Report: Paint Dropping into Water

Group Project #2

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Group 5

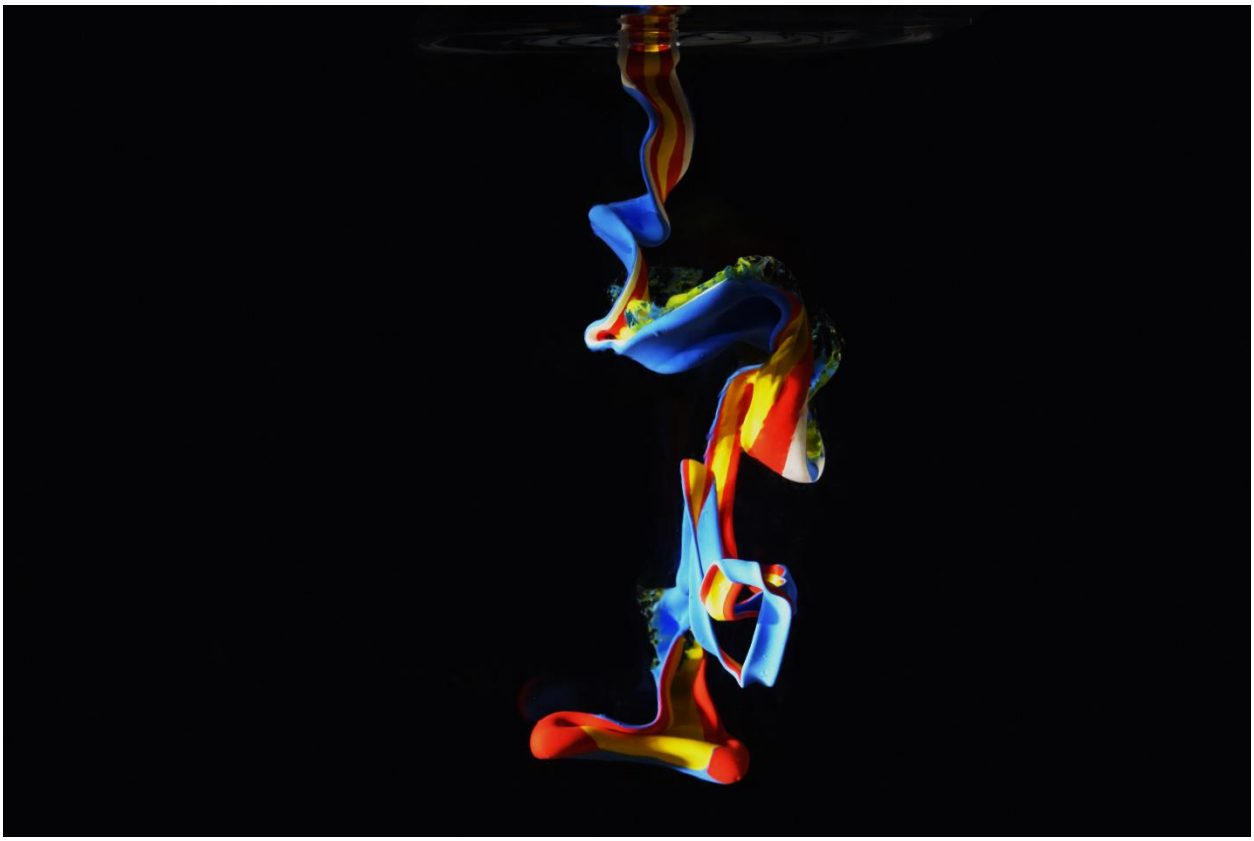

Figure 1: Final Image

For the second project, the team wanted to collect images of paint dropping into water, as inspired by some of the images found in the Best of Web projects at the beginning of the semester. Unfortunately, due to a lack of schedule coordination, the team was unable to all get together at the same time to take photos together, and from there, I had to work alone.

For the setup, there was a matte black poster board background, and a fish tank, approximately 1 gallon in volume, two of the walls being curved, two being planar and parallel, with an open top. The photos were taken through one of the flat walls. The tank was filled with regular tap water and bubbles that had accumulated on the walls were removed from the inner walls using a plastic spatula. Paint was then oriented on the edge of a plastic Tupperware container as shown in figure 2. Paint used was regular interior house paint, bought in 8 oz. sample sizes, which allowed for unique color selection in order to get the final Colorado flag coloring. The paint was water based, and began to diffuse in the water during the drops, which will be seen later in this report.

Figure 2: Paint prepared to be dropped into tank

The drops happened relatively quickly, so the shutter speed of the photos had to be set fairly high. The camera used was a Nikon D3300, equipped with an 18-55 mm lens, with the focal length set to 55 mm. The cameras shutter speed was set to be 1/640 seconds to try and resolve the flow, the aperture was set to f/9 in order to maintain a relatively large depth of field to maintain focus for the entirety of the flow, and the ISO was set to 1600 to make an appropriate exposure. In order to maintain the high shutter speed and the relatively small aperture without driving the ISO up too high, the photo had to be well lit. To the left of the tank, two night mountain biking lights were set up and focused on the edge of the tank. The lights were oriented in such a way that the flow would still be mostly front lit, without the shadow of the tank appearing in the background. This lighting also added an element of 3 dimensionality to the final photo, due to the areas of shadows and highlights formed by the light angle. The full scene setup is shown in figure 3.

Figure 3: Lighting, preparation, tank, and camera setup

Once the paint was dropped into the tank from just above the surface of the water, the camera, set to take roughly 6 photos per second, started taking a series of images. As the water-based paint fell into the water, it maintained its surface tension for a brief period of time

before it began to separate, creating a much more chaotic flow. The final image chosen, figure 1, shows the very beginning of this separation in fluid flows. The series of images depicting the fluid flow from this first image are shown in figure 4:

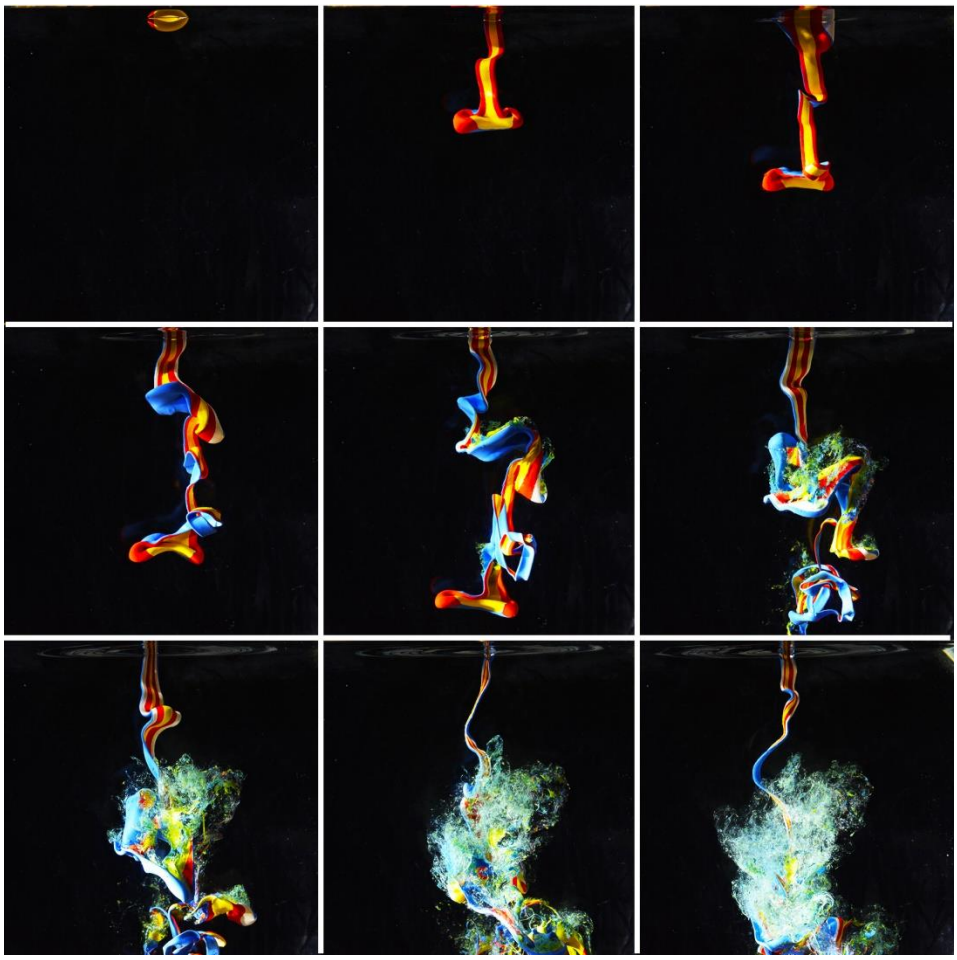

Figure 4: Flow Progression

Some other tests using larger amounts of paint revealed some other interesting flow phenomenon. One observation found was that after the paint broke up initially as seen in the images depicted in figure 4, the new water and paint mixture appeared to still remain separate from diffusing with the water that had not joined this mixture, making a sort of cloud-like texture. Some of the tests that used a larger amount of paint also revealed another interesting flow phenomenon where it looked like some of the paint had caught air bubbles upon entering the surface and rose through the cloudy mixture at the bottom up to the surface. Both of these flow phenomena can be seen in figure 5.

Figure 5: Other interesting flow phenomenon noted

It can It appears as though the yellow paint is mixing with the water the quickest, however more tests would be necessary to confirm whether or not this is actually the case. It is also interesting to note that the flow even moves upward at one point, and the fluid interactions even counteract gravity. It is also interesting to note that even though the ribbon of fluid twists and contorts as it falls into the water, the leading edge of the ribbon never seems to change orientation, suggesting that all of the other seemingly random motion of the tail of the ribbon is a result of flow instability coming from the leading edge.

Figure 6: Tank smudge lensing

Some critiques can be drawn from figure 1. While the fluid flow is in clear focus, appears fairly resolved, and represents the flow fairly well, there is a smudge in the front surface of the tank as shown in figure 6, where the flow is not very clear; the boundaries here have become poorly defined. This smudge was formed by the accumulation of a residue on the inner surface of the tank, which accumulated in some areas more than others due to the plastic spatula cleaning the bubbles off of the inner surfaces of the tank. These smudges were effectively cleaned using Window cleaner for future tests. There is also a visible reflection off of the back surface of the tank in figure 1. For future trials, the inner portion of the tank could be painted with a matte black paint, to escape reflections, and simplify the setup as well.