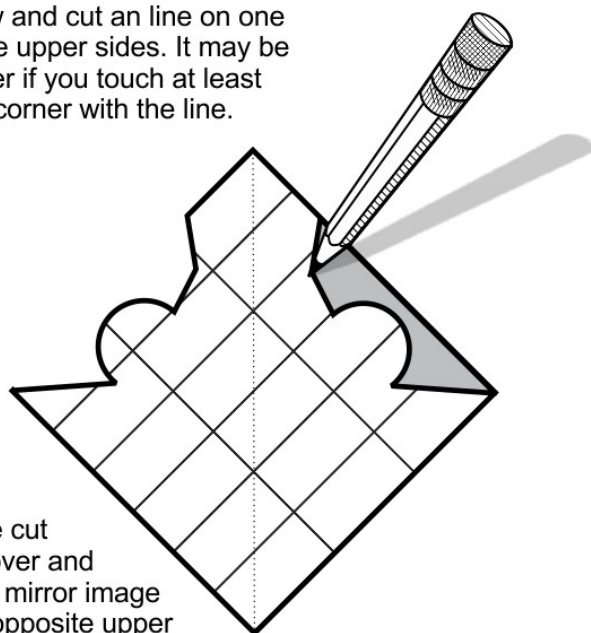
1 This technique creates a symmetrical tile. Rotate the square template to a diamond orientation. Draw and cut an line on one of the upper sides. It may be easier if you touch at least one corner with the line.



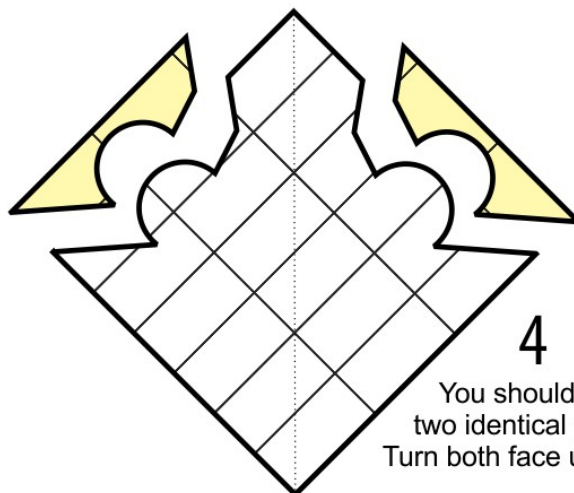
2 Cuts should not go past the center of the tile.



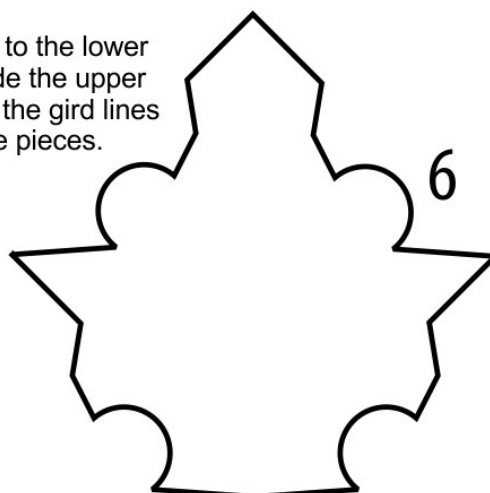
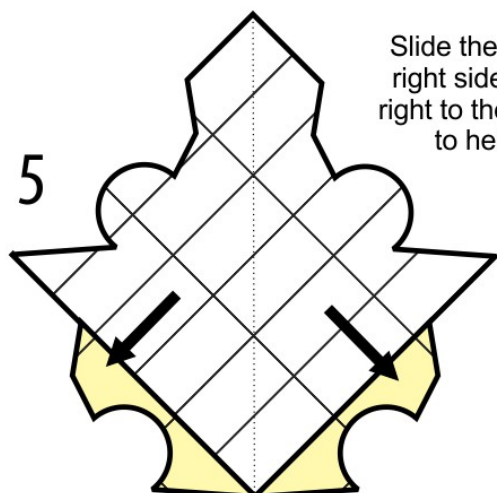
3 Flip the cut piece over and trace a mirror image to the opposite upper side. Take care to line it up carefully.



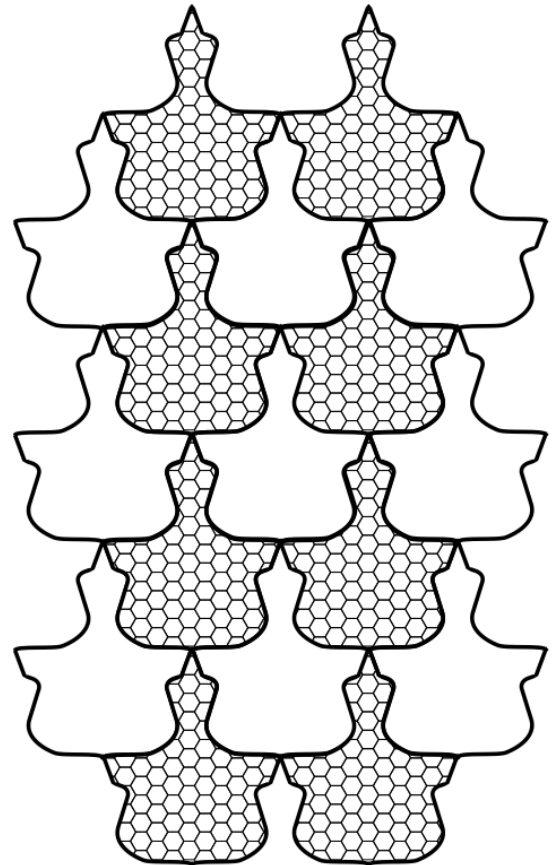
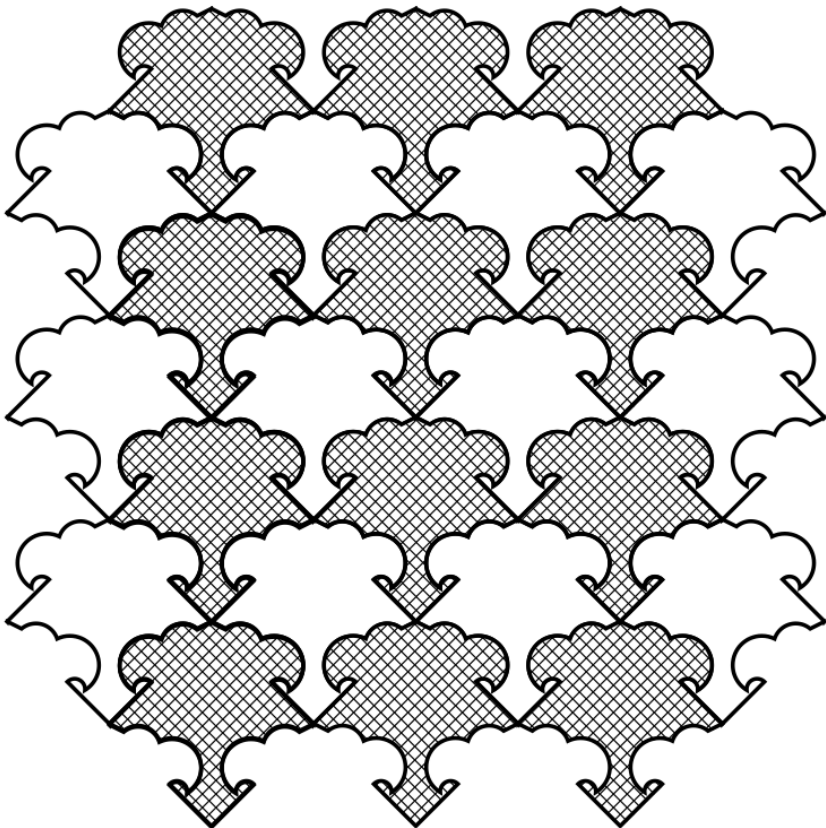
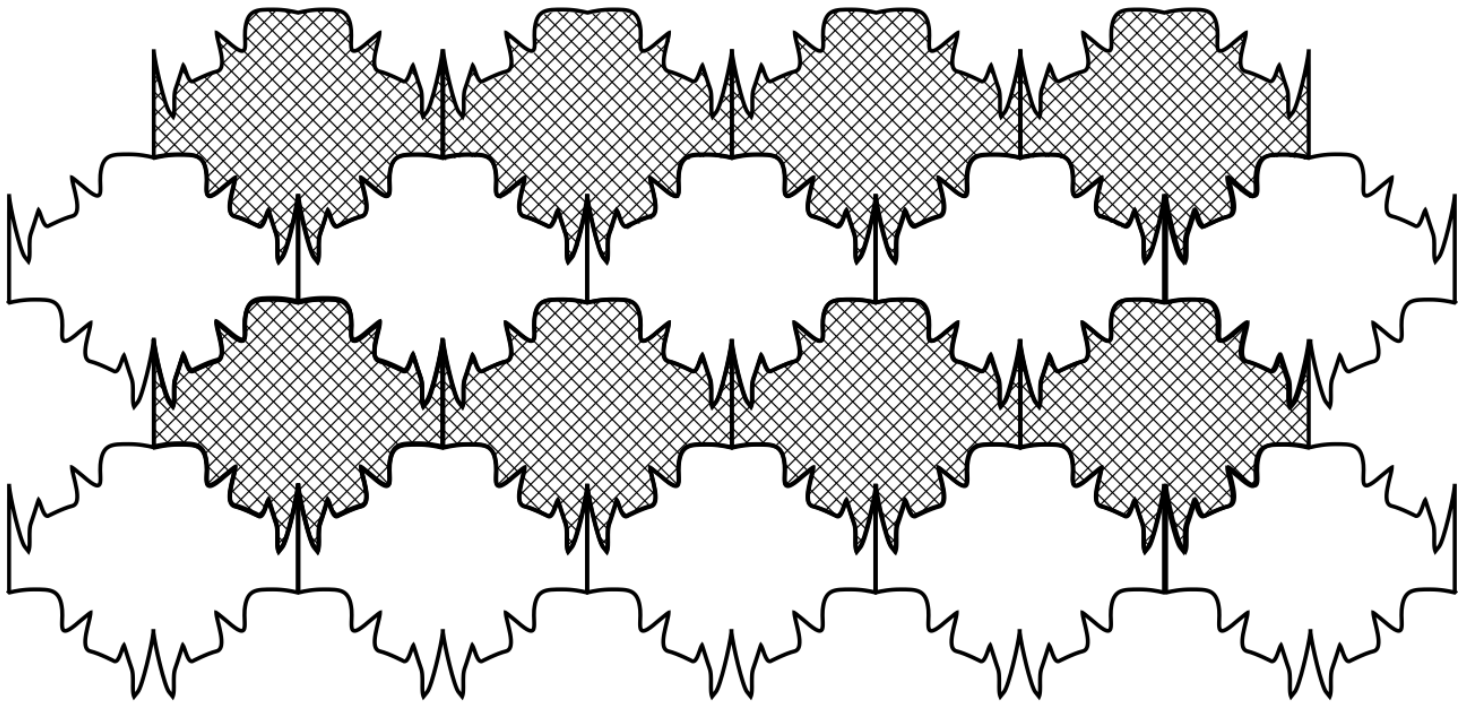
4 You should have two identical pieces. Turn both face up.



Slide the upper left piece to the lower right side and attach. Slide the upper right to the lower left. Use the grid lines to help you line up the pieces.



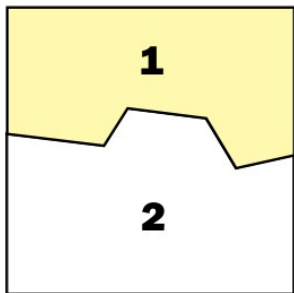
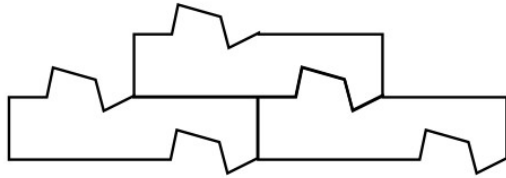
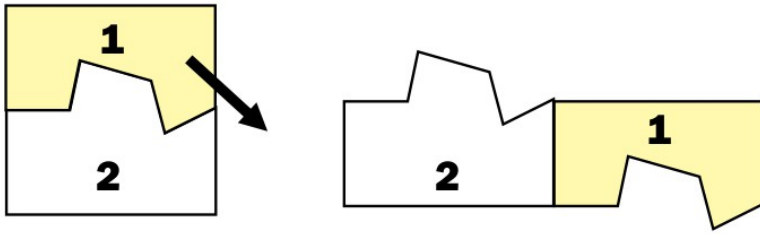
# SYMMETRICAL TESSELLATION



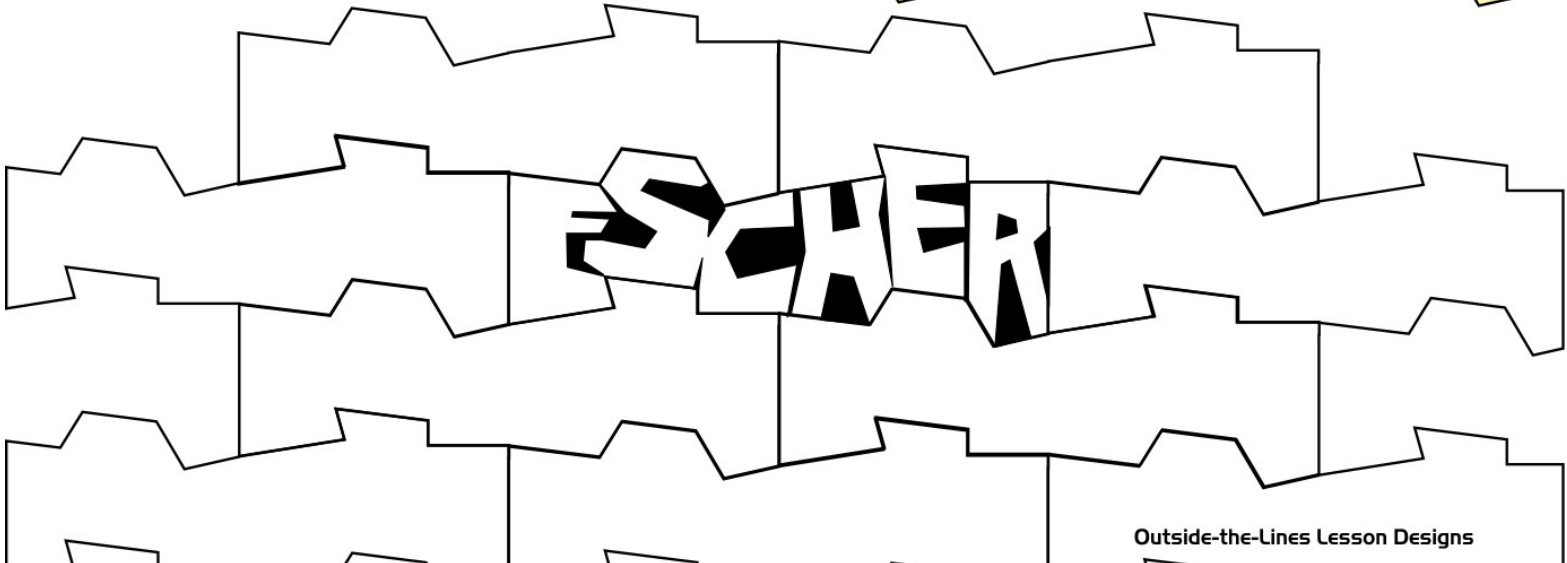
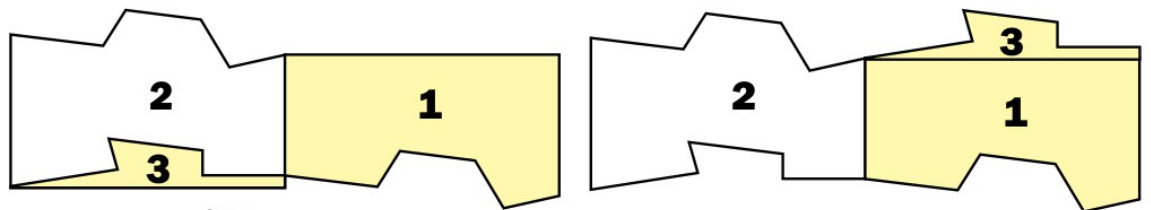


# TESSELLATION LETTERING

Creating a tile specifically for lettering is simple. A single line is cut approximately halfway down the shape and the pieces are reassembled side-by-side. The number of zigs and zags you cut lends itself to the number of letters that may be suggested in the tile. In this example the 3-level cut doubles to become ideal for a 5-8 letter word. More or less letters may require a more or less complex cut.

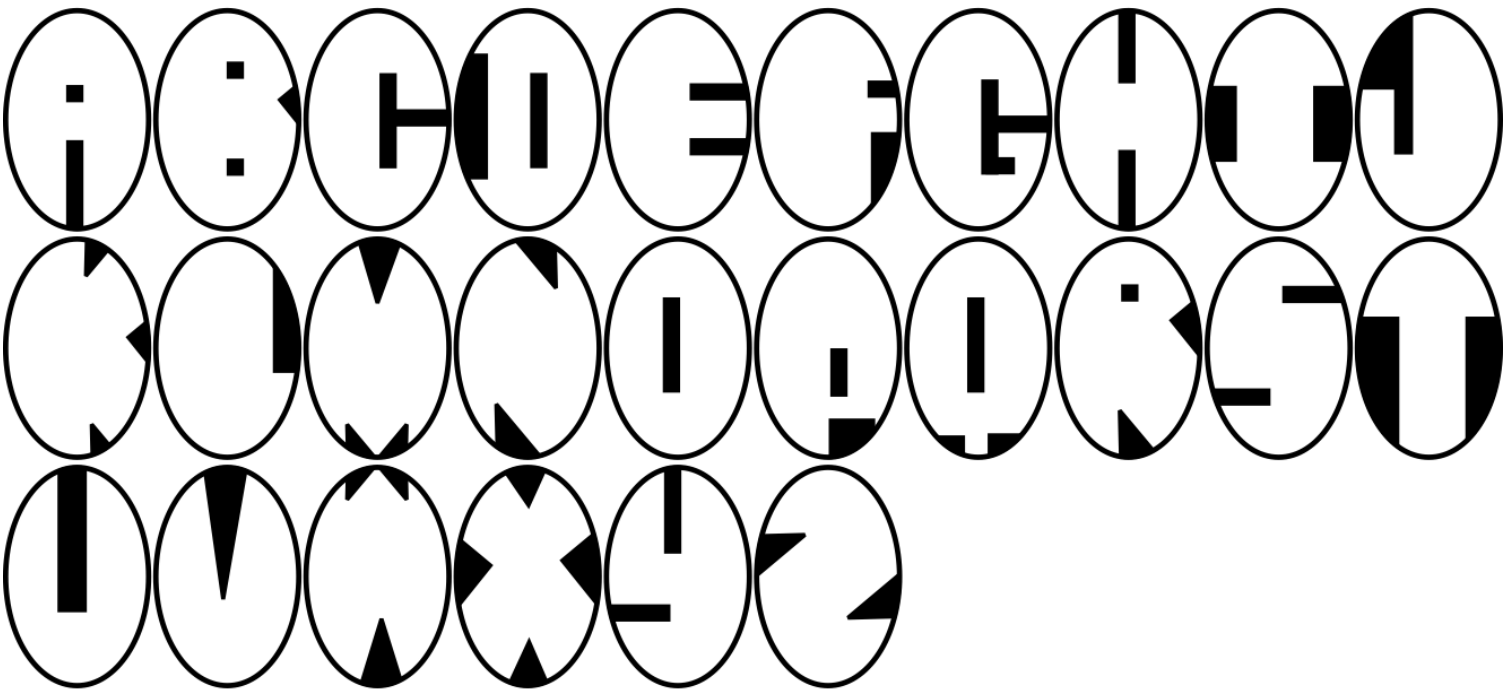
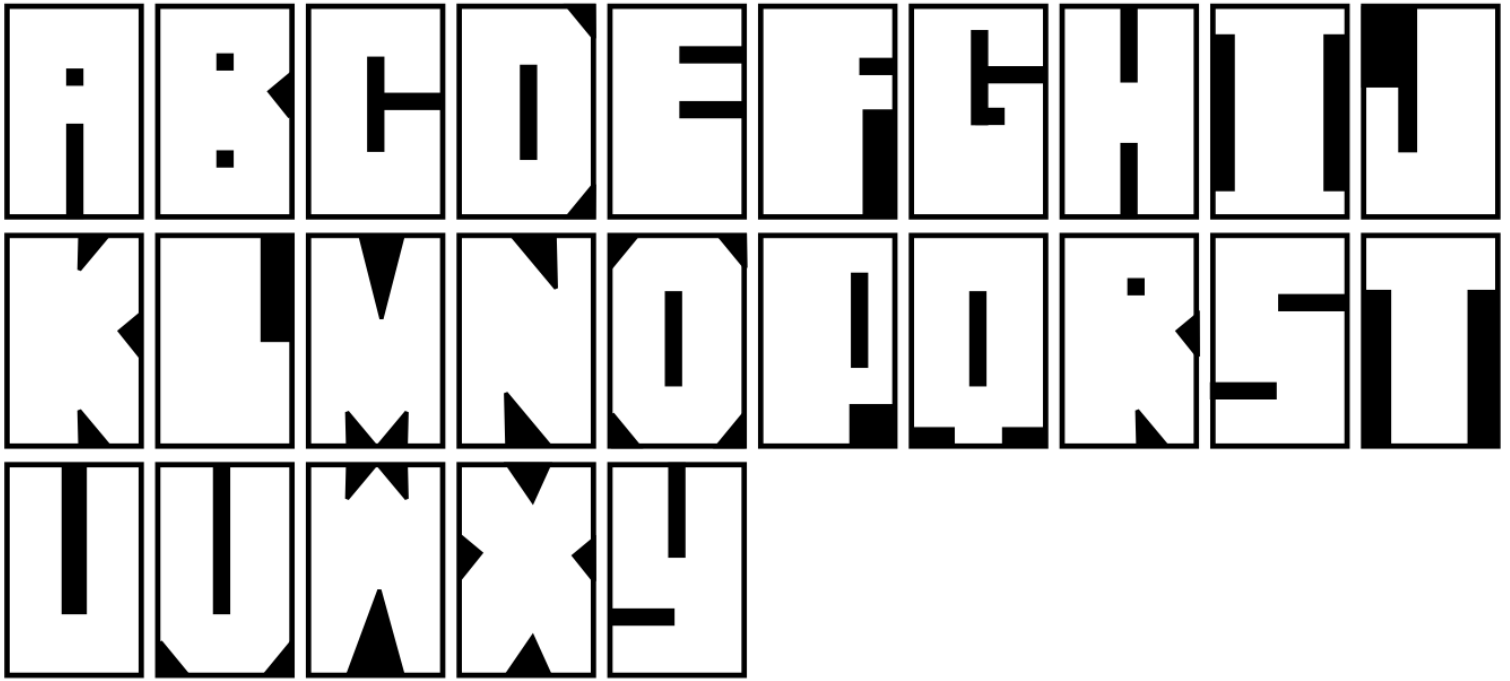


One can take the design of the tile a bit further by cutting the tile a 2nd time. This eliminates the flat edges that appear in the previous design.



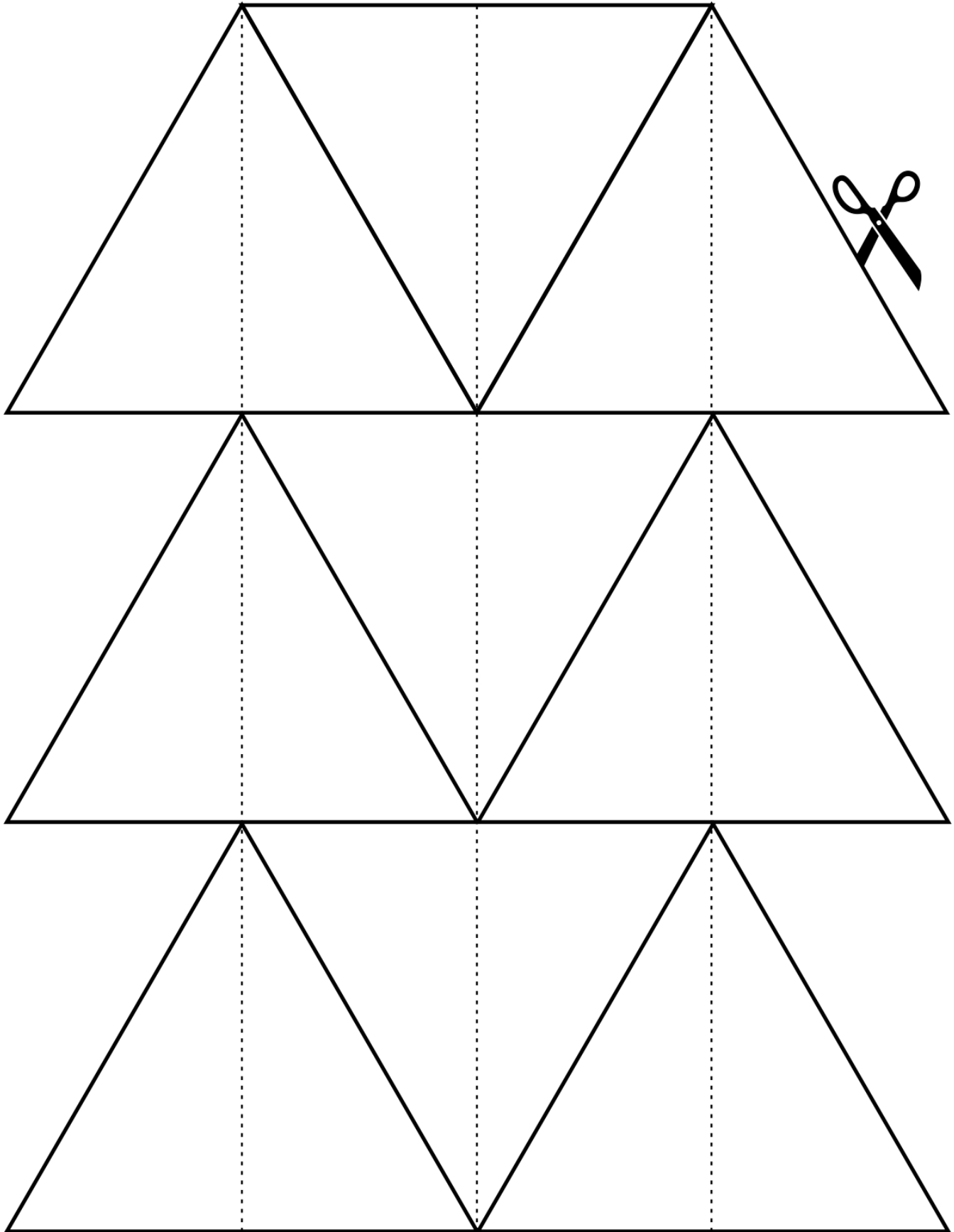
# TESSELLATION LETTERING

Below demonstrates how abstract letters can be created from various shapes. Stretch, bend, and form letters to whatever shape is featured in your tessellation tile.



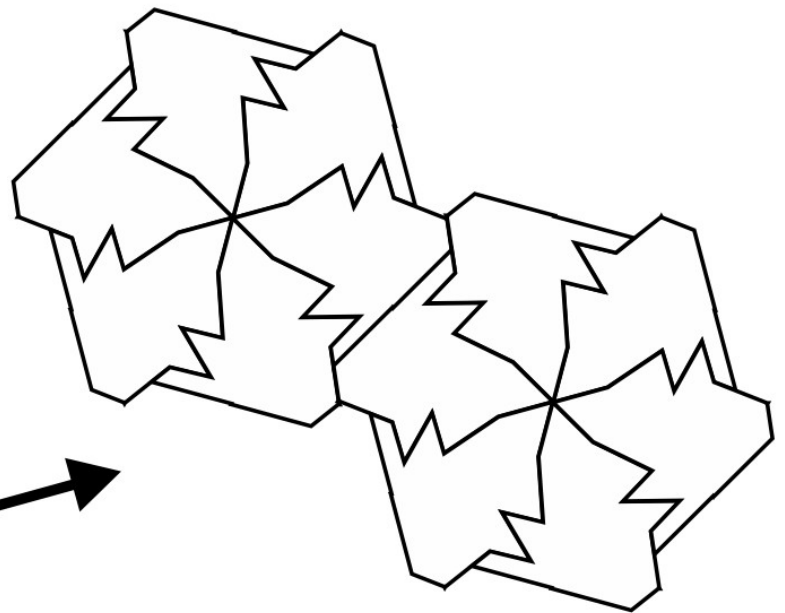
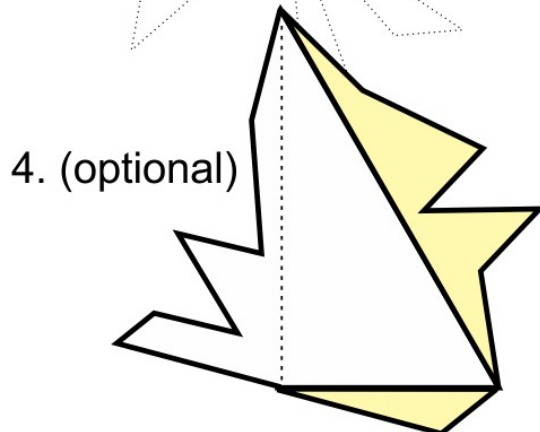
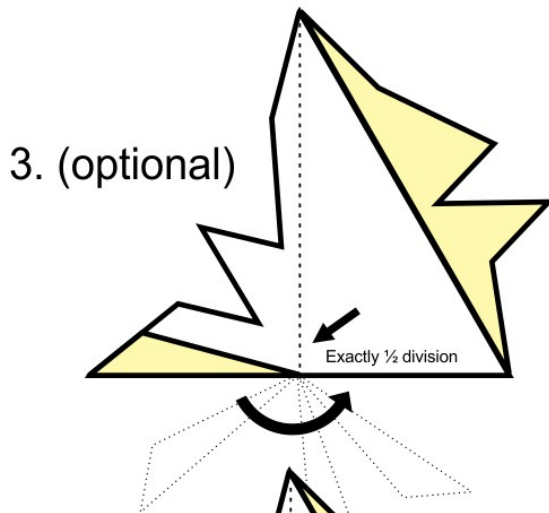
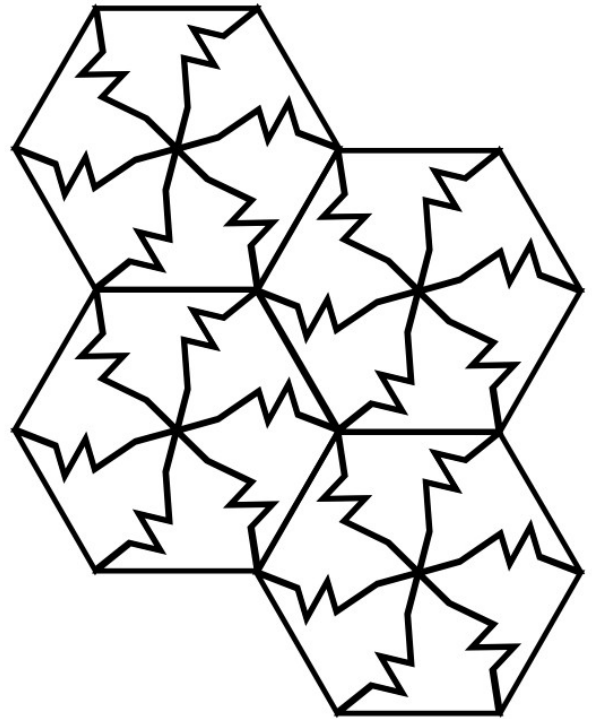
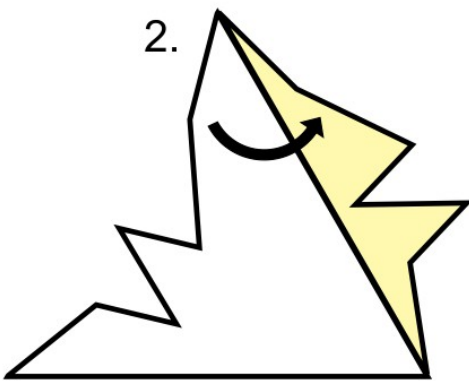
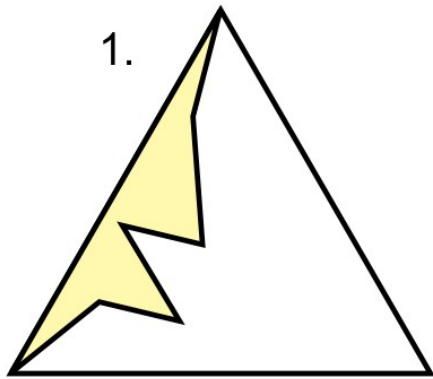
# TRIANGULAR TILES

These tiles may be cut apart for triangle-based tessellations.



# TRIANGULAR TILES

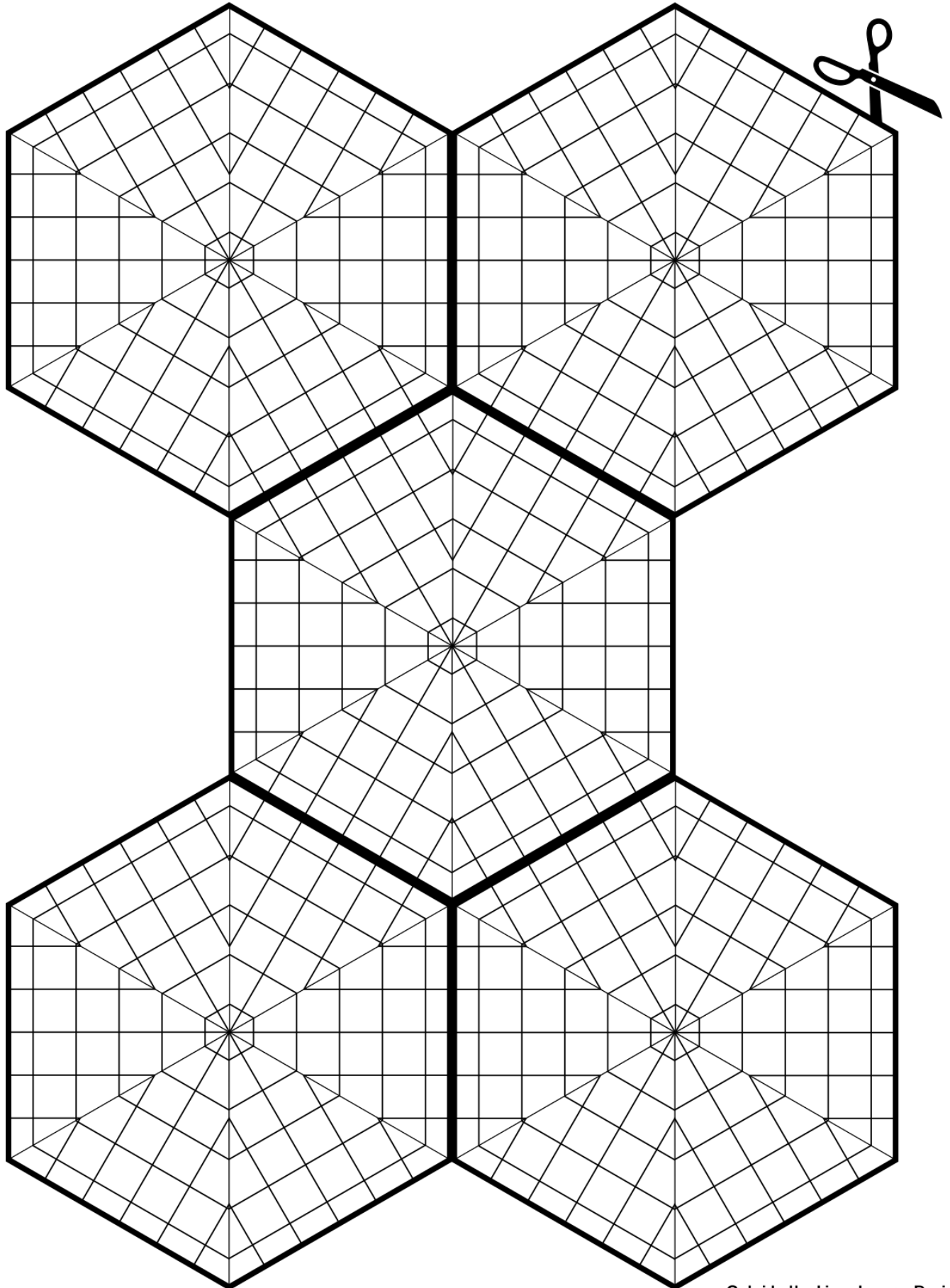
Still another variation is to begin a tile as a triangle. Cut from one side and rotate to the other. The pattern will create hexagonal shapes that tessellate. Optionally, one may choose to cut a piece from half of the remaining base of the triangle and rotate it to the other half of the base and re-attach.





# HEXAGONAL TILES

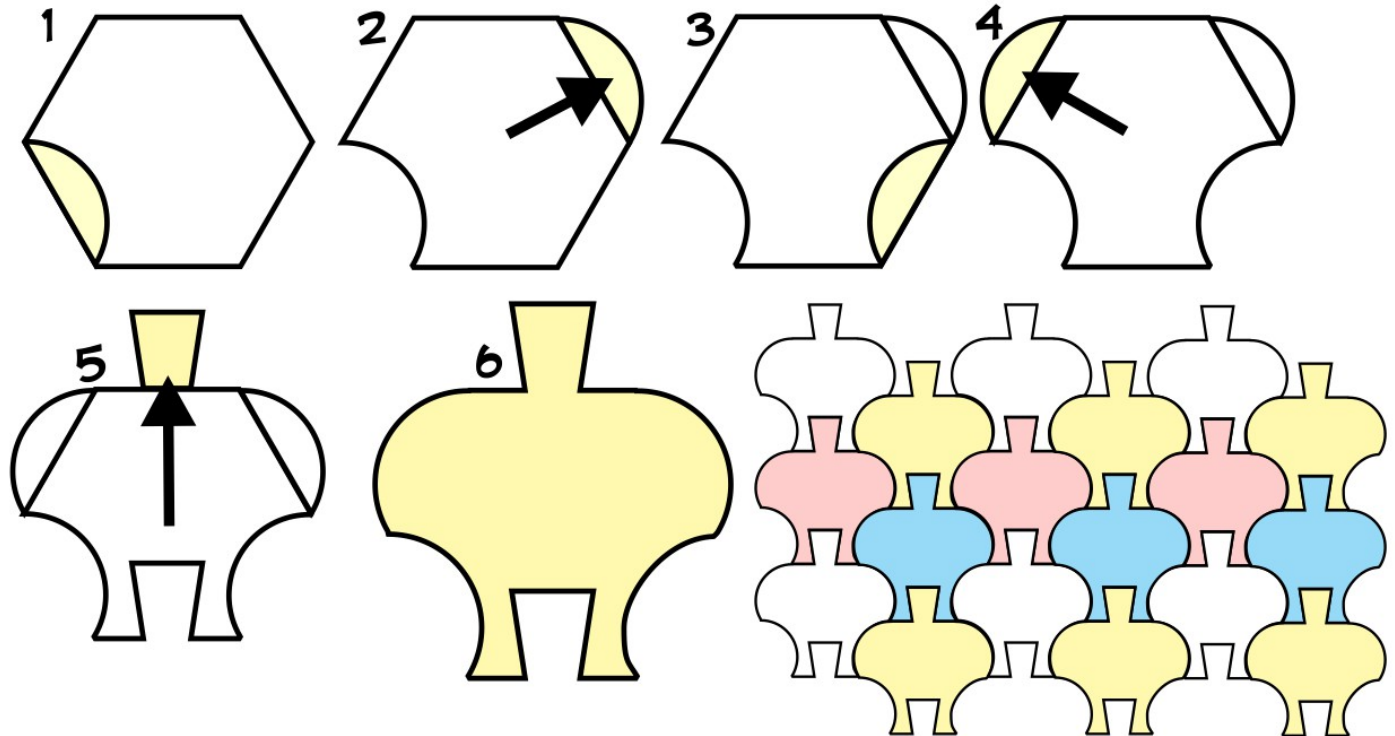
These tiles may be cut apart for hexagon-based tessellations.



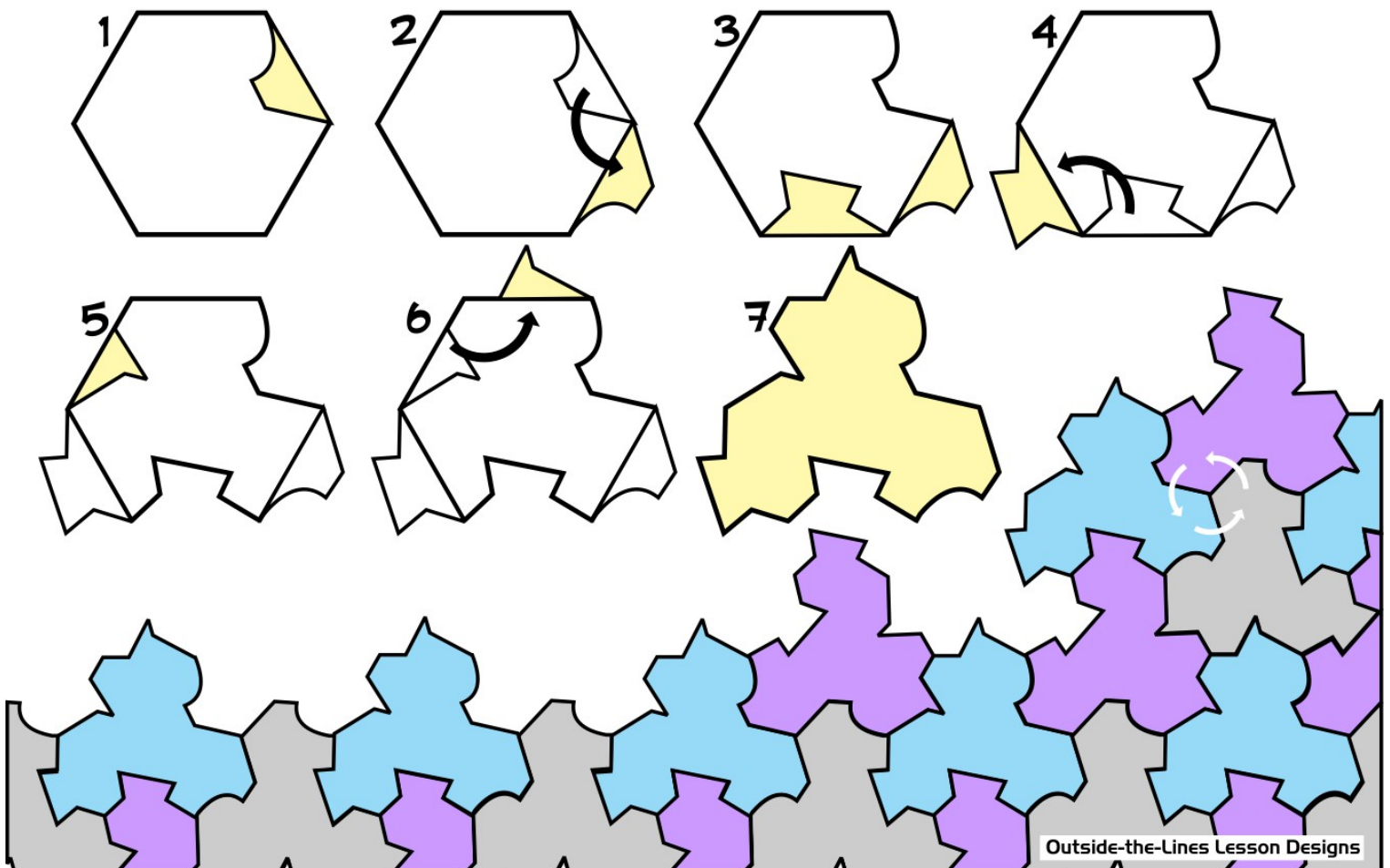
# HEXAGONAL TILES

Hexagons also tessellate. This means we can use a hexagon as a base shape to create a tile just as we do with squares and triangles. The translation or rotation technique may be used. This is more advanced only in the fact that there are more sides to keep track of.

## TRANSLATION

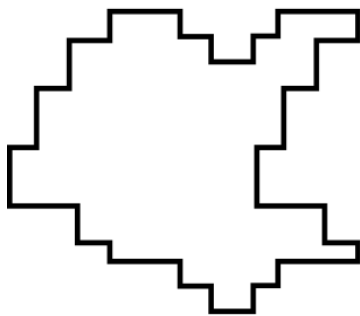
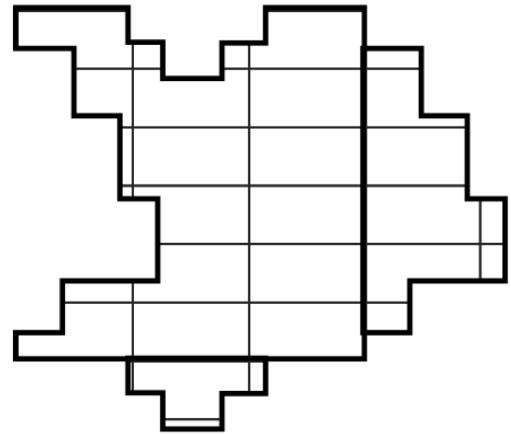
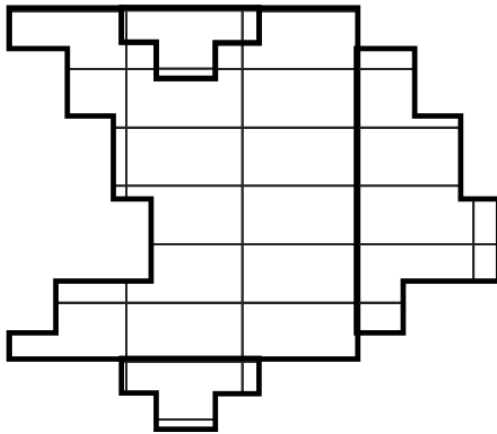
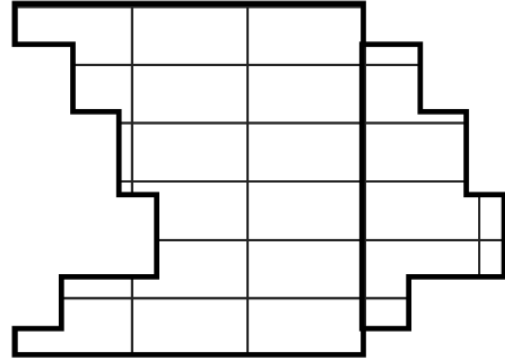
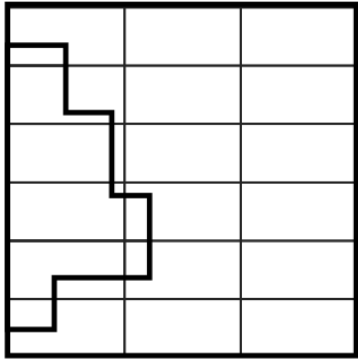


## ROTATION

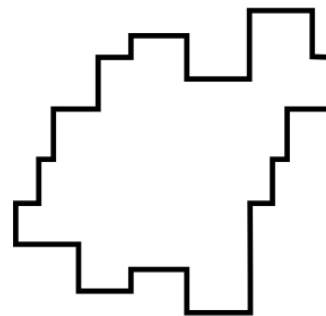


# 8-BIT INSPIRED TESSELLATION

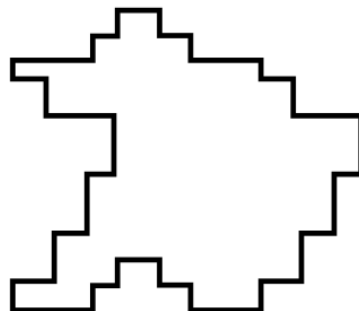
To give your tile a retro arcade look, make your cuts consist of perpendicular lines as shown. These tiles are reminiscent of 8-bit video games and minecraft-style designs.



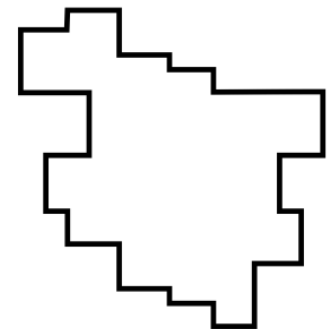
**A goblin face?**



**A dinosaur?**



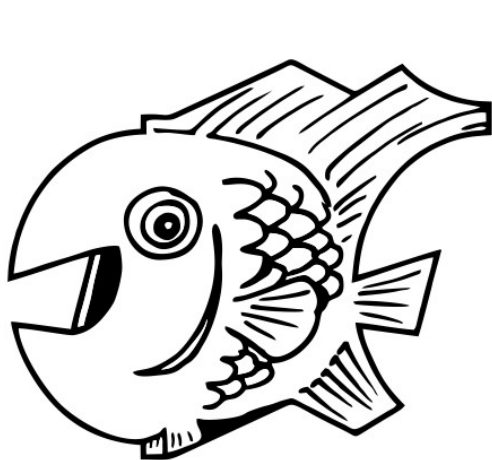
**A man in a hat and cape?**



**A flying dragon?**

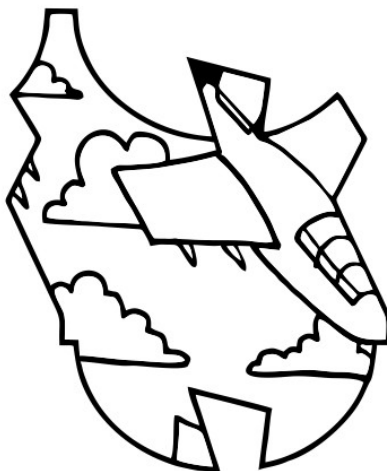
# INTERPRETING A TESSELLATION TILE

The most challenging part of creating a tessellation artwork is interpreting the tiles you create. This is where you identify something to make a blank tile into. It is best to create several tiles and then lay them out and look for a resemblance to something. It takes a considerable amount of imagination to spot a recognizable shape in those blank tiles. be sure to rotate each tile and even flip it over when trying to identify your subject matter. The following examples point out some helpful hints, cheats and guidelines for turning your tiles into something.



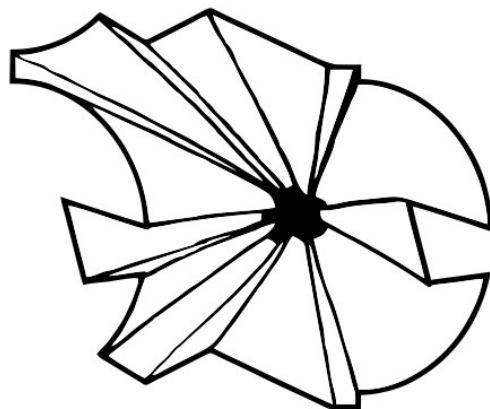
## SOMETIMES YOU GET LUCKY!

Luck plays a big part in your success...and you can actually increase your chances by simply creating more and more tiles. Sooner or later you'll hit on something.



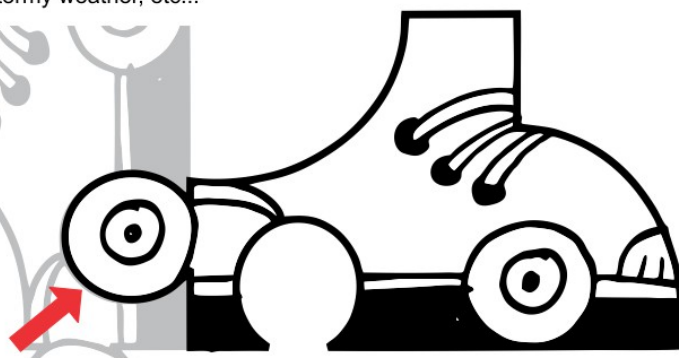
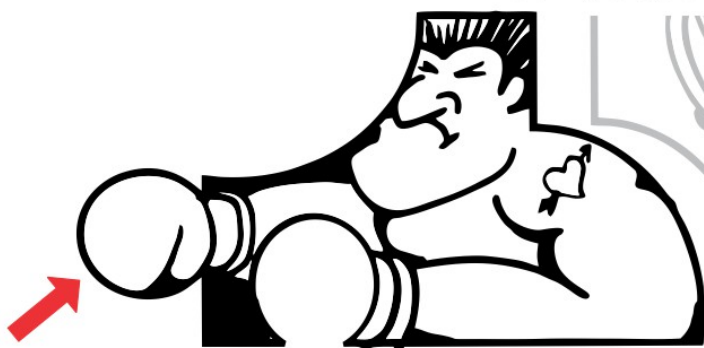
## CHEATING TECHNIQUE:

Its not true tessellation, but another strategy is to create an object out of part of the tile...whatever remains can become a background. The above design could allow for a variety of backgrounds occurring the design. Cloudy sky, then night sky, then stormy weather, etc...

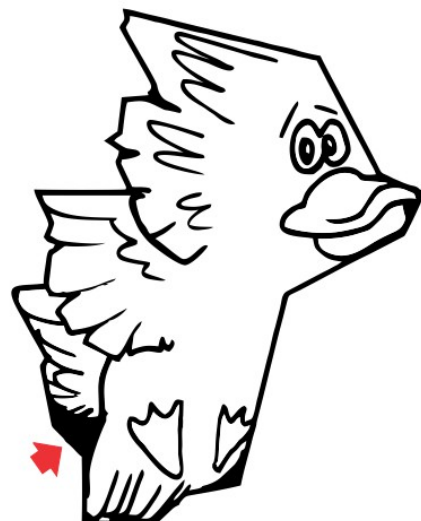


## NON-OBJECTIVE

Can't come up with anything? As a last resort, your tile could be non-objective. Just create a unique design inside your tile.



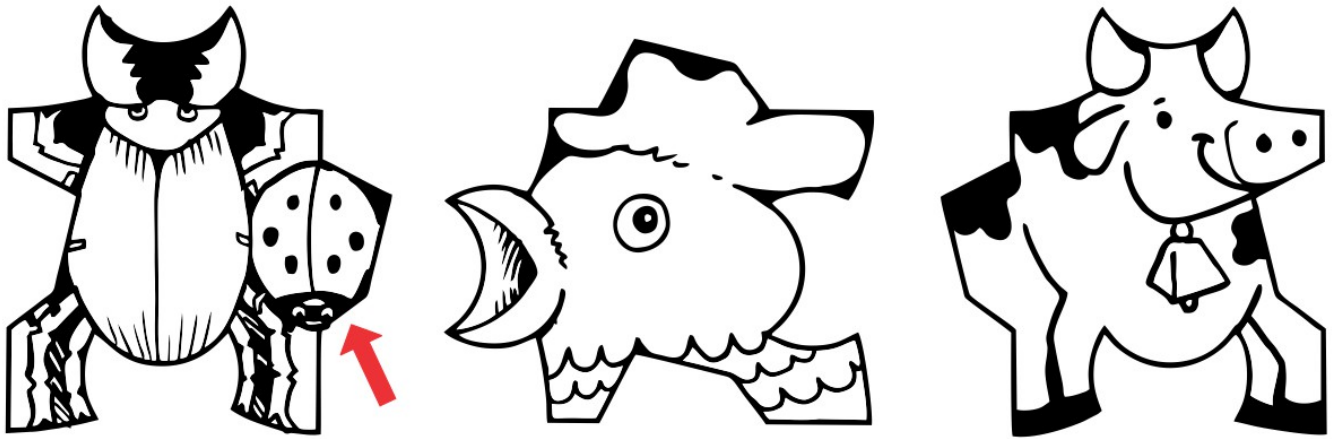
In this design, the round shape to the left becomes part of the adjacent object when the tiles are assembled.



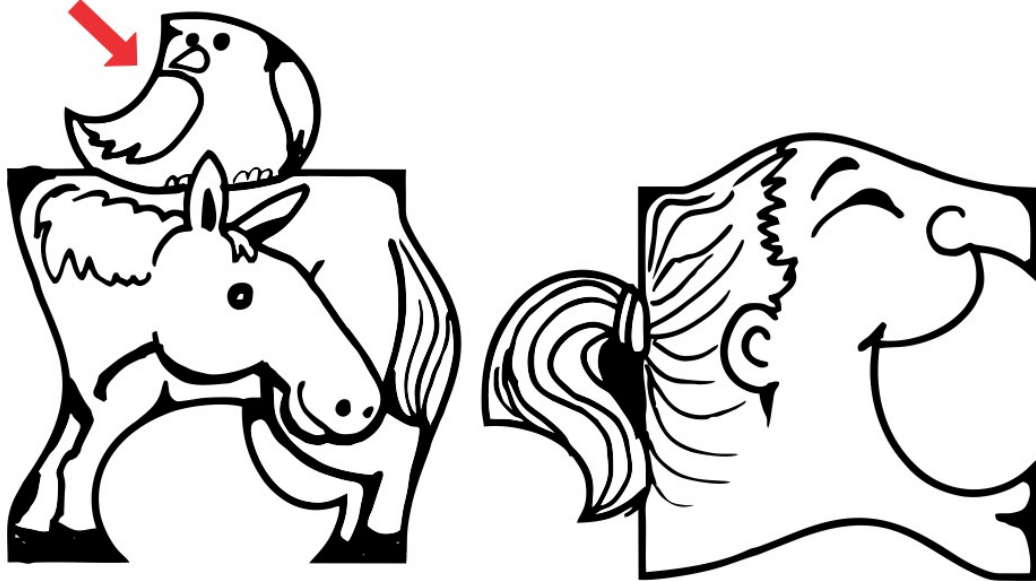
Use black to void out unusable areas, round corners, or otherwise adapt your shape to the object you are creating. Keep the use of this method to a minimum. True tessellating design should not need to rely on this too much.



## INTERPRETING A TESSELLATION TILE



You don't have to use the whole tile for a single object. Sometimes it's easier to draw your object on part of the tile and use the remaining shape to create a secondary object.

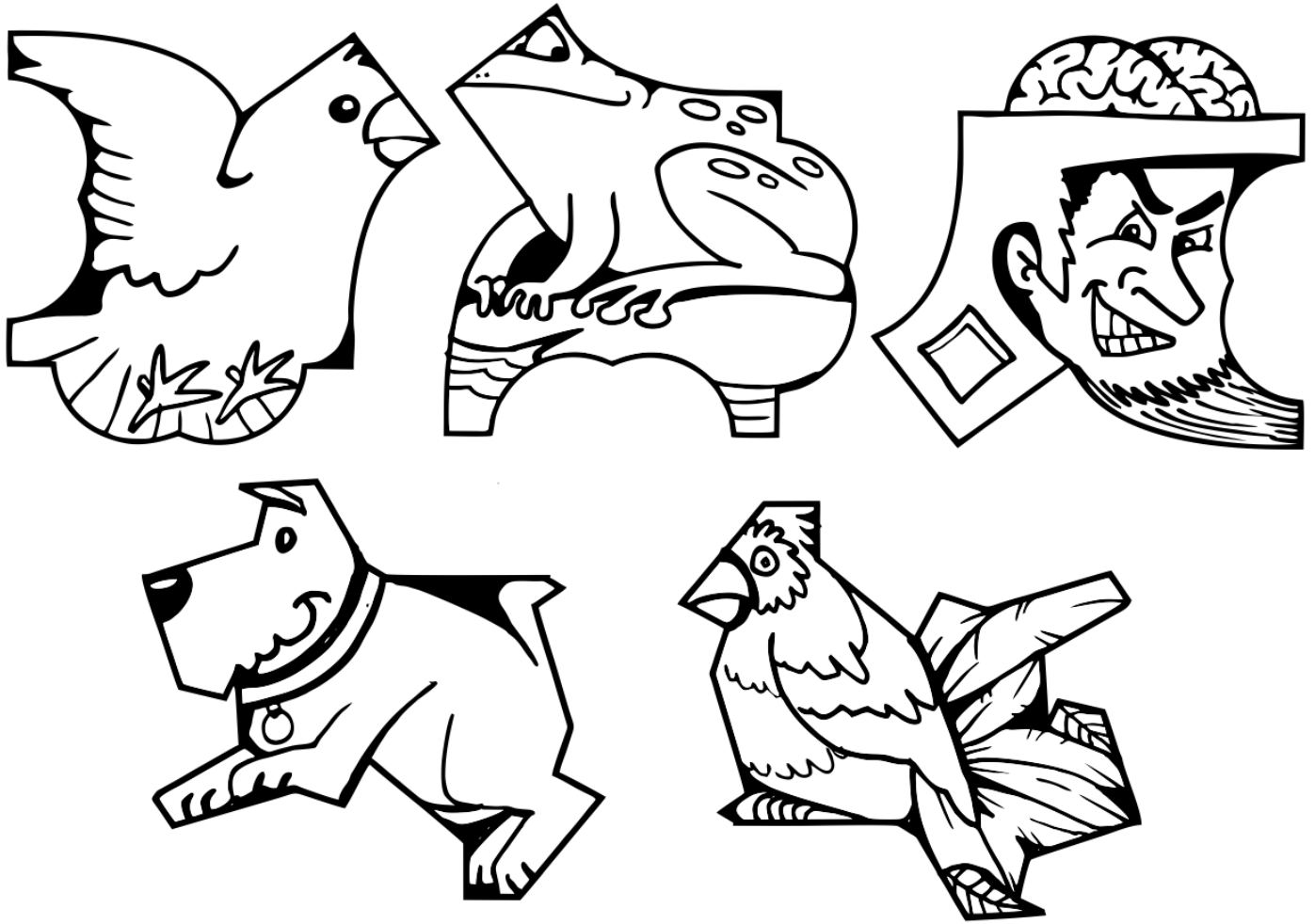


If you create a face or character, you have the opportunity to create a different expressions on the recurring faces in your final tessellation design.

### CHEATING TECHNIQUE:

In a particularly difficult situation, remaining, unusable shapes can be used as background. Again, this is not true tessellation so use this only as a last resort.

## INTERPRETING A TESSELLATION TILE



If you come up with more than one object for a single tile, consider alternating the objects in your final design. The dog and bird designs are created from the same tile. Below, the two designs are alternated in a pattern.

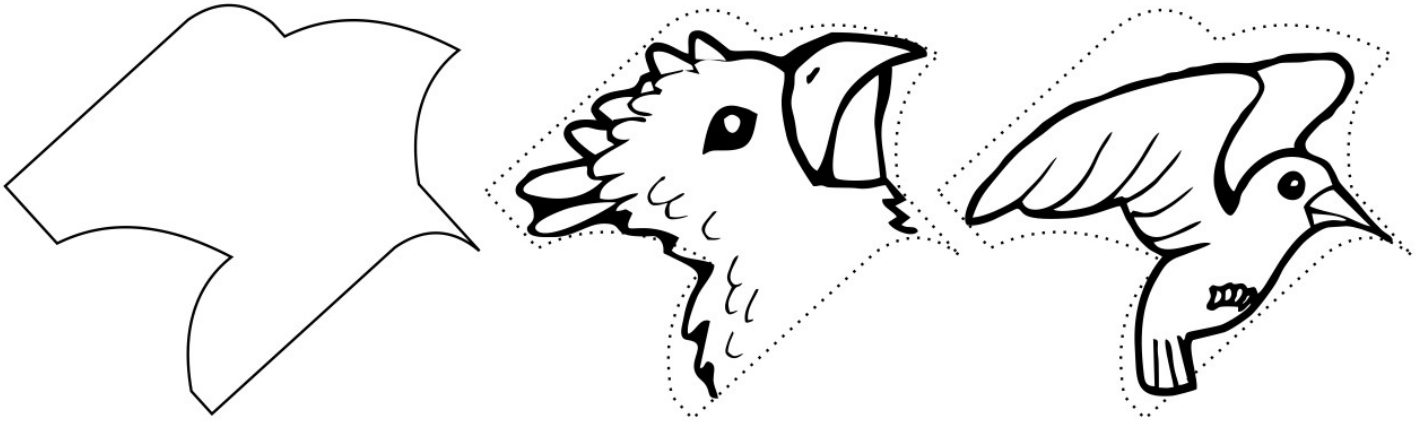


# METAMORPHOSIS TESSELLATION

Another tessellation strategy is to address metamorphosis with a tile. Often, one will have a tile which looks a tiny bit like two different things...but not very much like either. Additionally, there may be a strong desire to alter a tile slightly to make an object work better. METAMORPHOSIS could be the answer.

Alter the tile all you like to make two different subjects as below.

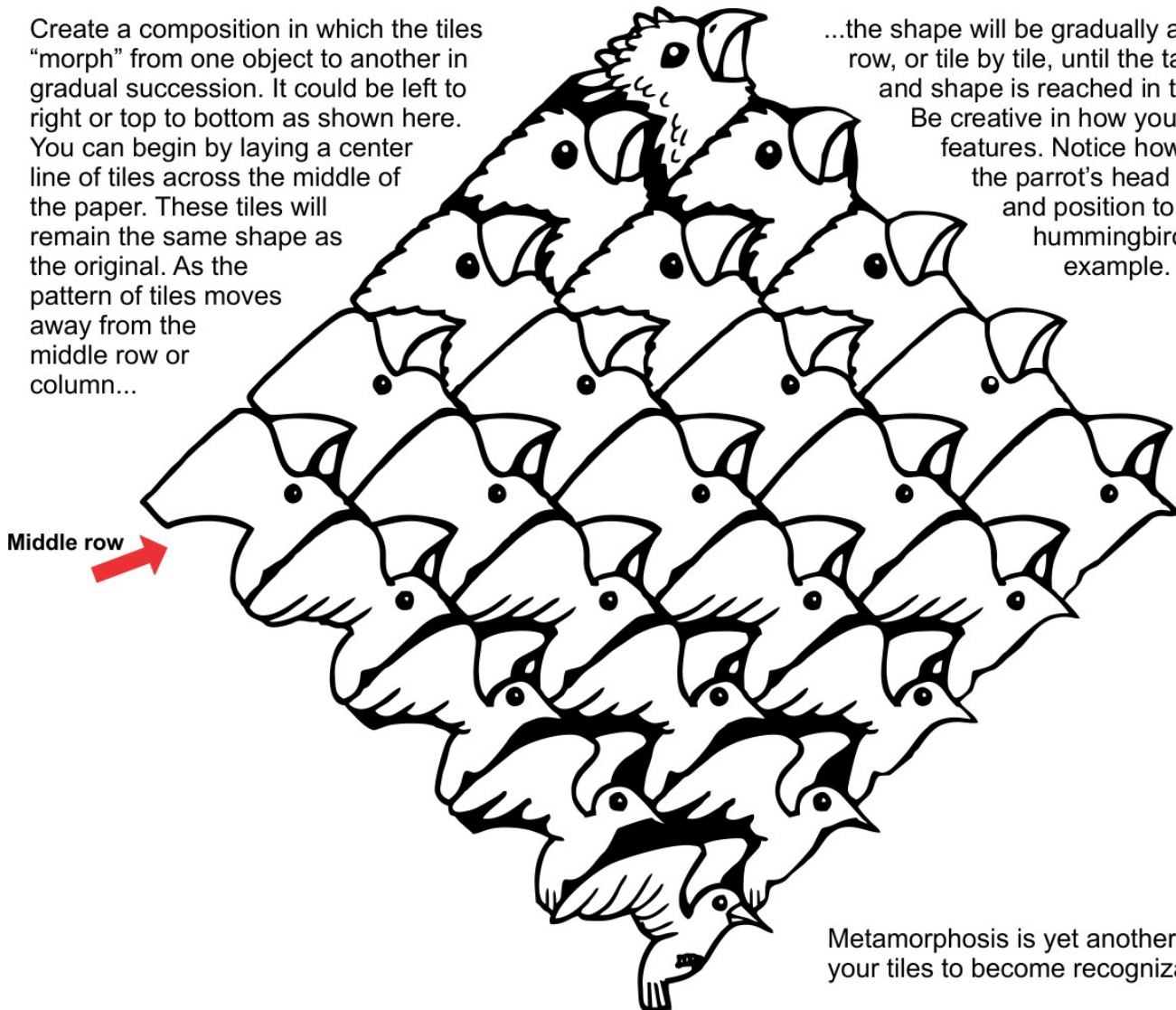
Notice how the shape only vaguely follows the contours of the original tile..



Create a composition in which the tiles “morph” from one object to another in gradual succession. It could be left to right or top to bottom as shown here. You can begin by laying a center line of tiles across the middle of the paper. These tiles will remain the same shape as the original. As the pattern of tiles moves away from the middle row or column...

...the shape will be gradually altered row by row, or tile by tile, until the target subject and shape is reached in the final row.

Be creative in how you change the features. Notice how the eye of the parrot’s head changes size and position to become the hummingbird’s eye in this example.

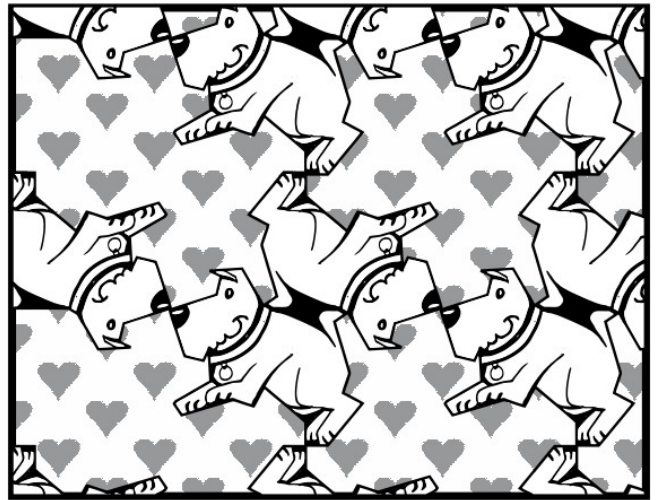
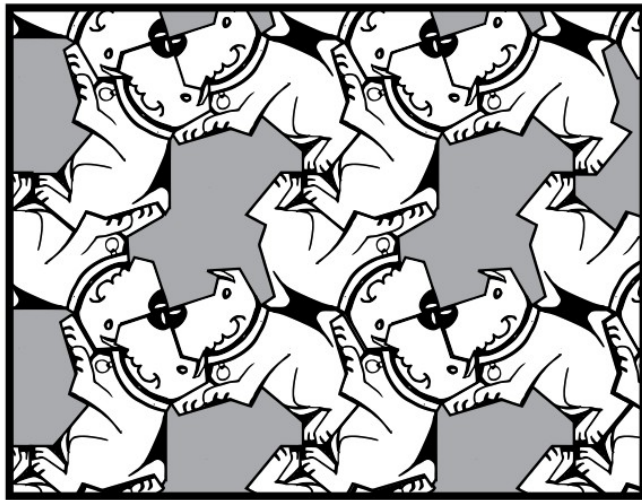
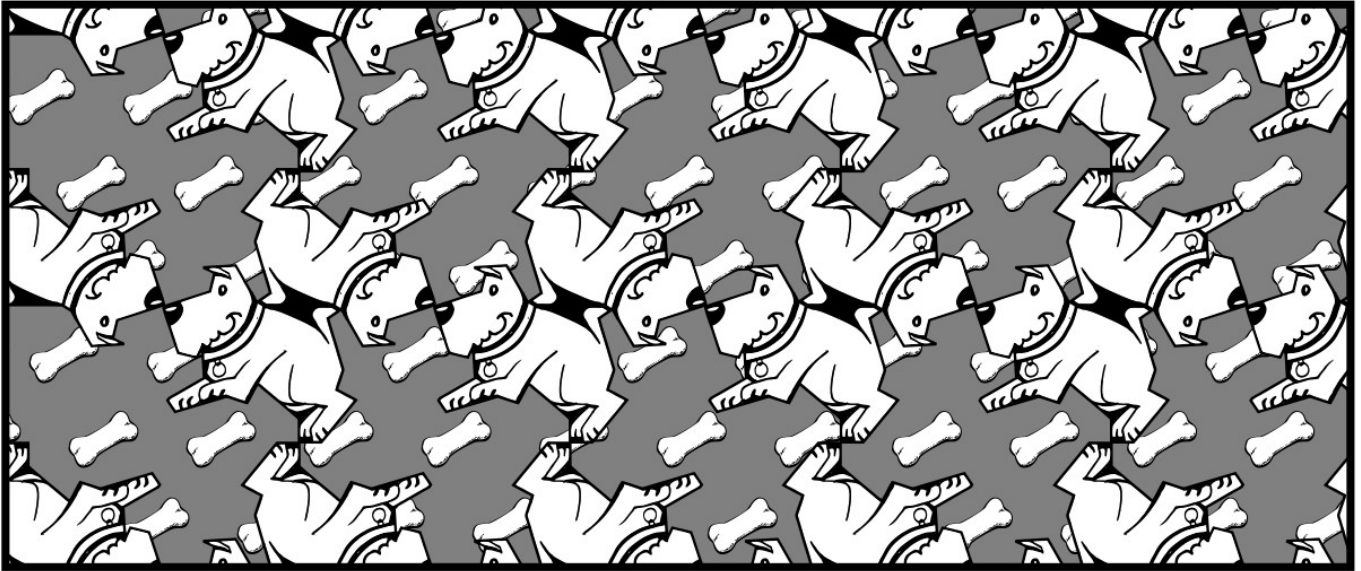


Metamorphosis is yet another way to force your tiles to become recognizable objects.



## CREATING ARTWORK FROM THE TILES

Every tile in a tessellation does not need to be rendered the same. One could choose to select certain tiles to interpret as a background in contrast to the other tiles. In the image below, the original tiles were omitted from certain places to reveal a background featuring other colors or patterns.







Outside-the-Lines Lesson Designs



