Team First Report

Tanner Wismer

Flow Visualization

Spring Semester 2018

MCEN 5151

March 1, 2018

University of Colorado, Boulder

For my team first image, I decided to do the food coloring in milk with dish soap experiment. I wanted to do this experiment because I was on the internet searching interesting looking fluid flow experiments and came across a cool video [2] showing the bright and vivid colors one could get from conducting this experiment. The materials I gathered from this experiment were purchased from Target and can be seen in Figure 1.

Figure 1: *Experiment Setup*

I used four different colors of food dye: yellow, blue, green, and red. The first step in the experiment was to pour two cups of 2% milk onto a flat surface (I used a plate) and then add four drops of food coloring of each color in the center of the milk. Once the food dye settled in the milk, the next step was to pour some dish soap on the end of a Q-tip and place the soap-covered end of the Q-tip in the center of the food coloring and milk. This caused a reaction that made the food coloring start spreading outwards towards the edge of the milk. The reaction of the food coloring when the Q-tip was placed in the center of the milk can be seen in Figure 2.

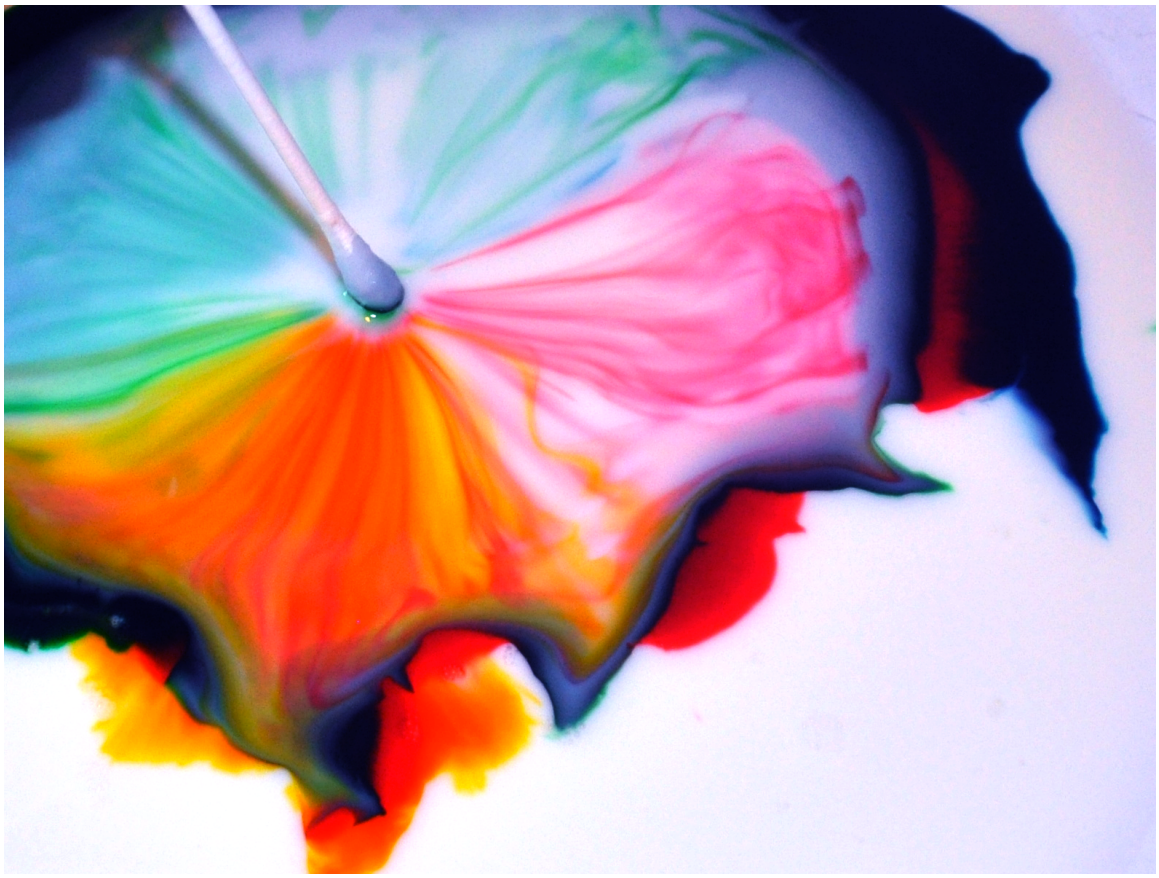

Figure 2: *Reaction of food coloring when soap covered end of Q-tip touched the surface of the milk*

I played around with putting the soap-covered end of the Q-tip in different areas of the milk to see how that changed the patterns of the colors in the milk. Once I got a lot of cool color patterns in the milk, I placed the junior mint peppermint crunch chocolates in the milk in the form of a smiley face for fun and it made the image more interesting. This final image can be seen in Figure 4 later in this report.

The reason the food coloring spreads throughout the milk in this way is because milk contains vitamins, proteins, minerals, and tiny droplets of fat

suspended in the solution. The fats and proteins are very sensitive to changes in the surrounding milk. The secret behind the bursting vivid colors is the chemistry of the small amount of dish soap applied. Dish soap has bipolar characteristics (polar on one end and nonpolar on the other end), which weakens the chemical bonds that hold the proteins and fats in the milk. The soap's hydrophilic end dissolves in the water in the milk and the hydrophobic end attaches to the fat in the milk [1]. The molecules of fat roll, twist, and bend in different directions as the soap molecules move around to join up with the fat molecules in the milk. As all these molecules are moving around in the milk, the food coloring molecules are bumped and moved around, providing an easy way to see all this activity that would otherwise be invisible. As the soap becomes evenly mixed with the milk, the rush of movement slows down and eventually stops. With the more milk you have, the more times you can place the soap-covered Q-tip in the milk to trigger this response. In my experiment, I placed the soap-covered Q-tip in the milk a total of four times to get my final result.

During my experiment, I had to change my photographic technique several times to get the desired result. The first problem I was experiencing was with the lighting. I was initially using the built in flash on my Nikon D90 DSLR camera as the lighting, while turning off every other light in the room. I noticed a very distracting glare reflecting off of the surface of the milk. After several steps of trial and error, I ended up turning off the flash from my camera and the lights in the room and opened the blinds to let sunlight be my source of light. I had to change the angle at which I was taking the picture several times, but I finally got a picture with no annoying glare. I then used varying distances from the lens of the camera to the surface of the milk until the entire experiment was captured and the edges of the plate were the edges of the image. The final distance from the camera lens and the surface of the milk was about two inches. Then, I uploaded my picture into Photoshop to do some cropping, contrast and brightness editing, and to enhance the colors. My original image and the final edited image can be seen below in Figures 3 and 4, respectively.

Figure 3: *Original image*

Figure 3: *Final edited image that was uploaded to flowvis.org*

The color enhancing done in Photoshop really made the colors stand out and pop in the final image compared to the original image. I enhanced the green, red, and yellow colors and edited the contrast and brightness to make for more vivid colors. I also cropped the image so the edges of the plate were not in the final picture to make the main focus on the patterns of the colors and the smiley face.

This image reveals how cool this experiment really is when you take the time to play around with the amount of food coloring used and amount of dish soap applied. I really liked the color patterns and swirls I was able to get, especially around the eyes of the smiley face. I also liked how the red peppermint on the chocolate blended with the red food coloring in the milk. One thing I dislike about the image is that I could have used more food dye colors to get more of a color contrast in the picture. I think this experiment fulfilled my intent because I wanted an image with really vivid colors and this taught me more about editing in Photoshop. Overall, I enjoyed this experiment and it taught me new things about the relationship between milk and dish soap.

References:

[1] Spangler, Steve. "At-Home Science Experiments: Color-Changing Milk." *Scholastic.com*, www.scholastic.com/parents/resources/article/science-nature-activities/home-science-experiments-color-changing-milk.

[2] IncredibleScience. "Milk Food Coloring And Dish Soap Experiment ~ Incredible Science." *YouTube*, YouTube, 17 Feb. 2014, www.youtube.com/watch?v=rqQSlEViNpk.