

Chris Kuhn
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Flow Visualization
Get Wet Project
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The Tie-Dyed Wine Glass

For the first project, 'Get Wet', I studied how neon food coloring reacts when it is dropped through corn oil and water. The intent behind my idea was to better understand the principles of fluid mechanics and visualize it in an aesthetically pleasing way. Since I only have minimal knowledge of flow dynamics this process was both new and compelling.

After a couple of experiments I found the apparatus that best housed the flow as well as the most interesting combinations of food coloring. I learned that the food coloring was the most attention grabbing when it started to diffuse at the bottom of a wine glass. A normal glass seemed to ordinary and boring, while the cloud that took form in the shape of the wine glass was much more fascinating. I then brought the components of the experiment outside and placed the glass on a table in front of a background made of black matte board.

After everything was set up I filled the glass (which is 4 inches tall and 3 inches wide, excluding the base) $\frac{3}{4}$ full of water. Then I poured a thin layer of corn oil on top of the water. The oil didn't mix with the water because of its properties, rather it settled on top of the water and formed a boundary layer.

Next I simultaneously put two drops of each red, yellow, blue and purple neon food coloring in separate spots of the corn oil. Since the food coloring, which is made mostly of propylene glycol didn't mix with the corn oil it formed a bubble on top of it. This created surface tension instability and the oil could only support the food coloring for about a minute. Once it fell through the oil and reached the water negatively buoyant plumes of various colors fell to the bottom of the wine glass because propylene glycol is 1.04 times denser than water. Colorful clouds began to form in the glass as the food coloring diffused in the water. This process took several minutes and the most interesting

images came before the dye was fully diffused. Since I photographed this outside on a sunny day I didn't need to use any additional lighting or flash.

For the photograph I kneeled about 1 to 1.5 feet away from the apparatus and focused in as close in as possible. In most of the shots the wine glass took up the entire field of view, which was about 3 inches wide and 4 inches tall. The entire time I used my Canon EF 28-135mm f/3.5-5.6 lens focused almost all the way in at 120mm and set the focal length on 1 foot. I use this lens with a Canon EOS Digital Rebel. I set a normal aperture at f 5.6 and a normal shutter speed of 1/125 second. Since it's a digital camera I didn't have a choice in film. Once I selected the image that I wanted to display I used Photoshop only to crop and get rid of the glare that appeared as white spots on the glass. I used the smudge tool for this purpose.

I had an incredibly hard time choosing which image to use because there was a couple that I really liked. I particularly like this image because it shows what is going on in the entire glass after the food coloring has had a couple minutes to diffuse in the water. The colors that are both isolated and mixed create a very vibrant image that reminds me of tie-dye. The boundary layer between the water and corn oil is also visible near the top of the image and it is clear that the food coloring has not mixed with the oil at all. You can also see how the food coloring is starting to collect at the bottom of the glass and form a dark cloud since the propylene glycol is denser than the water. The only thing that I dislike about the image is that the glare is still visible and the spots where I had to fix it can be noticed under close inspection. I pretty much understand the fluid physics of the image as Professor Hertzberg explained it to me, but I don't quite get why the food coloring wont mix with the corn oil and how it moves through it.