Introduction

In March 2004, I decided to reinvestigate color mixing and color matching. Furthermore, I approached this process as if I'd never done it before. I chose the second edition of **"The New Munsell Student Color Set"** by Jim Long and Joy Turner Lake as an instruction tool. This user-friendly handbook provides up to date information about color perception and the opportunity to use it.

"2004-17": Analogous Color Combination

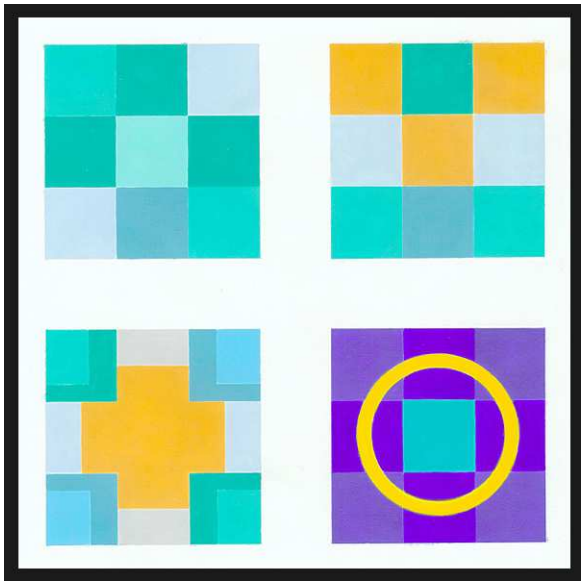

Figure 1
"2004-17 (Analogous Color Combination)"

Acrylic on 65 lb. neutral pH cover paper
11" x 8.5"

"2004-17" (Figure 1) is an experiment in analogous color combination. It was an exercise at the end of **"Chapter 9: Combining Colors."** The three hue families I chose from the Munsell Hue Circle were: purple-blue, blue, and blue-green. Then I was instructed to choose the complement (yellow-red) of the middle color (blue) for contrast purposes. First I had to mix my paints to match the Munsell color chips. I read

in **"Chapter 10: Color in Designed Products, Installations, and Printing"** that daylight is considered excellent in rendering colors. I used the north light coming in my front windows to illuminate the Munsell chips and my own color samples so that I could accurately compare them. I would make adjustments accordingly until I achieved what *appeared* to me to be an accurate match. I'm red-green color blind so this can become a very lengthy process.

Color blindness is the inability to differentiate between different colors. The most common type is red-green color blindness. This occurs in 8% of males and 0.4% of females. It occurs when either the red or green cones are not present or not functioning properly. People with this problem are not completely unable to see red or green, but often confuse the two colors. This in an inherited disorder and affects men more commonly since the capacity for color vision is located in the X chromosome. (Women have 2 X chromosomes, so the probability of inheriting at least one X with normal color vision is high; men have only 1 X chromosome to work with.) "How Vision Works," howstuffworks.com

For example: I had to mix 5BG 8/4—this means 5 blue-green, value 8/chroma 4. "Each of the ten hue families is further sub-divided into ten more hue families with the number 5 designating the center, or most true representation of that hue family, and the number 10 designating the hue family that is halfway between two adjacent true hues." (p. 3, **"The New Munsell Student Color Set,"** Turner and Lake) Now, Phthalo Green (Blue Shade) is 5BG, so that one wasn't such a difficult "match" to achieve. But for the other ones I did something like this: I wanted 5YR—so I found the closest YR to 5 that I had in my paint box—that was Quinacridone Gold at 6YR—then I had to move it back toward 5—so I found C. P. Cadmium Orange which is 2YR—I kept playing with that and then added Hansa Yellow Medium which is 2Y (a yellow that is on the border of yellow-red).

I proceeded to the next part of the exercise after I matched the color chips according to my color vision disability, which is intensified by the brown pigment in my macula lutae and my aging eyes. How do these two factors also affect how I see the colors I'm matching? "People have different amounts of pigment in their macula lutae

(Figure 2). This is a brownish pigment that floats over the fovea to absorb ultraviolet wavelengths and protect the small area packed with cone receptors where vision is most acute. Unfortunately, it also absorbs some blue wavelengths, so more blue light reaches the receptors of some individuals than others, thus causing small differences in their color perception. Moreover, a sad fact is that color perception changes as people age because the lens of the eye yellows. This yellowness reduces the blue light that reaches the receptors." (p. 117, **"The New Munsell Student Color Set,"** Turner and Lake)

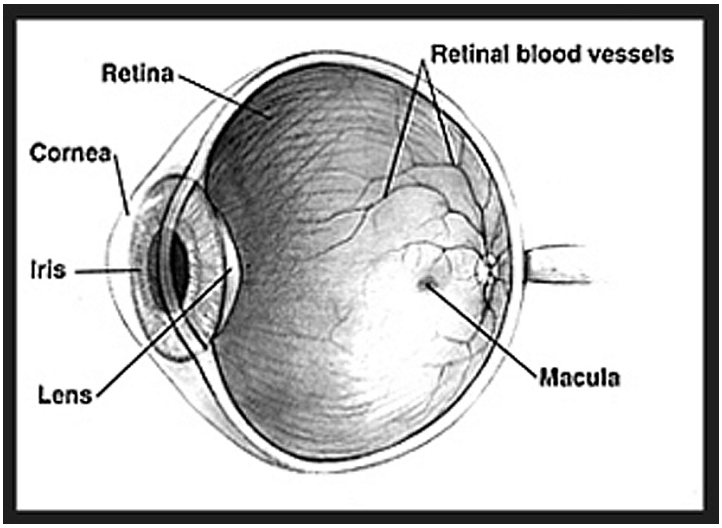

Figure 2
Human Eye: Cross-Sectional View
NIH National Eye Institute
This image is in the public domain.

I painted 2" x 2" squares with each hue—then I cut each square into four 1" squares. I put acid-free repositionable glue dots on the back of each so that I could stick them down and rearrange them if I needed to. Then I incorporated the following principles of color control I learned in **Chapter 9**: one hue family dominates, keep the value of the colors similar over most of the design, and use the complement of one of the colors (or black, white, or gray) for contrast purposes.

My first design (upper left) features PB-B-BG. My second design (upper right) features PB-B-BG-YR. My third design (lower left) features the same hue families as my second design—but with a more elaborate arrangement and the addition of Golden

Artist Colors Neutral Gray N8. Then for the fourth design I did something a bit different. I wanted to use only 1 example of each hue family including the YR complement. I selected colors from the "Munsell Notational Listings: Golden Heavy Body Acrylics" (http://www.goldenpaints.com/technicaldata/munsell.php) with different chromas and values (although the values are close to each other) and applied them pure.

Munsell Color Paths

"2004-19": Horizontal Inward Path

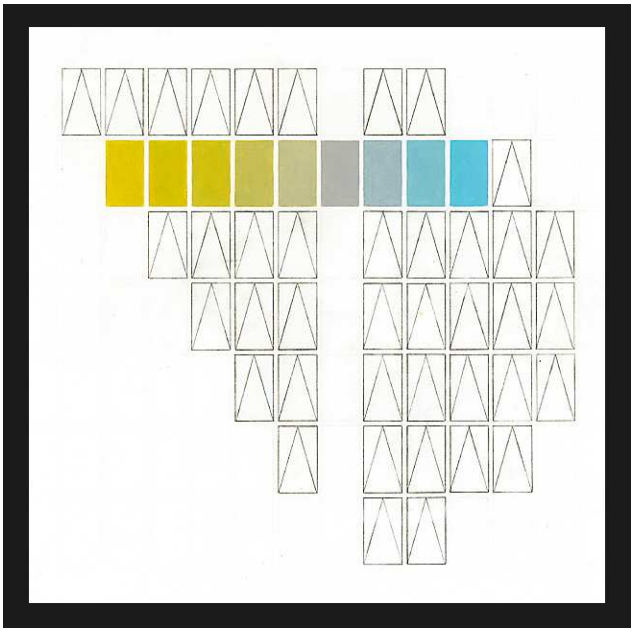

Figure 3
"2004-19 (Horizontal Inward Path)"
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Acrylic on 65 lb. neutral pH cover paper
8.5" x 11"

"2004-19" (Figure 3) is an example of a **Munsell color path**. These are color sequences that move along or through the color solid. "Because each color has three dimensions, an arrangement of all colors takes a three-dimensional form. The color systems developed since the 1600s all display colors in some kind of geometric shape, which is referred to as a color solid. The path can move horizontally, or it can be

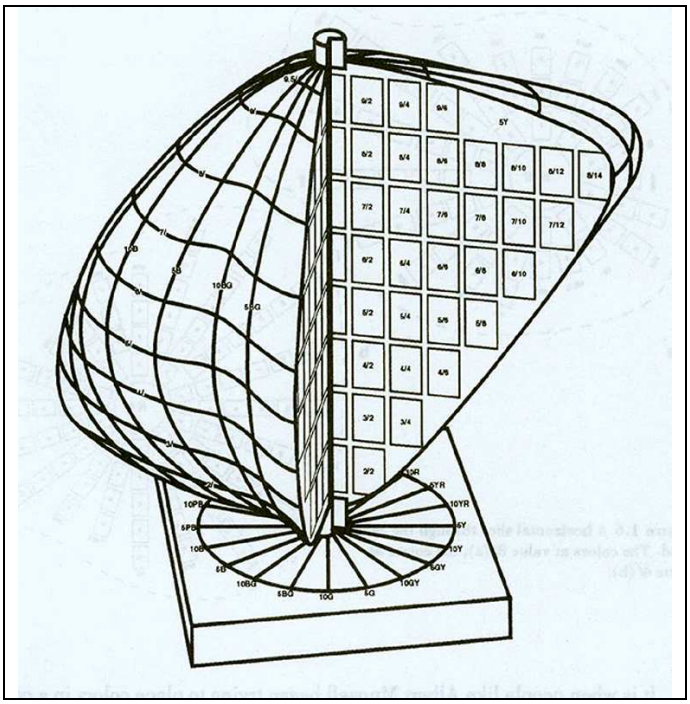

Figure 4
The Munsell Color Solid

slanted either up or down." (pp. 9 and 109, **"The New Munsell Student Color Set,"** Turner and Lake).

This is a **horizontal inward path**: 5Y 7/10, 5Y 7/8, 5Y 7/6, 5Y 7/4, 5Y 7/2, N 7/, 5PB 7/4, 5PB 7/6. I decided to create diagrams that represent a cross-section of the color solid. Munsell describes his color solid **(Figure 4)** as a deformed grapefruit. Each section represents a hue family. A value scale proceeds up the core (N 1/ is black at the bottom and N 9/ is white at the top). The chroma of each hue is highest at the skin of the grapefruit. As a hue moves in toward the value scale, it decreases is chroma. I made the cross-section diagram so that I can see how the path moves through the color solid. The rectangles with the triangles in them represent missing color chips. This way I can see the shape of each grapefruit section and compare them. All sections bulge in different spots. The bulge is where the hue has the most chroma. I am training myself to really see. I am studying where hues reach their maximum chroma. I am learning to look at a color chip and match it one dimension at a time (hue, value, and chroma).

“2004-20”: Inward Diagonal Downward Path

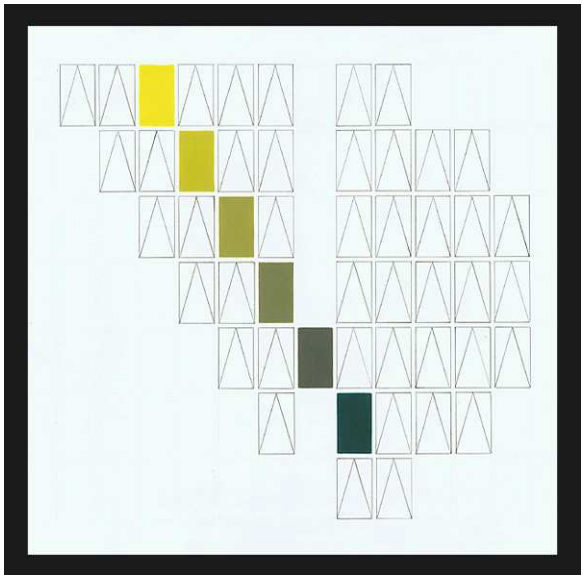

Figure 5
“2004-20 (Inward Diagonal Downward Path)”
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Acrylic on 65 lb. neutral pH cover paper
8.5” x 11”

Figure 6
“2004-21 (Electron Orbitals)”
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Acrylic on 65 lb. neutral pH cover paper
11” x 8.5”

“2004-21 (Electron Orbitals)” (Figure 6) is painted with a palette I created representing an **inward diagonal downward** color path. These shapes are an assortment of electron orbitals. This is what they look like to me (starting from the upper left and moving across the picture from left to right):

Row 1: the planet Saturn from directly above, the robot from “Lost in Space,” those little glasses that don’t have the sticks that go on your ears—they just sit on the bridge of your nose, and a butterfly

Row 2: a narcissistic light bulb with wings staring at its refection at the shore of a pretty lake, a headless flying squirrel from directly above, “Cosmo’s moon,” and the Incredible Hulk at cheerleading practice

Row 3: a peanut, dumbbell, one of those strange flying insects that live in the bathroom around the corner from the frame shop (where I’ve been employed since 3 October 1988), and the planetary model of the atom

Figure 7
“2004-22 (Inward Diagonal Downward Path II)”

Acrylic on 65 lb. neutral pH cover paper
11” x 8.5”

"2004-23": Inward Diagonal Upward Path

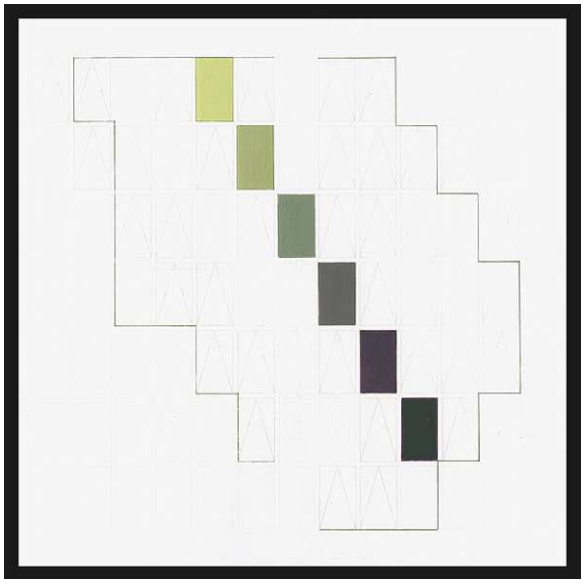

Figure 8
"2004-23 (Inward Diagonal Upward Path)"

Acrylic on 65 lb. neutral pH cover paper
8.5" x 11"

"2004-23" (Figure 8) is an example of an **inward diagonal upward** color path. It starts with 5P and goes through the Munsell color solid to 5GY. The purples were tough to match. I got the idea to start with Primary Cyan (5.4PB 3.2/8.4) and adjust the value first. After that I changed the hue by gradually adding Quinacridone Magenta (10RP 2.50/10.0). Finally, I added the Golden Artist Colors Neutral Gray with the appropriate value to correct the chroma of the mixture. I found it easier to really see what I was looking at by using this method versus starting with Ultramarine Violet (2.5P 2.50/2.0). When I started with Ultramarine Violet, I had a difficult time figuring out if the mixture needed more red or red-purple or more blue or purple-blue.

"2004-24": Inward Color Path (Last Variation)

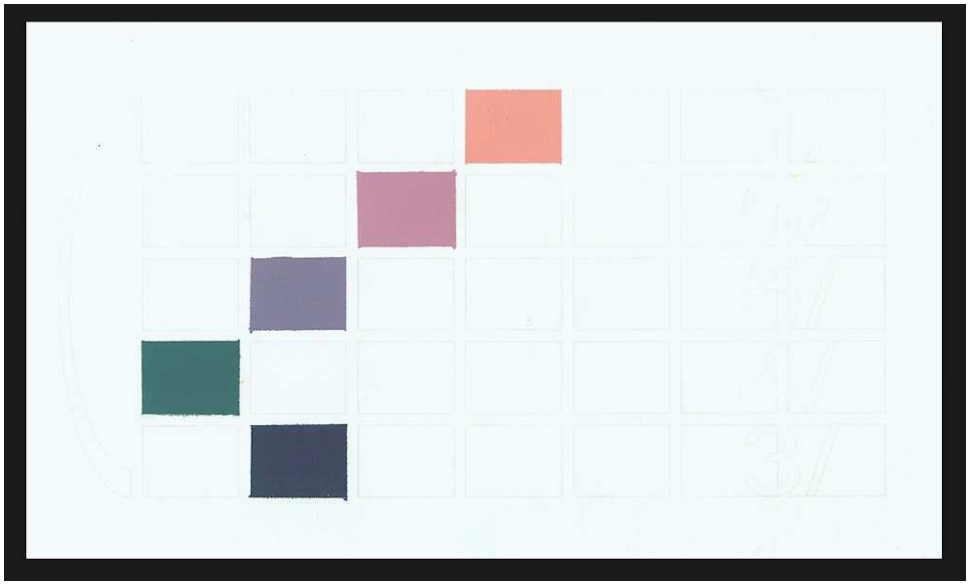

Figure 9
"2004-24 (Inward Color Path—Last Variation)"
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Acrylic on 65 lb. neutral pH cover paper
8.5" x 11"

"2004-24" (Figure 9) is the last variation of an **inward** color path. This color path travels through the color solid without passing through the gray scale. In this case, the hues would not be complementary (5R 7/8, 5RP 6/6, 5P 5/4, 5PB 4/2, 5B 3/4).

First, think of the hue circle as a 10 hour clock. We will put 5R at 12 o'clock. Now let's move counterclockwise—5RP is at 11 o'clock, 5P is at 10, 5PB is at 9, and 5B is at 8. The format of the **"The New Munsell Student Color Set"** is a 10" x 7.5" three-ring binder. Take out the five hue charts for the abovementioned hues and pile the charts one on top of the other on a flat surface. 5R is on the bottom followed by 5RP, 5P, 5PB, and 5B. Use two twisty-ties (like the ones that come with trash bags) to keep the charts together. Thread one through the top loose-leaf holes and twist it, and thread the other one through the bottom loose-leaf holes and twist it. Use these twisty-ties as a hinge device and fan out the pages so that they can stand up with the bottom of the hue charts on the flat surface in front of you. You want the twisty-ties on your left. This is where the gray scale is located, so these color chips have the least amount of

chroma. The 5B chart will be closest to you and the 5R chart will be the farthest from you. Low chroma will be on your left and high chroma will be on your right. Look down at these charts and imagine them as pages of transparent bricks—the only bricks that have color are the ones representing the Munsell color chips that make up this inward color path. **"2004-24"** depicts the abovementioned aerial view of this particular ***inward*** color path.

Figure 10
"2004-25 (Inward Color Path—Last Variation II)"
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Acrylic on 65 lb. neutral pH cover paper
11" x 8.5"

"2004-26": Flat Spiral Color Path

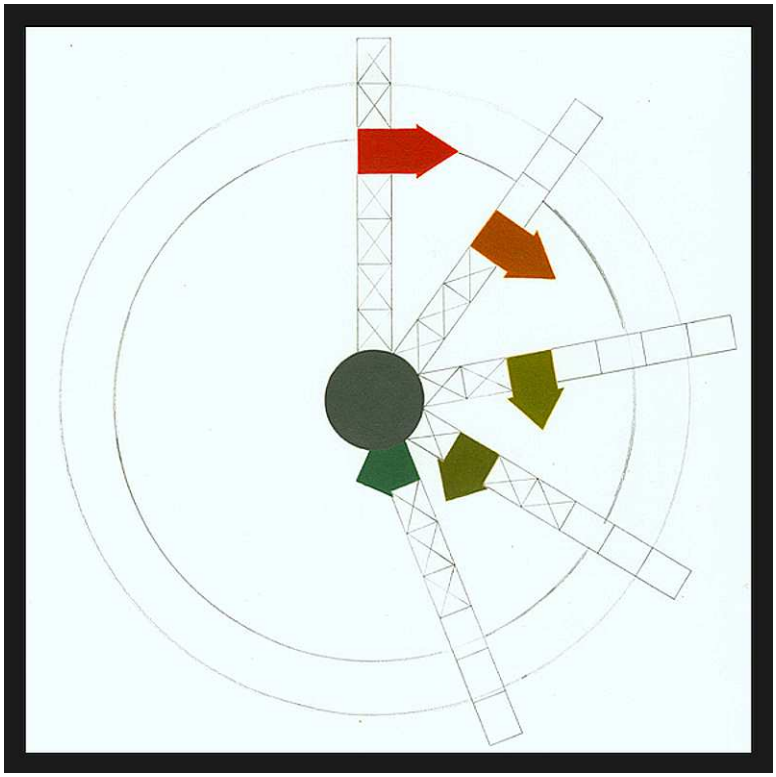

Figure 11
"2004-26 (Flat Spiral Color Path)"
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Acrylic on 65 lb. neutral pH cover paper
11" x 8.5"

"2004-26" (Figure 11) is an example of a **flat spiral** color path. It makes a spiral in the Munsell color solid, while remaining at the same value level, but changing in hue and chroma. The spiral can begin at any level and rotate in either direction. For example: 5R 5/10, 5YR 5/8, 5Y 5/6, 5GY 5/4, 5G 5/2, N5/.

Here's how I thought to create this very three-dimensional path on a two-dimensional surface. I imagined stripping down the color solid so that all that remained was value level 5. The X marks represent the color chips that aren't included in my picture. I did this so that the viewer knows how intense these particular hues can get at value level 5. I made the arrow for 5R 5/10 the longest because it represents the most intense hue in this color path. Then as you move along in a clockwise direction, the

arrows get shorter and shorter because the chroma numbers get lower and lower (which means the color's intensity is decreasing). The center circle represents the N5/ level of the gray scale.

"2004-27": Upward Cylindrical Spiral Color Path

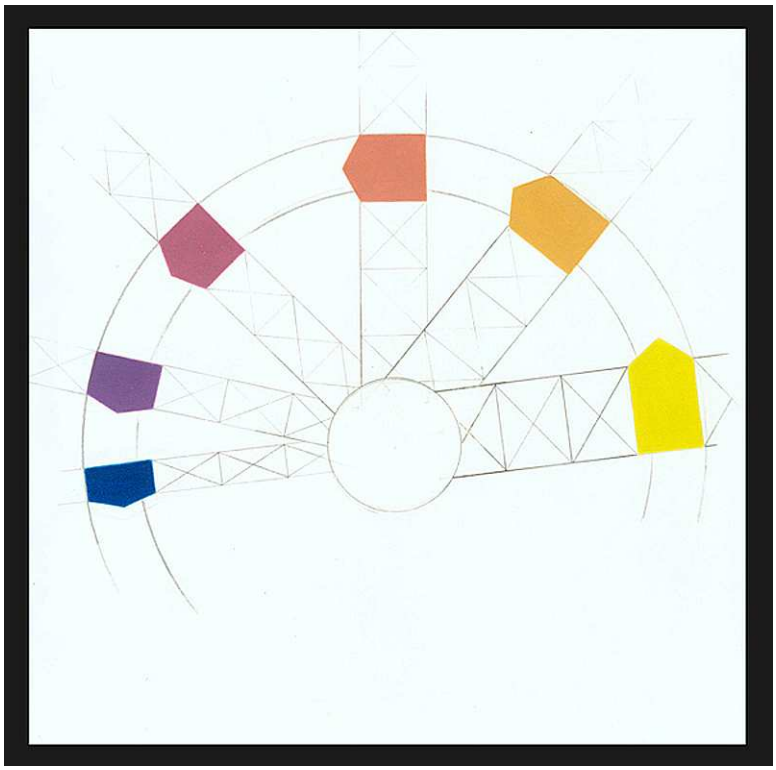

Figure 12
"2004-27 (Upward Cylindrical Spiral Color Path)"
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Acrylic on 65 lb. neutral pH cover paper
11" x 8.5"

Another path winds as an upward cylindrical spiral in Munsell space, while staying the same distance from the gray scale as it moves through the color solid. The path can wind in either direction. The colors change in two dimensions—hue and value. (p. 109, **"The New Munsell Student Color Set,"** Turner and Lake)

"2004-27" (Figure 12) is an example of an **upward cylindrical spiral.** It includes the following colors: 5Y 8/8, 5YR 7/8, 5R 6/8, 5RP 5/8, 5P 4/8, and 5PB 3/8. In the painting you will notice that the yellow strip is the widest. As you move your way down the solid the strips get narrower and the arrows point you in a counterclockwise direction.

"2004-28": Conical Spiral Color Path

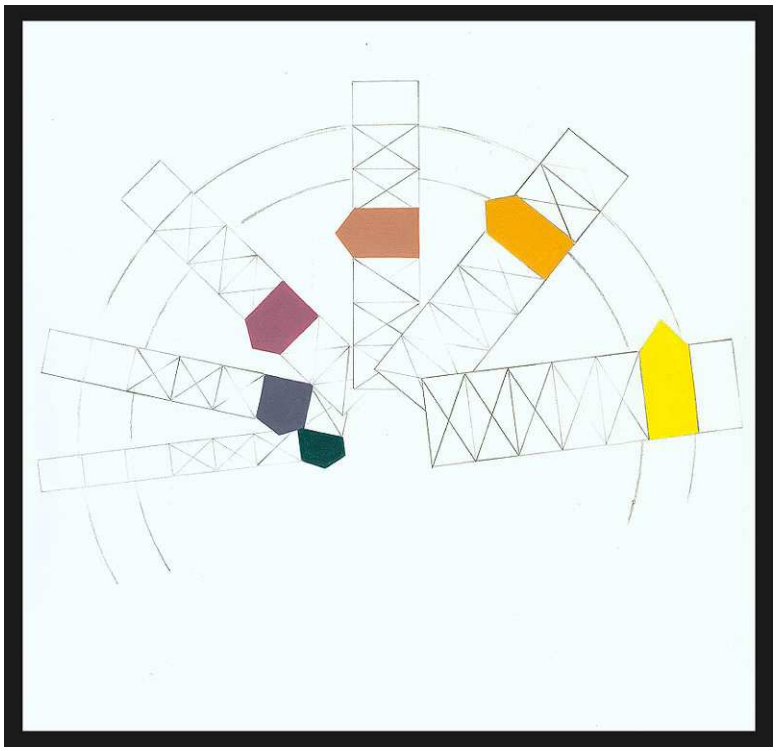

Figure 13
"2004-28 (Conical Spiral Color Path)"
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Acrylic on 65 lb. neutral pH cover paper
11" x 8.5"

Another sequence makes a corkscrew shape in Munsell space. This conical spiral can begin at any hue and wind its way either up or down. In this path colors change in all three dimensions [hue, value, and chroma]. (p. 109, **"The New Munsell Student Color Set,"** Turner and Lake)

“2004-28” (Figure 13) includes the following colors: 5Y 8/12, 5YR 7/10, 5R 6/8, 5RP 5/6, 5P 4/4, 5PB 3/2. This **conical spiral** is winding down in a counterclockwise direction. It’s very similar—visually—to **“2004-27.”** The main difference is that as the path moves toward PB, not only the widths of the “chips” gradually become narrower (because they are getting farther and farther from you) they also move in closer to the grayscale.

Linda Jean Fisher, 2004