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Get Wet Assignment
FILM 4200-001
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Color-Changing Milk



This experiment was conducted in order to "get your feet wet" but also to capture a picture or video that illustrates fluid motion and the physics behind the phenomenon. During the earlier days at the start of my education, I clearly remember doing an experiment similar to this and wondering what causes these effects. My initial intentions for this assignment was to create a simple apparatus but clearly demonstrate flow visualization.

The experiment consisted of just common items that could be found in any household: a bowl, food coloring, milk, soap, and a Q-tip (optional). To start, I had used a large quart sized bowl in order to observe the full effect of the fluid and filled it roughly with 3-4 cups of milk. I had used a matte white bowl just to minimize the reflective effects from the dishware. Once the milk was added, I gathered four different types of food coloring (blue, red, yellow, and green) and added 2 drops of each at the center of the bowl creating a ring shape. After this was complete, I dipped a q-tip in soap and touched the center surface of the milk and watched the colors disperse, creating the image displayed above.

The physics behind this effect is more of a chemical one, however. Milk, which is mostly water, also contains other nutrients including fats and proteins that are sensitive to changes in its surrounding. At the surface, the water molecules experience a pulling and pushing force causing the water at the surface to contract, minimizing the surface area called surface tension. Depending on different compounds, some may be hydrophilic while others are hydrophobic. Adding these compounds (soap in our case), decreases the surface tension within this area and the fatty molecules within the milk become separated. The higher surrounding surface tension then pulls the milk along with its food color outward, creating this phenomenon.

The camera that was used was just a standard phone camera which was a Samsung Galaxy S8. Taking this photo was quite difficult and required multiple trials of this experiment before finding the right shot. I had set up three light sources surrounding the bowl in order to achieve even lighting. The camera was then setup from a top down view allowing me to get a full shot of the fluid. The settings of the camera is shown below:

Camera	
Camera maker	samsung
Camera model	SM-G955U
F-stop	f/1.7
Exposure time	1/120 sec.
ISO speed	ISO-100
Exposure bias	0 step
Focal length	4 mm
Dimensions	2832 x 1960
Width	2832 pixels
Height	1960 pixels

Table 1. Camera Settings

I had conducted this experiment about 3-4 times taking roughly 5 shots each time before I had captured the shot that I had liked the most. Since I created an even light source, there was very minimal post processing in Photoshop which is seen in comparison below.



Figure 1. Imaging processing in photoshop - Original on the left, Final on the right

As seen in **Figure 1**, little contrast was added and was slightly cropped for symmetry. After reviewing over this picture, the image reveals the white spots within the food coloring demonstrating the location where the soap was added causing the dispersion. I really admire how this photo came out, and how I am visually able to see the flow of individual colors, however; upon thinking about it, I should have taken a video capture in order to see the motion of the fluid. A plan on improving and developing this experiment would be placing different drops of food coloring at different locations or using multiple drops of soap.