



Team Third

Jordan Nahabetian
In collaboration with Riley Kenyon
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Purpose

This Team Third image had the same constraints as all other team assignments in this class which was to image or video any intentional flow. Fractals have always amazed me in their unrelenting beauty. I wanted to create a fractal pattern and researched various ways I could achieve this within my work. I came across a YouTube video (<https://www.youtube.com/watch?v=hZy4kGqoJq8&t=295s>) by a user named Myriam's Nature and recreated her dendritic paint with my teammate Riley Kenyon. When setting up the experiment, we each played an equal role in mixing the materials and putting them together.

Flow Apparatus and Analysis

The set-up of this flow was relatively simple. We laid out an evenly-mixed solution of 1 part room temperature tap water to 7-10 parts DecoArt Crafter's white acrylic paint on a flat plastic surface. We mixed 1 part Liquitex acrylic ink with 2 parts Kroger 91% isopropyl alcohol separately from the acrylic paint mixture. We did this twice; once with Cadmium Yellow Light acrylic ink and once with Turquoise Deep acrylic ink. Once the acrylic ink was mixed with the rubbing alcohol, we dipped the pointed tip of a paintbrush handle into it and touched it to the acrylic paint. We played with the amount of drops in the center of one fractal patch as well and the location of those drops. The more we added, the wider the spreading would be. Our lighting was a fluorescent light which we diffused with a white sheet of paper. There was also very soft light coming from the window.

The way the alcohol/acrylic ink interacted with the paint was what created the initial outward spreading of the particles in my image. This fractal phenomenon is difficult to examine properly. The dendritic effect of the alcohol seems to be at least partially explained by the Marangoni Effect where there is a surface tension gradient between two fluids (1). The alcohol has a lower surface tension which catalyzes its expansion through the acrylic paint. Once the alcohol evaporates, the acrylic ink particulates are left in its wake which is why we see the leftover color.

Fractals that gives a similar pattern to these can be found in nature from a river, lightning strikes on wood, and crystal formation. The fractal pattern in paint is still unclear, but can potentially be explained by the detachment of alcohol/acrylic ink particles to take the path which depletes the least energy through the medium (2). In other words, much like a river, these particles are taking the path of least resistance.

Photographic Technique

The specifications of the camera settings can be found in figure 1 below.

Dimensions	6000 x 4000
Size	22.9 MB
Authors	
Camera maker	NIKON CORPORATION
Camera model	NIKON D5200
Camera serial number	9612475
ISO speed	ISO-317
F-stop	f/4.8
Exposure time	1/500 sec.
Exposure bias	0 step
Exposure program	Manual
Metering mode	Spot
Flash mode	No flash
Focal length	40 mm

Figure 1

I setup my camera to have a relatively quick shutter speed as to prevent motion blur. I wanted my image to be as sharp as it looked in real life. I had a lower ISO to reduce graininess. The flow was flat and my camera was pointed straight down on it about 7 inches away. I would've taken the image closer, but the camera would not focus when it was too close to the subject.

In post-processing, I used Adobe Lightroom to cut out any grain in the image and then transferred it over to Adobe Photoshop. I inverted the image, increased the brightness, darkened the blacks, increased the contrast a bit, cropped the image, and then finally increased the lightness on the colored areas.



Figure 2 Original Image

Reflection

I am pleased with how the image turned out. It is crisp, colorful, mysterious, and beautiful. While it's an artistic photo, the physics of it are still quite unclear. It was interesting how the Cadmium Yellow Light acrylic ink spread slower than the Turquoise Deep acrylic ink, although they were similar in dilutions. The experiment was difficult to control given that the solutions evaporated while we were using them. If I was to change this image, I would make it a video. This photo doesn't quite capture the motion of the alcohol spreading and the fractals forming, which was beautiful to witness.

(2) "Selforganization and stability of fractals." *QuantBio*. Web.

<http://quantbiolab.com/research/selforganization-and-stability-of-fractals>

(1) Wikipedia contributors. "Marangoni Effect." *Wikipedia, The Free Encyclopedia*.

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2018. Web.

<https://en.wikipedia.org/w/index.php?title=Special:CiteThisPage&page=Marango>

[ni_effect&id=839041233](#)