

Enamel Principles

1. Thermal Expansion and Counter Enamel
2. Sifting onto a Curved Surface
3. Copper and Firescale
4. De-Greasing Copper?
5. Time/Temperature Relationship
6. Firing Stages
7. Intention
8. Transparency and Air Bubbles: Layer Thickness
9. Transparency and Air Bubbles: Grain Size
10. Mesh Size: what is it?
11. Chemical Reactions
12. Fine Silver and Reflectivity
13. Warpage

Principles to Understand

1. Metal Preparation

Dome to prevent warpage

2. Counter Enamel

Balance the stress created with enamel layer on metal
Equal (or close) amount of enamel on back
Will back of piece be seen? Use trivet

3. Enamel Layer Thickness

1st layer direct on metal: cannot be too thick
2nd layer on top of enamel can be thicker
transparent layer must be thin

4. Fine Silver and Reflectivity

Compression vs Porosity
Flashing to seal the porosity

5. Copper and Reflectivity

"Clear" transparents with high heat first firing

6. Chemical Reactions

Silver: enamels with gold (reds, oranges, pinks, opal white)
Copper: Colors with manganese have reaction
Colors with gold fire dark

7. Transparency

Air bubbles appear as cloudy areas
Larger grain size, less air bubbles
Thinner layer, less air bubbles

8. Unleaded with leaded enamels

Use unleaded UNDER leaded enamels

9. Firing Time & Temperature Relationship

Hotter the kiln, shorter the firing time.

10. Firing Stages

Enamel surface changes from sugar to orange peel to gloss
Orange peel ranges from grains just beginning to join together
to almost perfectly smooth
Overfiring is relative to what you want

11. Warpage

Hot metal becomes soft and moves under weight of enamel
Longer, asymmetrical shapes warp more, use thicker metal
You have approximately 8 seconds to press on enamel after it
comes out of the kiln to repair warpage

12. Fix dome with one layer of enamel fired

Enamel will still be somewhat flexible if no counter enamel has
been fired

13. Color Layers

You can use transparent, opaque, and opalescent colors
in any order
Opacques will cover up layer below
Transparents can be darkened with a second layer but
not lightened.

13. Each Enamel Grain has Depth (size of grain)

Depth of transparent enamel creates Value

14. Each Enamel Grain has an Edge

This is where the color ends

15. Water Quality may effect enamel

Fire transparent enamel to check for cloudiness
Use distilled water for last rinses to remove salts

16. Enamel does not have to be dried before firing

Use toilet paper to blot out excess water

17. Kylr fyre should be dried before firing

Prevents gas bubbles from lifting enamels or foil

18. Blu-Stik does not have to be dry before firing.

19. Kylr fyre and 3 Dimensional Forms

3 parts water to 1 part Kylr fyre

20. Degrease Metal before wet application

Use spit or penny brite (cleans copper)

21. Fire Opalescent enamel at lower temperatures.

Between 1300 and 1400. This applies to all firings
if there is opal enamel on the piece.

Mesh Size, Particle Size, and Transparent Clarity

Mesh Size*

Mesh size is an indicator of glass particle size. The mesh number indicates the number of openings in a linear inch in a standard wire mesh screen. 80 Mesh would be 80 openings per linear inch. 6 Mesh would be six openings per linear inch.

A double mesh number such as 80/200 describes the glass particle sizes which pass through an 80 mesh screen, but stay on top of a 200 mesh screen.

80 Mesh enamel is the standard mesh size that Thompson sells. It is the mesh size used for most enameling procedures. It is glass that has been ground to a particle size slightly finer than "granular sugar".

6/20 Mesh enamels are particles that have an average diameter of about 1/16" to 1/8". This particle size is ideal for bead making on copper tubing, fired with a torch.

100 Mesh is particles that will pass through a standard 100 mesh wire screen (100 openings per linear inch). This mesh size is slightly finer than 80 mesh.

150 Mesh is particles that will pass through a standard 150 mesh wire screen (150 openings per linear inch). This mesh size is finer than 100 mesh.

200 Mesh is particles that will pass through a standard 200 mesh wire screen (200 openings per linear inch). This mesh size is finer than 150 mesh.

325 Mesh is particles that will pass through a standard 325 mesh wire screen (325 openings per linear inch). This mesh size is finer than 200 mesh and resembles "flour" in particle size.

Clarity and Mesh Size

The larger the grain (smaller the mesh size) the clearer the enamel

Wet enamel: rinse out the finer grains

Dry enamel: sift out the finer grains

The thinner the layer of enamel the clearer it will be.

Sifting and Mesh Size

Sifting finer mesh sizes (smaller grains) will give you crisper edges both with stencils and when using scrafitto (scratching through one layer to get to expose the previous layer) techniques

*from www.thompsonenamel.com

Air Bubbles and Clarity

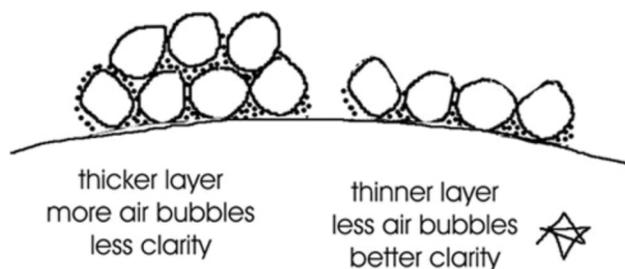
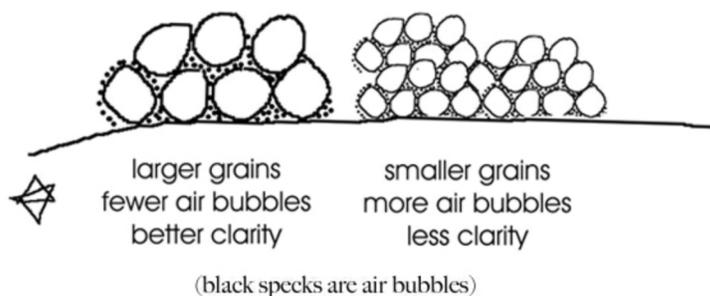
The key to having clear transparent colors is to consider the two factors:

1). Particle/grain size

2). Thickness of the layer

To prepare your transparent enamels for a wet application, you'll need to remove the finest particles.

Air bubbles cause cloudiness in glass. The more fine particles, the more air bubbles will be present in the layer, as air bubbles surround each grain of enamel.



Rinsing out the Fine particles

If I am using 80 mesh enamel straight out of the jar/bag, I always grind it up slightly with a mortar and pestle, using water. Most often I use ordinary tap water (I've had to use distilled water once when enameling in the desert city of Tucson, AZ). This breaks down the grains slightly removing any older surface enamel which may not be as clear as the inner part of each particle. I then pour this into a 1 oz medicine cup and swirl it around to get the finest particles to float in the water, while the heavier grains fall to the bottom of the cup. I pour out the water, being careful not to pour out the larger particles. I pour the water into a plastic shoebox or bucket so that the fine enamel grains don't go down the drain to contaminate the drain and clog it up. Repeat this process until the water is crystal clear, with no fine grains floating around in the water.

Grinding enamel from lump.

I prefer to use lump form enamel for several reasons:

- * It has an unlimited shelf life
- * It is always crystal clear
- * the particle sizes can be bigger, giving me less air bubbles
- * it last longer after I have ground it up while sitting on my desk
 - * use a solid mortar, not a hollow one
- * the best I have found is made of aluminum oxide from CoorsTek

Firing Stages and Temperature

General Firing Information

I fire my enamels at approximately 1400 to 1450 degrees fahrenheit.

If I'm using opalescent enamels I will fire at a lower temperature and not let the kiln temperature reach 1400.

I keep my firing glasses on my head and the glove on my hand while I'm firing to remind me that I'm in the kiln.

I don't let myself pay attention to or focus on anything; i will lose track of time and overfire the piece.

Make sure your firing area is clean of any black flaking off from the firing screens. Clean it up as needed.

I generally try to fire to just past orange peel, so that the surface is just slightly glossy.

Generally, sugar fired surface needs to be fired longer if you are going to either glue foil to the surface or paint another layer of enamel over it. It is so porous that the glue or water will soak down like a sponge below the surface.

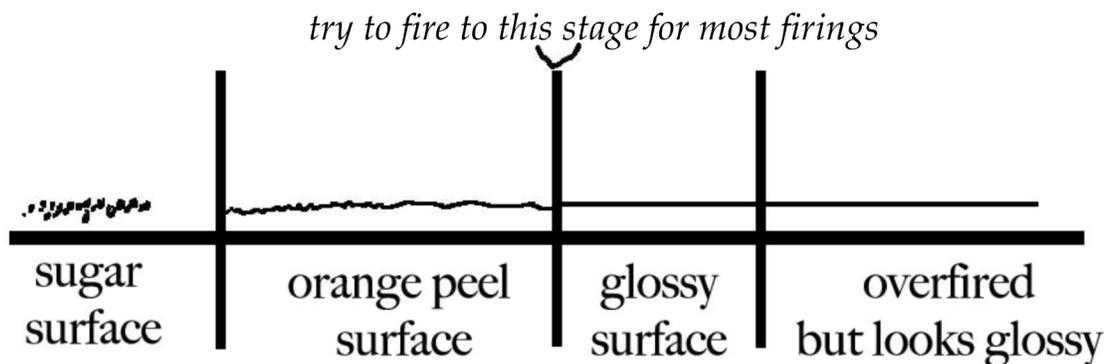
Train yourself to see when the enamel changes from Orange Peel to Glossy.

If you can catch it at this stage you will not over fire it.

Temperature/Firing Time Relationship

The hotter the temperature, the shorter the firing time

The cooler the temperature, the longer the firing time



Sugar Surface

resembles sugar cookie surface; each individual grain of enamel melts and pulls into itself, making a tiny ball of glass

Orange Peel Surface

resembles the skin of an orange; individual grains have begun to fuse together but the surface still has a texture. Orange peel surface has many different looks, from very textural to almost smooth.

Glossy Surface

surface texture has leveled out and is completely smooth

Over fired Surface

There is not a "specific" over fired look. It may look the same as glossy.

The enamel is over fired when the firing has gone past the desired effect and the enamel begins to do things you don't want it to do: crawl up the side of a cloisonne wire, turn an undesirable color, bubble through a top layer, etc.

Firing Your Enamel

1. Putting your piece into the kiln:

screen
trivets
firing cloth
scalex
double sided pieces

2. Use a trowel or a firing fork

keep the screen LEVEL
place the screen into the kiln straight, not at an angle

3. Before you put your piece into the kiln...

- where do you want to place the screen?
- any temperature considerations?
- is there anything you need to do when you remove the piece from the kiln?
- do you have a plan?

4. What is your INTENTION?

- what Result do you want? What Result do you want to avoid?
- what must happen/change in order to get this result?
- how will you know if you've achieved the result? what can you look for?

5. things to look for:

- firing stages: sugar, orange peel, glossy
- color of the screen or trivet
- time it
- watch glue burn away

6. Safety

- black trivets and screens can still be hot. don't grab them
- don't assume anything is cool
- don't talk while you are in the kiln
- don't become interested in anything else when you are in the kiln
- breathe and stay relaxed when going into the kiln and removing your piece from the kiln
- don't walk around with a hot screen

Prepare a Copper Shape with Opaque White Enamel

Step by Step

1. cut out/stamp/saw your copper shape
2. anneal (to soften it to make it easier to “dome”)
3. dome it slightly in a dapping block: very slight dome
4. sift an even layer of opaque white enamel (unleaded thompson 1020) onto the front
5. place onto a firing screen and fire until glossy
6. after cooling, wipe or rinse off excess/loose firescale or oxidation
7. check dome to make sure that your piece is not wobbly; reshape gently if necessary
8. sift a thicker layer (2-3 times thicker) onto the back: counter-enamel layer
9. balance piece in a trivet, place trivet onto firing screen, and fire until “orange peel”
10. after cooling, wipe excess firescale off edges
11. sift a second layer, even thicker than first counter-enamel layer.
12. balance in trivet and fire to “orange peel”
13. after piece has cooled, paint a thin layer of scalex onto the back if back will not be seen
14. piece is now ready for next firing using a firing cloth instead of trivet

Tips

3. make a custom dapping block using “jett sett”
3. make a gently sloping dome, too domed will be more difficult to place wires or grind when finished.
4. tilt piece slightly so enamel falls at 90 degree angle onto metal surface. rotate the piece as you sift.
4. first layer sifting: approximate 3 grains high. do some tests to see how much is required to create an even layer covering metal
5. slide a tool (spatula) under the piece to remove it from your fingers without smudging the edges: gently place onto screen
6. Quench your piece if desired. wait at least 20-30 seconds after removing from kiln. careful not to spill your hot pieces
7. use this ability to press the sides down after one layer to refine your dome. you don't have to make your first dome step perfect
8. if your first counter-enamel layer is too thick, it will pull away at the edges when fired and create a thicker ridge next to bare edge
9. figure out positioning of the piece onto the trivet before you sift the enamel. this way if it falls you haven't spilled your enamel
10. trivets take more time to cool. be careful when touching them after firing
11. you can sift a thicker layer onto fired enamel than you can onto bare metal without the edges pulling towards the center
13. make sure you check the front afterwards to make sure no scalex has gotten onto the front. it will act as a resist and enamel won't stick to any areas coated with scalex. when painting on the scalex start in middle of piece and brush towards the outside edges
14. you can fire your piece to “set” the scalex into the counter enamel, or proceed to the your next step and fire it then.

Grains of Glass/Panes of Glass Principles (Understanding Enamel Layers)

Principle 1:

Each grain of enamel creates a “pane of glass” which has Depth

Depth: How thick and high the grain of enamel is.
The larger the grain the deeper in value it will be because it is a thicker Pane of Glass.

Principle 2:

Each grain of enamel has an “edge”.

Width: Each grain has an edge where it meets the neighboring grains. The closer in value and hue these edges are the more they will blend together. Larger grains of different enamels will have more noticeable edges where they meet. The edges of smaller grains will not be as noticeable as the edges of larger grains.

Principle 3:

A group of grains creates a layer, which is also a pane of glass

An enamel layer also has depth and will have edges if it doesn't cover the entire surface.

Depth: A thicker layer will have a deeper value than a thin layer of the same transparent enamel.

An uneven layer of a transparent enamel will have highs and lows which creates thicker and thinner areas of glass. This will create differences in value (light and dark).

Edges: Where a layer ends (any amount not covering the entire surface), there will be an edge created. This edge will be in contrast to the layer of enamel underneath it. The closer in color/hue and value the two layers are, the less pronounced the edge will be.

Principle 4:

Enamel can be opaque, transparent, or opalescent

Mixing enamel on the same layer:

You can mix different types of enamel together within a layer to create a variety of effects (opacity, color/hue, grain size)
The above principles (depth and edge) are factors which determine how the layer will look.

Mixing enamel on the different layers:

You can layer any combination of enamels over one another. An opaque will cover up what is underneath it. Transparent and opalescent will let different amounts of light through, depending on the colors below, and the value of the upper enamel layer.

Principle 5:

You can remove all or part of a layer after it has been fired

Use a diamond burr and water to drill through enamel layers, exposing bottom layers. You can remove a whole layer or just portions of the layer.

Make a Transparent Enamel "Letter"

Learn what any Transparent Color looks like:

1. Direct on silver
2. Direct on gold
3. Direct on opaque white
4. With a flux layer between the silver foil and the color.

Green N38, (or any other green, blue, purple, brown)

Pink, orange, or red: N15, L96, 755 (these will have chemical reactions with the silver foil)

N3 Flux

Copper discs

silver and gold foil

kylr fire



Foil (cut, apply with glue, dry, fire)

Step 1: Cut pieces of silver and gold foil with your scissors. One small gold foil piece per shape

Step 2: Dip your brush into the kylr fire, paint a thin layer onto the front of a piece, and use your wet brush to

Step 3: pick up a piece of silver foil. Place it on your shape. smooth out bubbles/wrinkles. repeat to fill one side.

Step 4: repeat on other side, but only place foil on bottom 1/4 of piece. on top 1/4 place a small piece of gold foil.

Step 5: Dry and Place on top of firing cloth and screen.

Step 6: Add a very small drop of Blue Stick glue on a part of the white. fire your piece. Watch it burn away from black, to brown, to yellow, to clear.

Step 7: Cool and keep your fingers off the front to prevent grease from getting onto the surface.

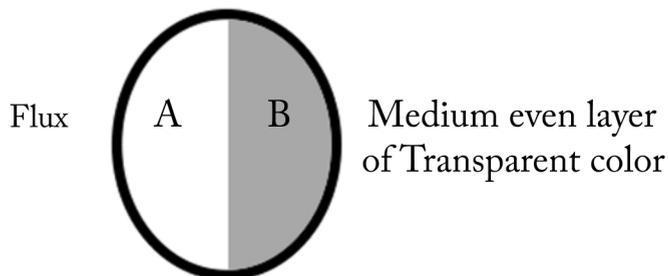
Color Layer #1

Side A: Paint a layer of N3 Flux over left side. Make it a little too thin (bare spots) towards bottom

Side B: right side: Paint an even layer of N38 (or other color) covering silver /gold foil and any visible white.

Blot excess water using toilet paper.

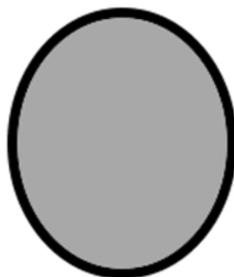
Fire to glossy.



Color Layer #2

N38 (or other color) over entire piece.

Blot and fire to glossy



Transparent Enamel Words

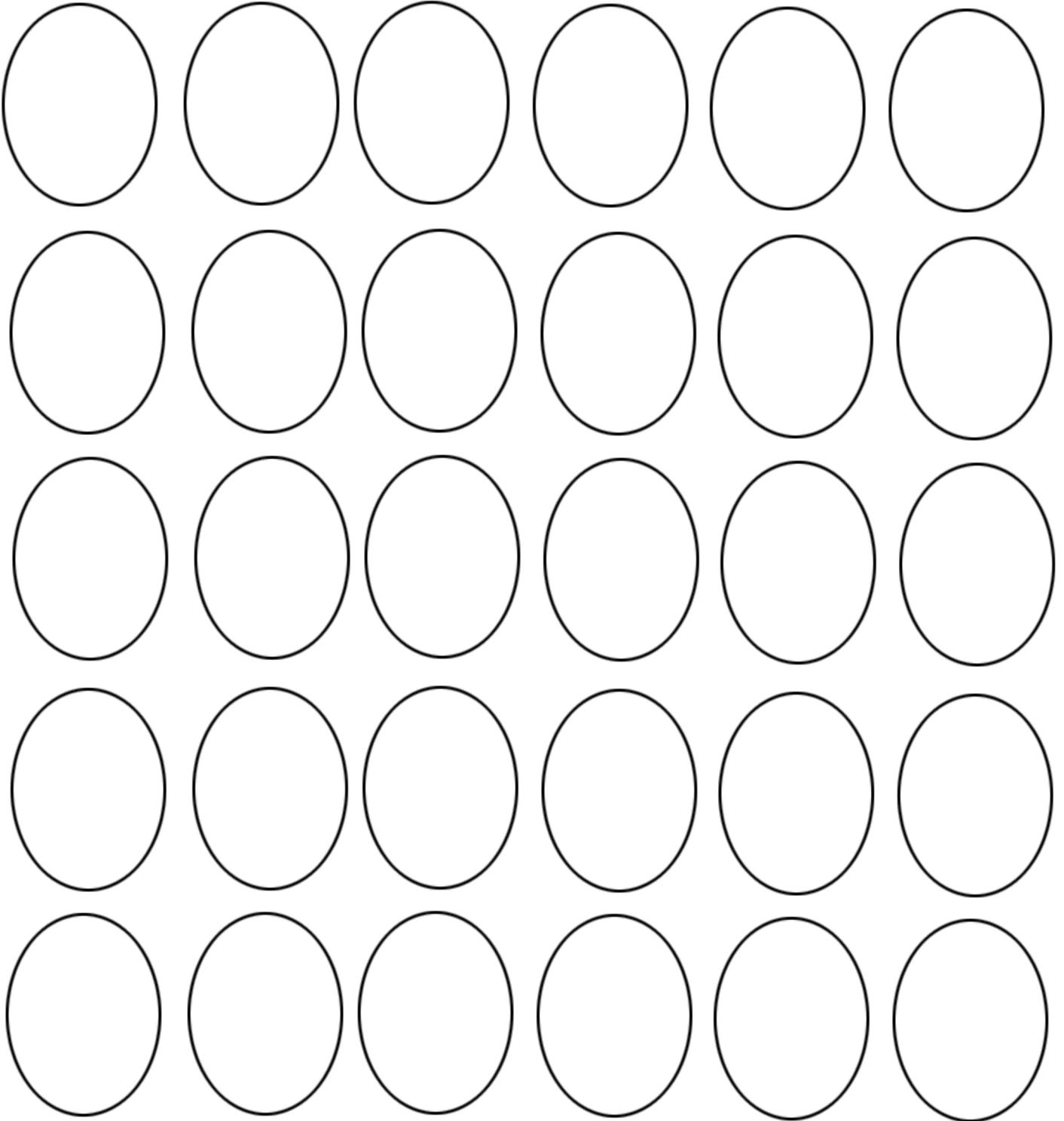
1. Single Color Gradation (2 enamels: light and medium value colors, same hue)
2. Single Color Gradation (3 enamels: light, medium, and dark value colors, same hue)
3. Single Color Gradation (3 enamels: light and medium value colors, same hue, with flux and opal white)
4. Change the Hue (Add a different color over a base color to create a new Hue)
5. Transparent enamel over Opaque white
6. Transparent enamel over other light value Opaque colors: yellow, green, blue, beige, pink, purple
7. Transparent enamel over salt and pepper Opaque color combination
8. Transparent enamel over foil patterns (over opaque white enamel)
9. Transparent enamel over foil patterns (over opaque black enamel)
10. Flux over Foil patterns over Transparent colors
11. Flux over Foil patterns over Opaque colors

Value Sketches

What do i see? What can I change?

Value

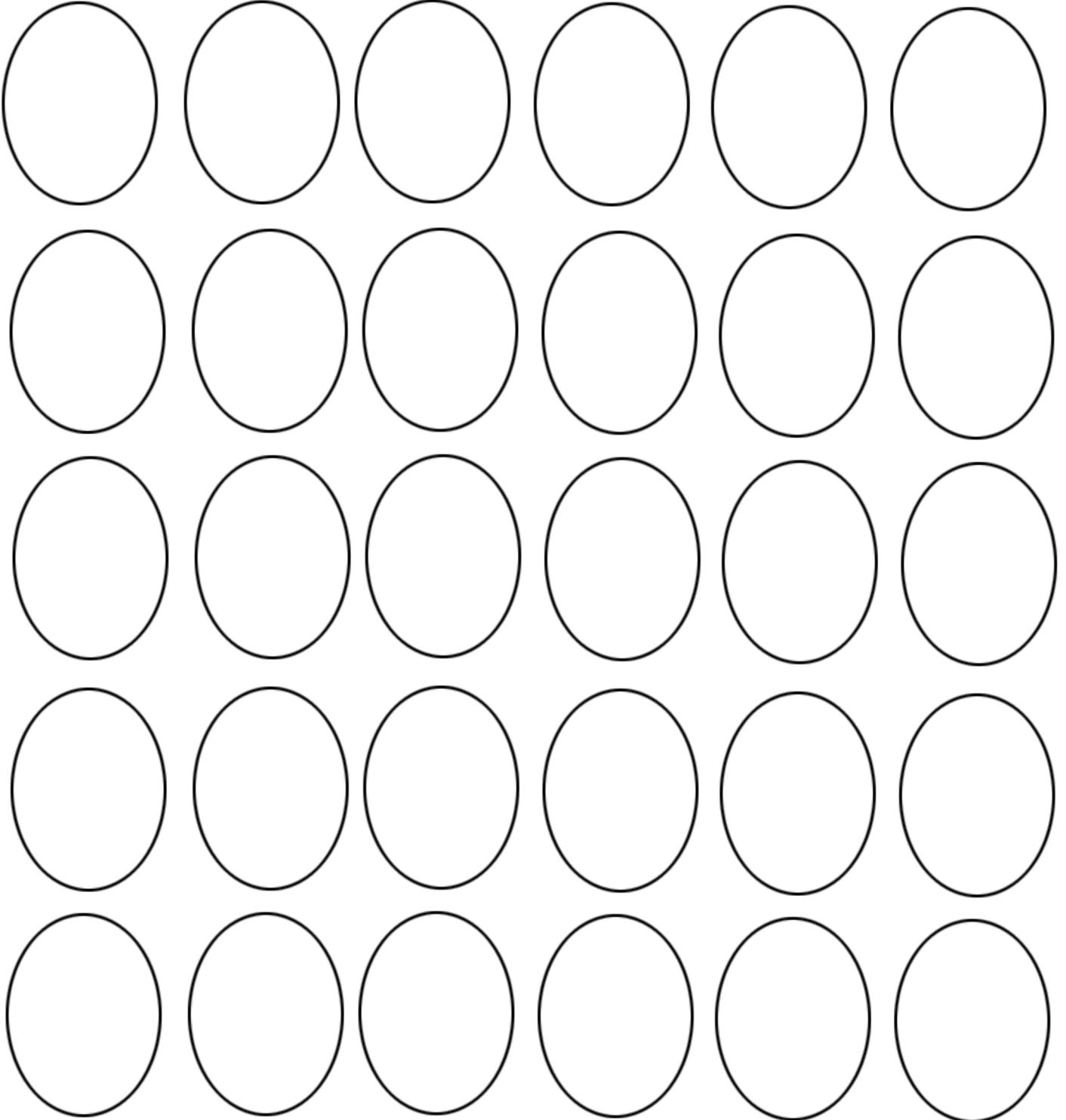
1. Using the side of a soft black pencil, create a gradation from one side to the other (dark to light)
2. Make 10 "what if" value variations
3. Play with the side of your pencil to create "expressive value changes"
4. Make marks using only one value



Play with Shapes

What do i see? What can I change?

1. Draw one line so that the oval is divided into two different shapes.
2. Draw two lines so that the oval is divided into three or more shapes.



Play with Patterns

What do i see? What can I change?

1. Draw small shape.
2. Draw the same shape twice.
3. Draw many of the same shapes together/

