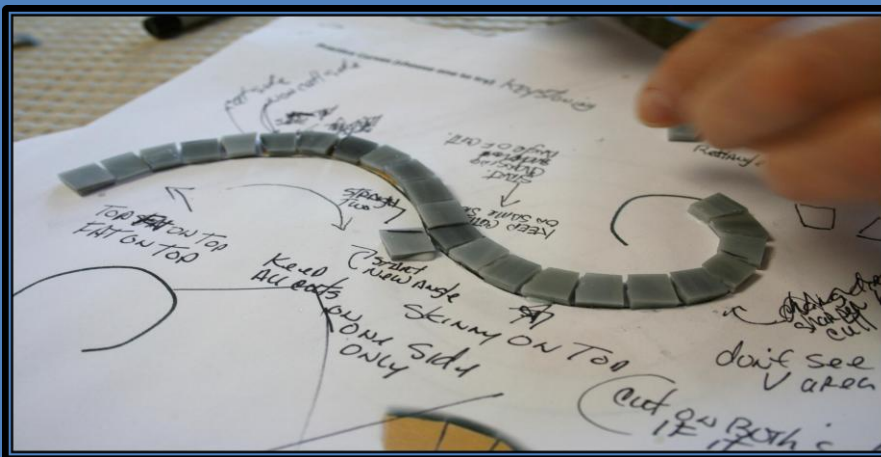


# ANDAMENTO & KEYSTONING E-WORKSHOP

The purpose of this hands-on virtual workshop is to introduce you to my own personal mosaic keystoneing techniques, as well as the way in which I combine these techniques to create effective andamento. This e-workshop was developed based on lessons taught in several studio classes, and it incorporates the feedback of many students.

*Advanced techniques for smooth curves and natural lines in mosaic*



By Crystal Thomas

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## Materials

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This workshop includes 5 hands-on practices ([with “answer keys” at the end](#)). The practices are designed to be printed and worked on directly as templates. So get out your **wheeled nippers** and some glass. Preferably, you’ll want a large handful of **stained glass squares** in three sizes:

- 3/4 inch
- 1/2 inch
- 3/8 inch

You could use vitreous for the practices, but you’ll find that stained glass squares allow for more precise and predictable cuts. You can buy these three sizes of glass in many colors at:

<http://mosaicbymaria.com/> and <http://www.stainedglasstile.com/>

You may also choose to cut **paper squares** for these exercises, particularly Practice 1 & 2, as I do in my workshops. This reduces waste when you are just learning the basics of precise angled cuts.

You’ll also want some **clear contact paper**, which you can buy at your local drug store, hardware store, Target, etc. Tape a piece down, sticky side up, over each practice in this workshop so that you can place your glass directly on the design. Your glass won’t slip, but you’ll be able to move it easily. This method also allows you to re-use the templates (not to mention the glass) as many times as you like.

OK, now get yourself a cup of coffee or tea, or perhaps a nice glass of wine (in my classes, mimosas are the tradition), and make yourself comfortable. Let’s get started!

## Andamento & Opus

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We'll start with a brief introduction to the concepts of *andamento* and *opus*.

- **Andamento** can be described as the flow and rhythm of your tesserae.
- **Opus** is the name used to describe the way in which tiles are laid relative to one another to create andamento.

The two terms are very closely related, but you can think of *andamento* as the **flow** and *opus* as the **pattern** used to create the flow. They are used together to create a sense of **movement**, **mood**, or just a **feeling**. While *andamento* is usually reserved for discussions of flow or movement, *opus* can be used to achieve any effect, including lack of movement; for example, you can use certain types of *opus* to achieve a flat look for a mosaic background.

The next page shows a small selection of traditional *opus* examples. For more in-depth coverage of *opus*, please visit:

<http://www.thejoyofshards.co.uk/glossary/index.shtml>, in particular:

- [Opus](#)
- [Opus musivum](#)
- [Opus paladianum](#)
- [Opus regulatum](#)
- [Opus sectile](#)
- [Opus tessellatum](#)
- [Opus vermiculatum](#)

And also: <http://www.mosaic-tile-art.com/mosaic.html>

Here are few classic opus examples:

#### **Opus regulatum**

Straight laid, as seen on many bathroom floors and shower walls. Creates a stable, calm background, but can be difficult to align perfectly.



#### **Opus tessellatum**

Opus regulatum, laid in offset rows, as in a brick wall. This method creates a slight sense of movement and is easier to lay.



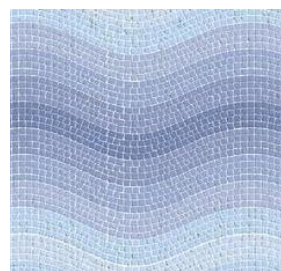
#### **Opus vermiculatum**

Smoothly flowing lines that follow soft contours, usually around a central object. Best for creating a sense of movement. Often combined with Opus tessellatum.



#### **Opus musivum**

Smoothly flowing lines that follow soft contours, sometimes continuing an opus vermiculatum pattern, often filling an entire background. Creates a strong sense of movement.



#### **Opus palladianum ("crazy paving")**

Haphazard style incorporating random shapes. A lively and balanced choice for backgrounds.



#### **Opus sectile**

Larger pieces typically cut into a complete shape and inlaid into walls and floors to make a picture or pattern.



These classic examples are very basic, and you won't see most of them used on their own very often. My favorite examples of andamento combine more than one type of opus or use traditional opus in an unusual or interesting way, as you will see on the next page.

When you become comfortable with various types of opus, you can combine them to create effective and interesting andamento, as illustrated in these two examples.

Mosaic and photo © Helen Miles,  
<http://helenmilesmosaics.com/>



Mosaic and photo © Crystal Thomas



We'll move on to keystoneing next, and along the way we'll explore how good keystoneing can help you create the andamento effect you want to achieve.

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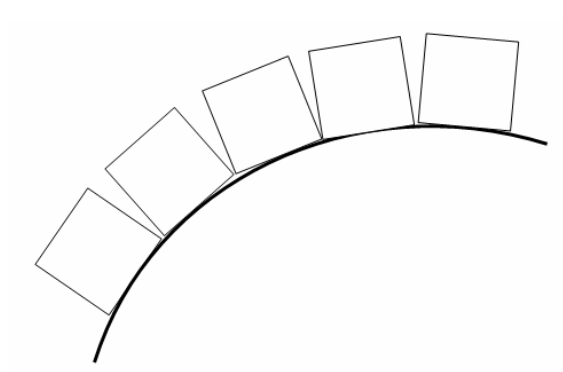


## Keystoning

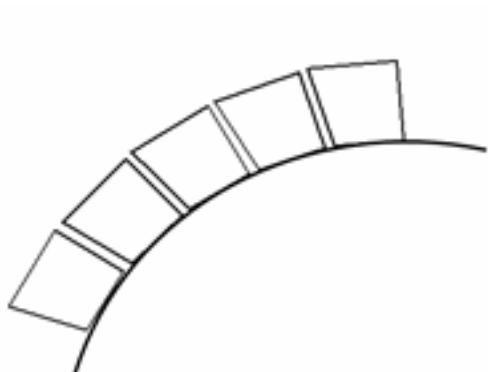
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**Keystoning** is essentially a way of cutting and placing tesserae side by side along a curve so that both the top and bottom corners meet. With good keystoning skills, you can control the curves in your mosaic and create effective andamento.

**Uncut** squares placed around a curve will create V shapes, but if each square is cut to follow the curve and meet the piece next to it, you will create a smooth line.



Uncut squares around a curve. For decorative mosaics, this look can be fine.



Squares with one side cut create a smooth appearance, better for creating flowing andamento.

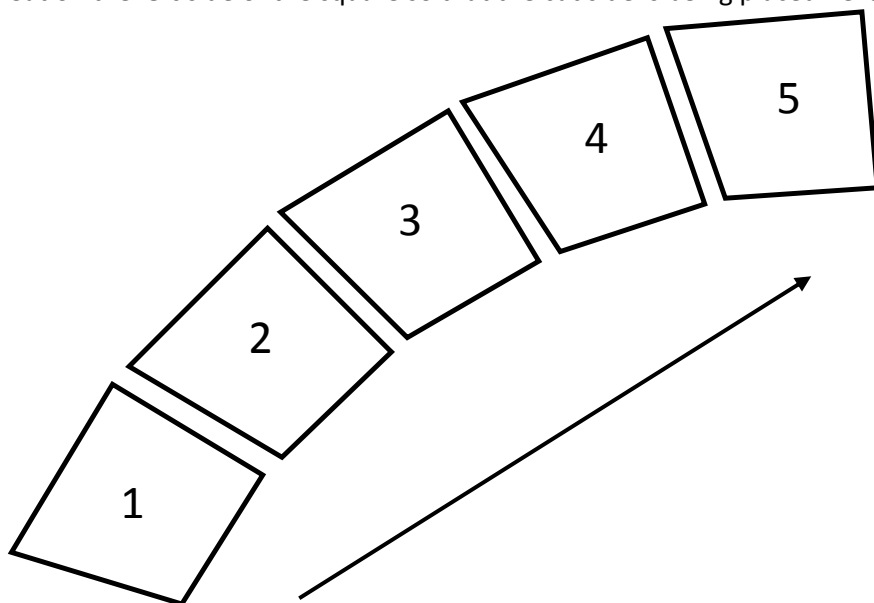
Here's the trickiest part to learn. It's also my #1 rule for effective keystoning, so it's worth it, even if you have to repeat it to yourself again and again (I still sometimes do). If you find it confusing at first, read through the next couple of pages, and then come back and review the concept.

To ensure a perfect fit, **cut an angle on one square to fit the uncut side of an adjacent square**, and continue with this pattern. If you lay an uncut side next to a cut side, you have much less control over your curve.

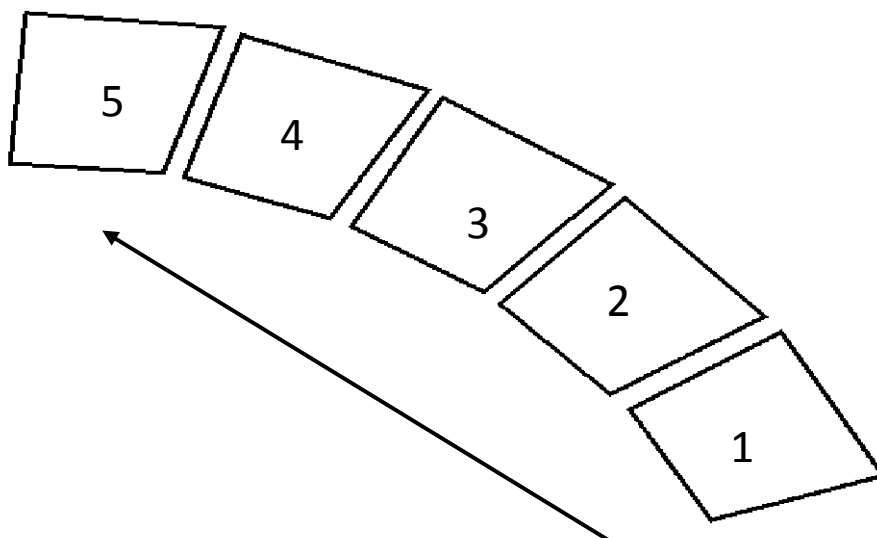
See the next page for a visual example.

**Left to right:**

Cut on the **left** side of the square so that the cut side is being placed next to an uncut (90° angle) side.

**Right to left:**

Cut on the **right** side of the square so that the cut side is being placed next to an uncut (90° angle) side.



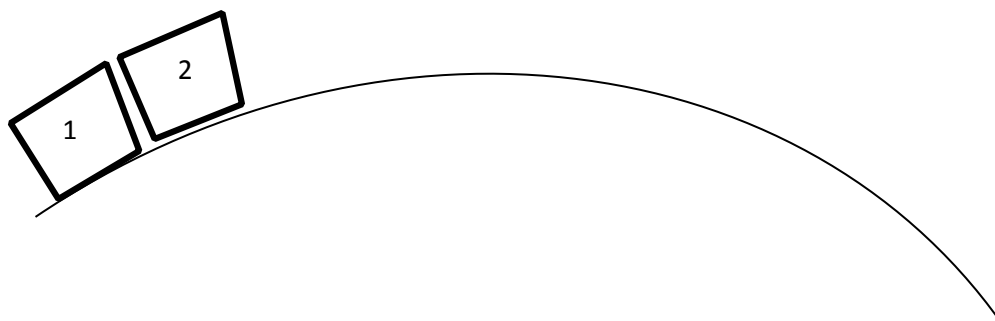


## PRACTICE 1

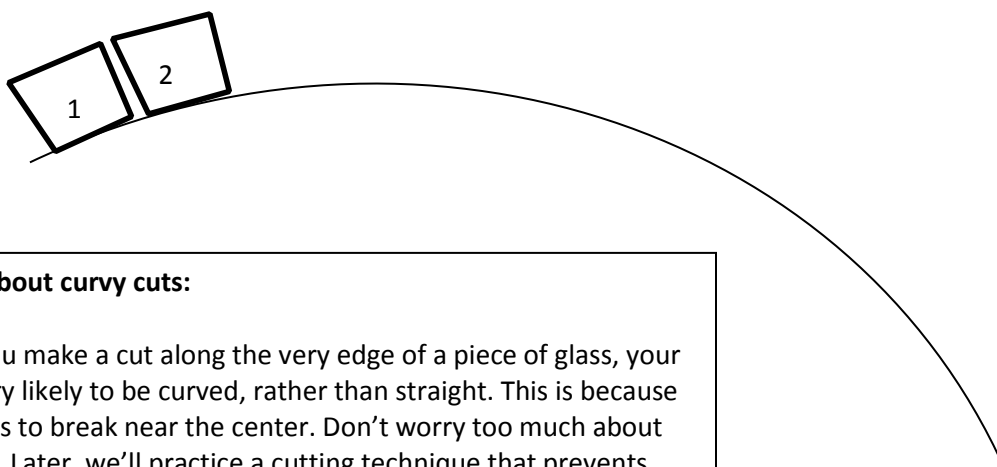
For this practice, I recommend uniformly cut **paper squares and scissors** if feasible. If not, start with your most dispensable ½-inch glass.

Print this page, and, if working with glass, tape a piece of clear contact paper over the patterns below.

On the first curve, lay an uncut side next to a cut side (yes, do it the “wrong” way!) and continue along the line. Note how much control you have over your curve. You are forced to guess the angle of your cut, so you have less control over the curve.



On the second curve, lay a cut side next to an uncut side (the “right” way now) and continue along the line. Note the increased control over your curve. You can lay the new piece next to its neighbor and eyeball, or even draw, the exact angle before you cut, which ultimately gives you more control over your curve.



### A note about curvy cuts:

When you make a cut along the very edge of a piece of glass, your cut is very likely to be curved, rather than straight. This is because glass likes to break near the center. Don't worry too much about this now. Later, we'll practice a cutting technique that prevents this from happening.

## Envisioning a Circle

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For some people, it's helpful to imagine that your curve is part of a circle, with straight lines that radiate out from a central point. *Each **angled cut** you make should align with an imaginary line* going to the center of the circle. (Don't focus on the angle of the uncut side of the square.)

Here are a couple rules of thumb for visualizing this way:

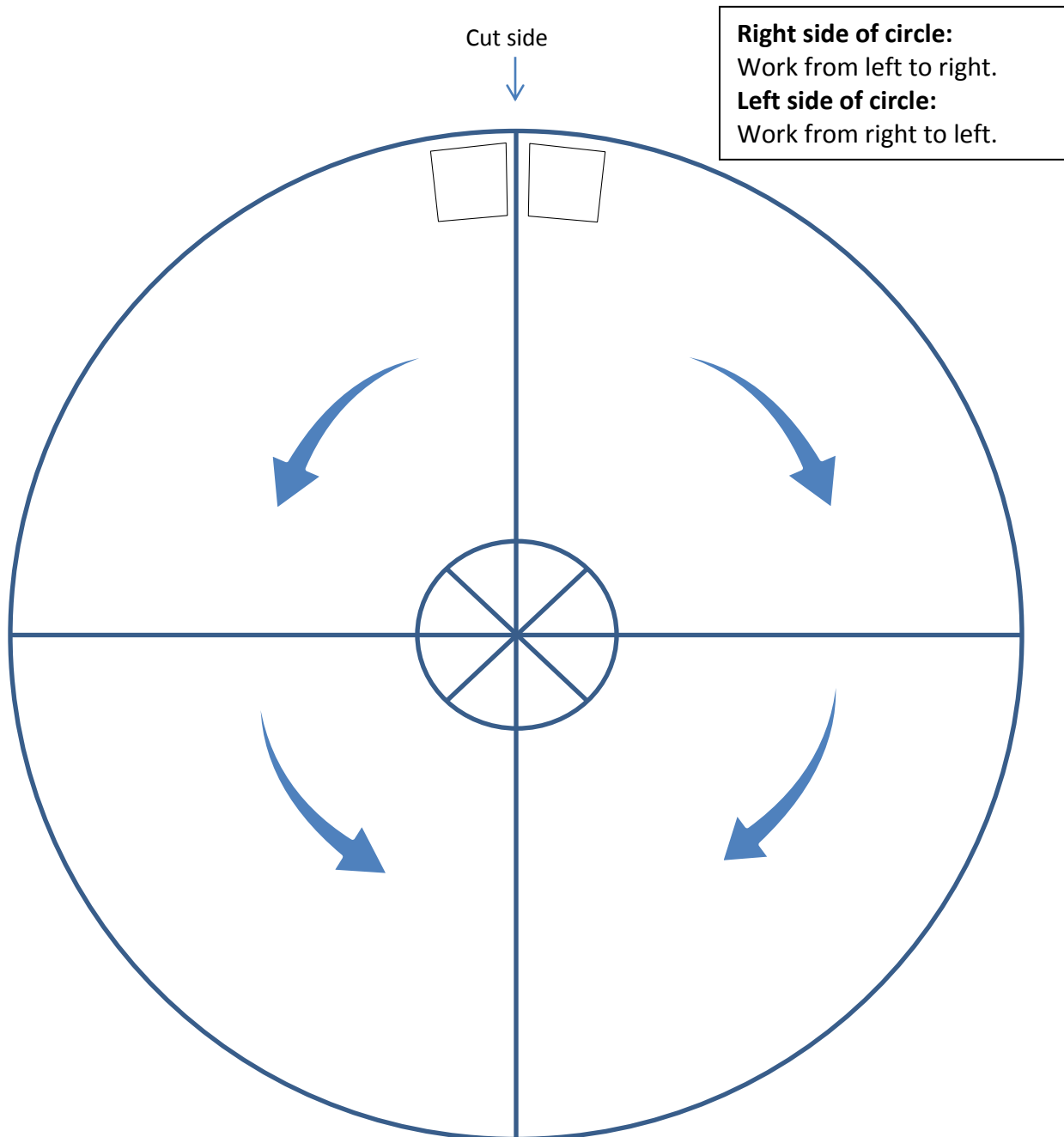
- For wider curves (the outside circle in this case), you should only need to cut one side of the square. Only at the very center of a circle should you need to cut both sides.
- The tighter the curve, the sharper the cut.

The practice and instructions are on the following page.

## PRACTICE 2

Using ½-inch stained glass squares or paper:

1. Try working in both directions on the outside curve of this circle.  
Remember: When working from right to left, cut on the **right side**. When working from left to right, cut on the **left side**.
2. Then practice cutting on both sides (trapezoids or triangles) to fit the inside circle.



## Curves That Change

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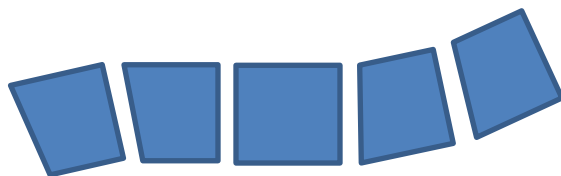
This next practice (on the next page) is very important for learning what to do when the direction of your curve changes. Many students get stuck for the first time on this practice, so it may be valuable for you to complete both sample curves. Just remember the rules and go slow, replacing pieces if you make a mistake.

When a curve changes direction, you will change the direction of your cutting angle (**for example, your angle may switch from wide on top and narrow on bottom to narrow on top and wide on bottom**), but try to keep all your cuts on the same side of the square for the length of the line.

Except in very tight or abruptly changing curves, you will have **one or more transition pieces** that do not need to be cut when you switch from one direction to another. Curves often straighten out momentarily before changing directions. In the example below, the square in the center is the transition piece. Without it, your line may not transition smoothly, and the result will be an abrupt, choppy curve.

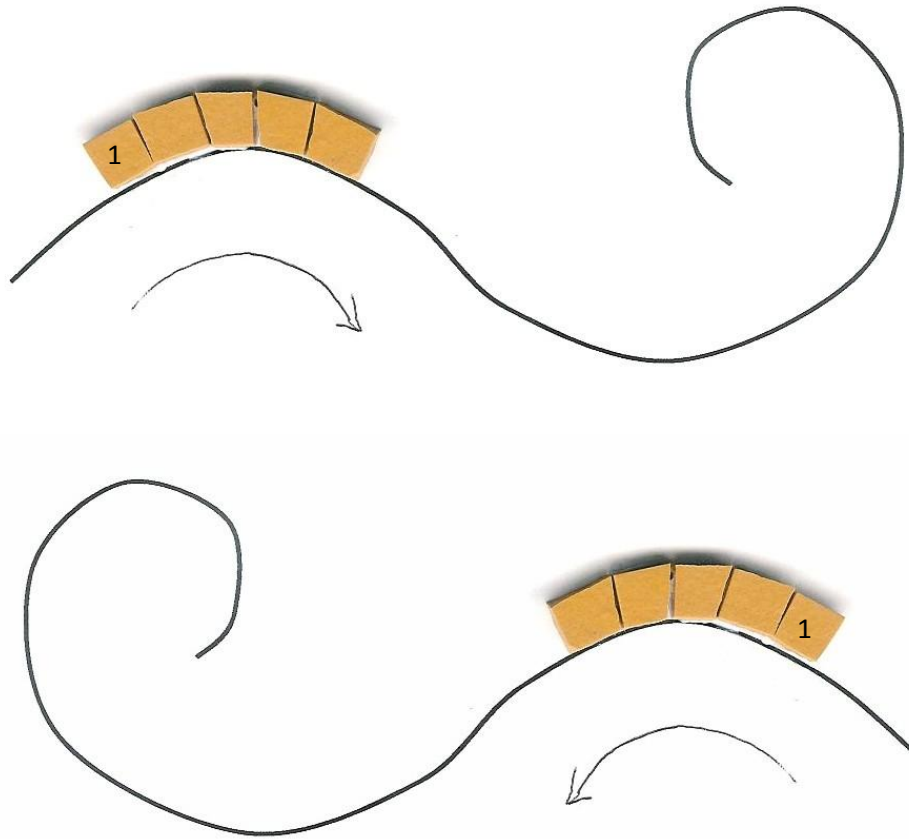
The following has helped many of my students:

**When in doubt, it may have straightened out.**



### PRACTICE 3

Using 3/8-inch glass squares, start on the #1 square and move along the curve to the end.



Remember:

- Working from right to left: cut on right
- Working from left to right: cut on left

Also remember:

Your line will straighten out when a curve changes direction. Use one or more uncut squares as transition pieces when this happens.

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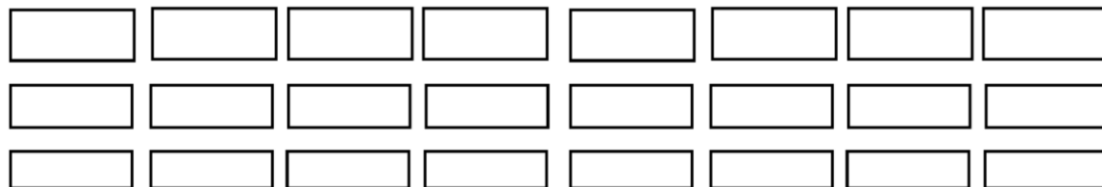
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## Working with Squares

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This next technique involves cutting larger squares into four pieces. This is an excellent way to prevent those curvy cuts, because glass is much more likely to break in a straight line if you cut down the center.

First, cut your squares in half into rectangles. Sort them by size and lay them out into 3 or 4 long rows (small, medium, large) before adhering. *Always work from one row at a time* to ensure even lines in your mosaic.



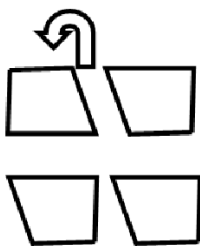
This process helps ensure that every piece you put down is similar in size to the piece next to it, creating better chances of a smooth line.

After you have your rows of rectangles laid out as above, you are ready to start placing your tesserae along a curve:

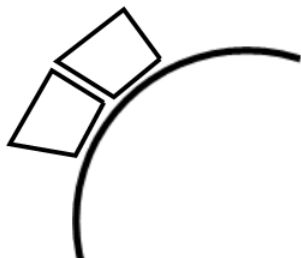
1. Cut down the center of a rectangle, at the appropriate angle for your curve.



2. Rotate one of the pieces 180 degrees. This creates **two pieces with identical cut angles**.

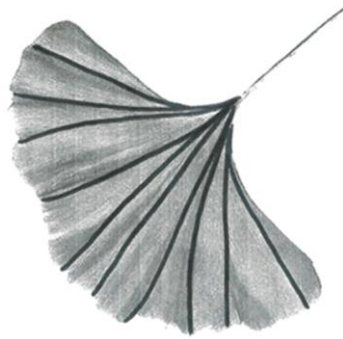


3. Place (cut side next to uncut side, as described earlier).



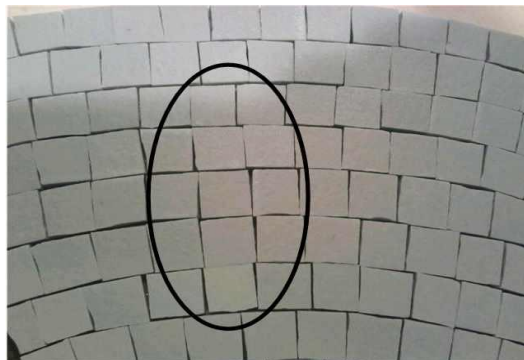
The next practice is designed to give you experience with **multiple adjacent rows**, incorporate some **andamento**, and fit rows of glass into the **inside spaces** between existing rows.

First, consider the contour lines of your image (or draw some), and place your tesserae along the major lines first; then fill in. Draw additional contour lines on your template if you like. In this ginkgo image, I've drawn contour lines (black) that I'll follow first, keystoneing as necessary along any curves. Then I'll fill the spaces in between. This creates a natural look. If I worked from one side of the leaf to the other, I'd quickly lose the contours of the leaf, and any andamento along with them.



However, keep in mind that any contour lines you draw are merely visual guidelines that serve as a reminder of where you're going. You will rarely follow them precisely, as it is very difficult to draw andamento lines that your tiles fit into perfectly.

**Tip:** While you're completing the next practice, watch out for unintended grout line "rivers," where several tiles stack up and align, creating a line. A stack of more than 3 or so draws the eye:



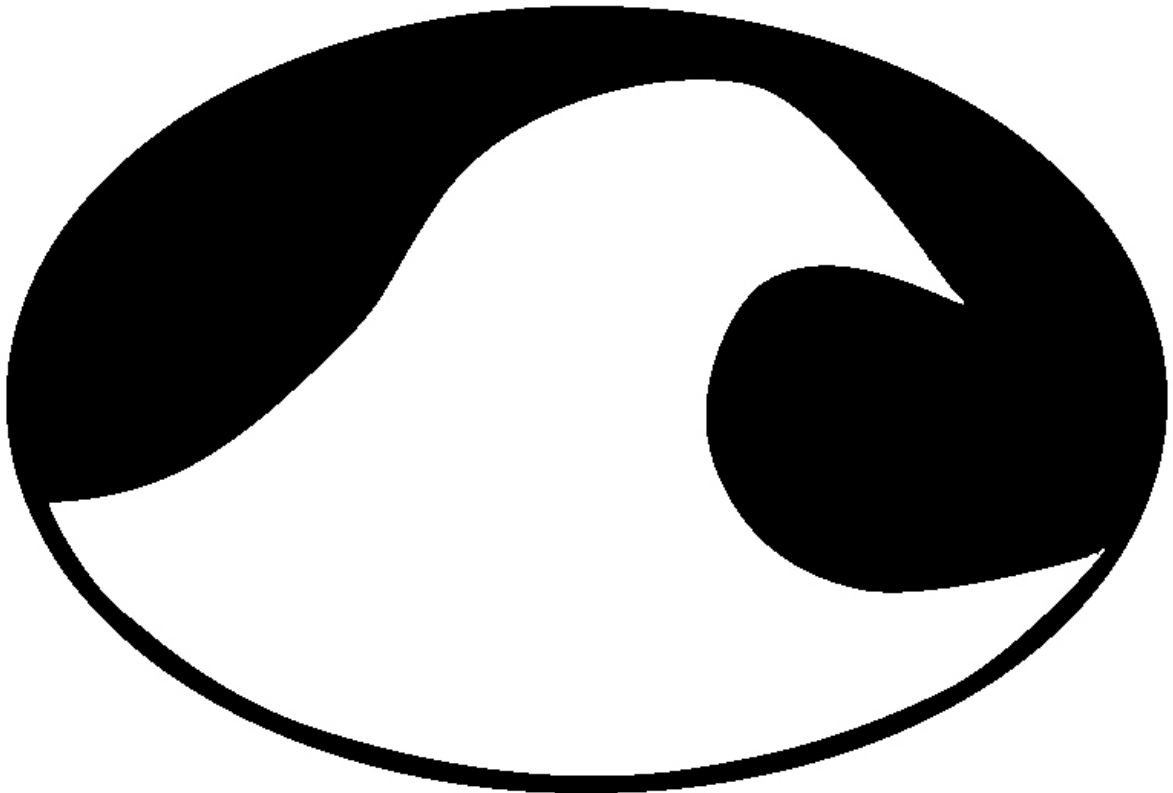


## PRACTICE 4

Using  $\frac{3}{4}$ -inch glass squares, follow the preceding guidelines to cut your glass into rectangles, make rows sorted by size, and cut them into smaller angled squares as you go.

Fill in the image of the wave below (the white portion) with glass using the keystoneing techniques described on the previous page.

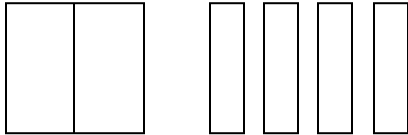
**Important:** Work from the outside in, rather than starting at the top or bottom of the wave and working your way across. For example, complete a row across the top, then a row along the right side, then the bottom, and so on, alternating until you reach the middle. In the center, your rows will become shorter and shorter and then eventually thinner in the very middle, requiring you to shave off the top or bottom of each piece to fit into the remaining space.



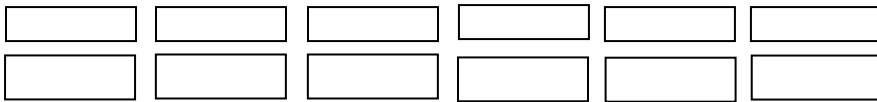
## Working with Rectangles

Working with rectangles is the last option covered in this workshop. For me, I find that thin rectangles allow for finer attention to detail, especially when I'm blending colors. If you look at my flower mosaics, you'll see that I use thin rectangles almost exclusively.

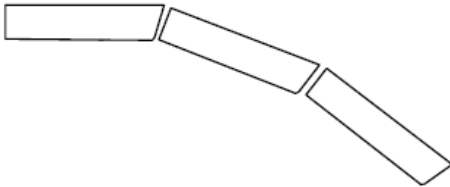
First, cut a square in half, and then cut each half in half again to create thin rectangles.



Arrange in rows by size, as you did with your squares.



Follow the same keystoneing techniques that you used with squares. With thin lines, angled cuts are likely to be less frequent and less sharp.



This work-in-progress example demonstrates working with thin rectangles in a free-flow fashion, following the natural contour lines of the flower petals first (see bottom petals) and then filling in (see upper-right petal).

## PRACTICE 5

Start with  $\frac{1}{2}$ -inch glass squares cut into four thin rectangles for this exercise.

Consider the contour lines of your image, and place your tesserae along the major lines first; then fill in as you did in the previous exercise. Draw additional contour lines on your template if you like.

If you need more practice with keystoneing, stick with the main contour lines of the leaf.

**OR:** Give yourself an andamento challenge. Try not strictly following the existing lines on this leaf. Instead, draw your own contour lines going in different directions. This is great for practicing with rows of tesserae that merge into each other or overlap.



Here's an example showing both squares and rectangles, andamento and keystoneing.



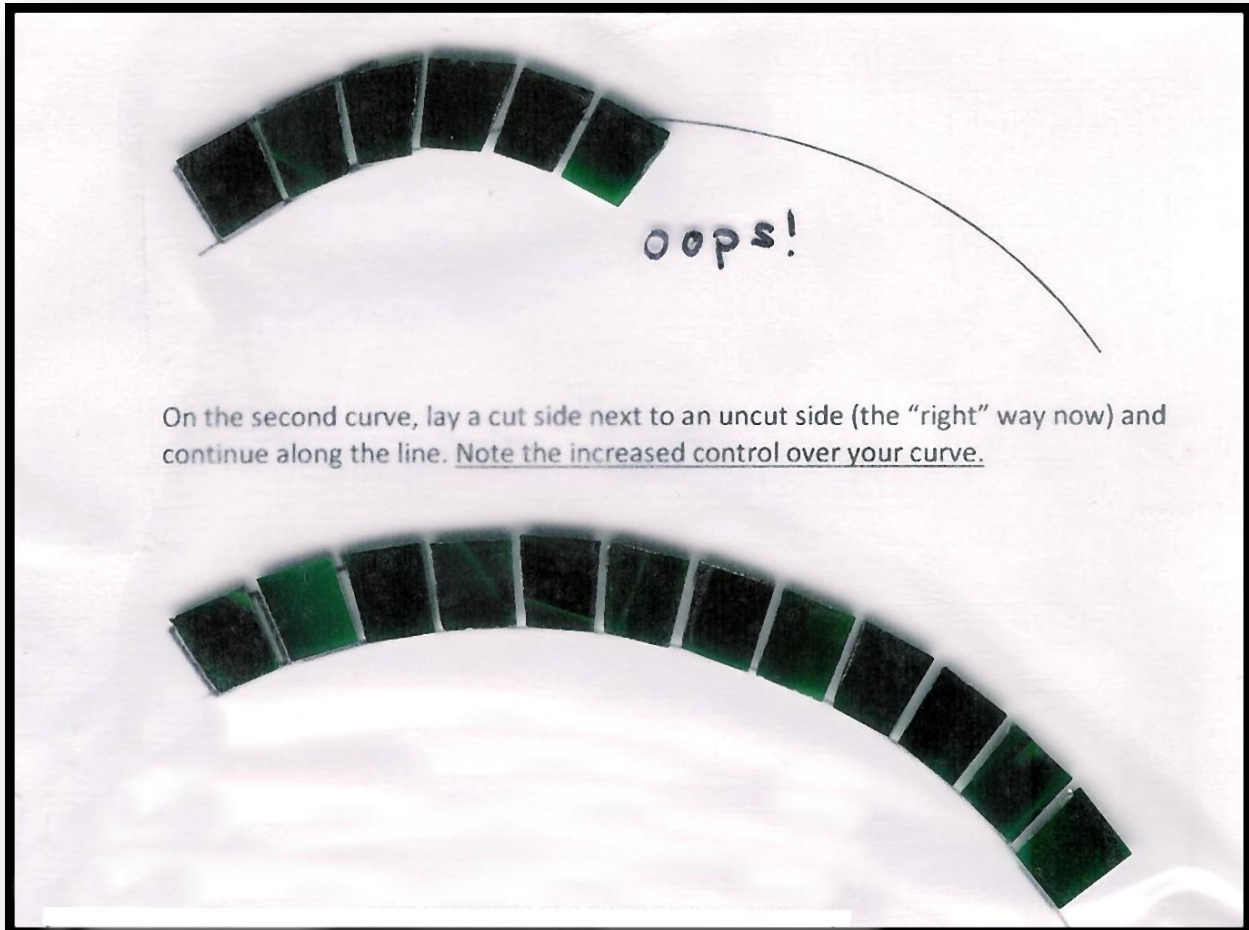
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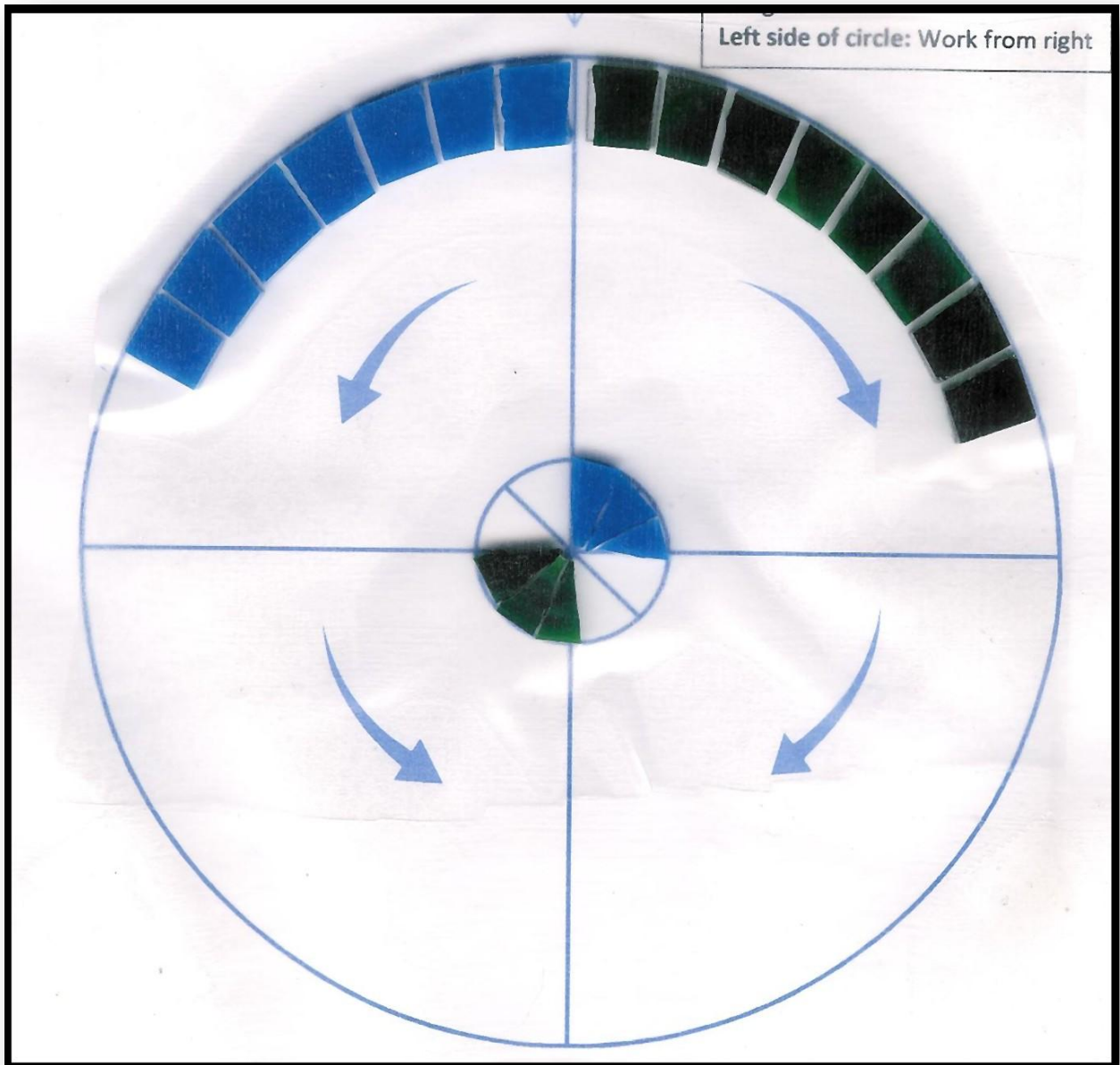
## ANSWER KEYS

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### PRACTICE 1

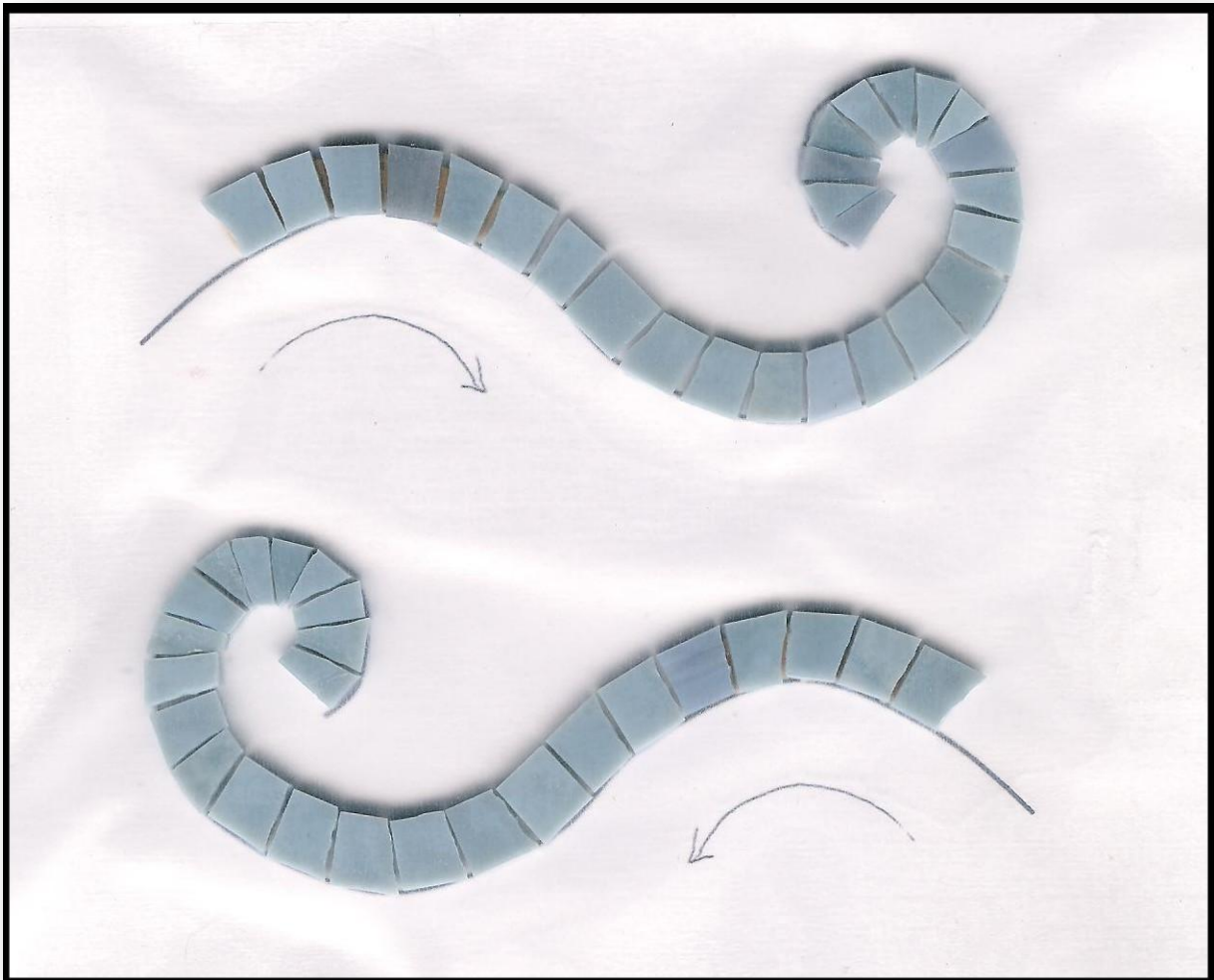


## PRACTICE 2



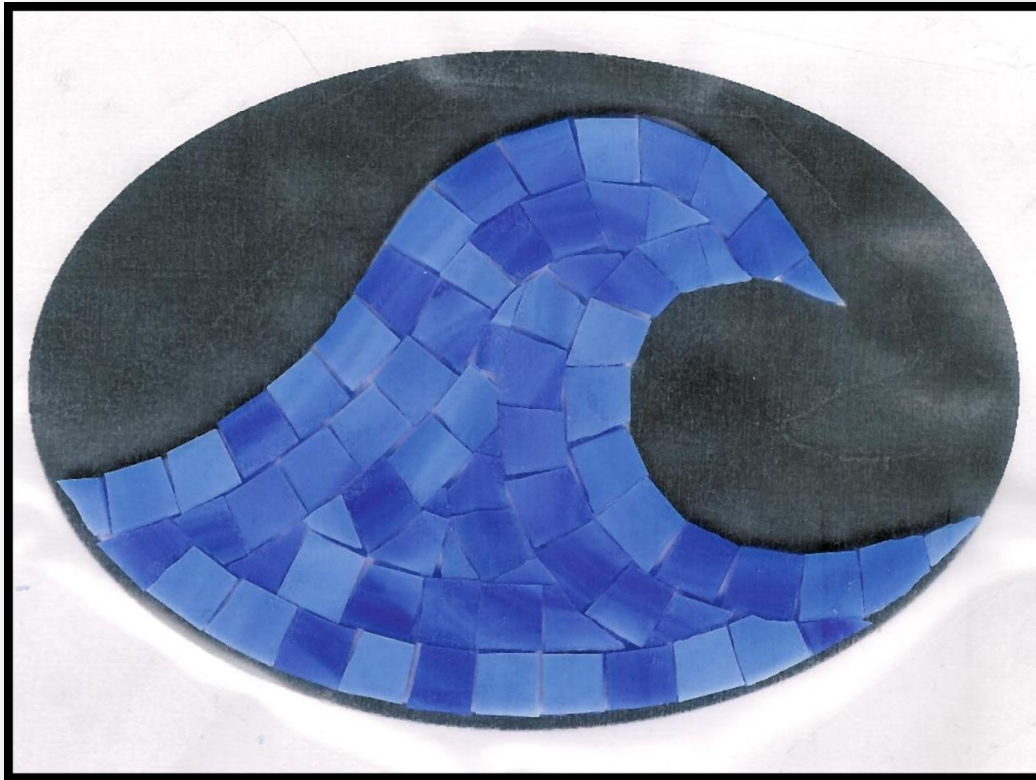


### PRACTICE 3

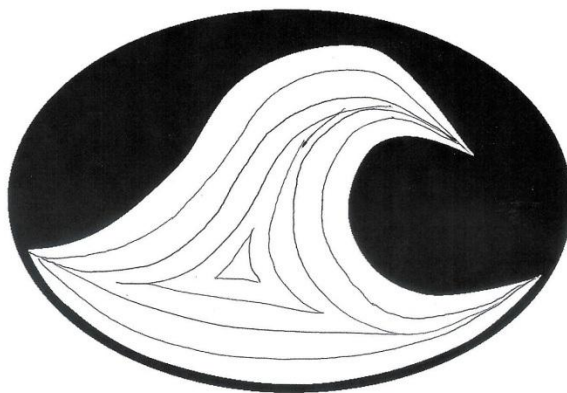




## PRACTICE 4



Note that there are a variety of ways to approach this shape. For example, you may choose to taper all three sides all the way to the three points, something like this:



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## PRACTICE 5



In this example, I used two colors and mixed the direction of my lines, adding andamento variety. I drew a curvy line down the center, which I followed with the lighter green glass. I followed the andamento of the leaf (working from the top and bottom of each leaf segment toward the center) with the darker green glass.