

Team Image 2
Kelsey DeGeorge



Flow Visualization
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University of Colorado at Boulder
Professor Jean Hertzberg

Purpose:

The purpose of the first team image was to collaborate with classmates to create a beautiful and unique image while capturing the dynamics behind fluid flow. For this image, I wanted to explore the interaction between fluids that behaved entirely differently. I chose both liquid food dye and corn syrup due to the completely different viscosities, densities, and fluid behaviors. One of the most significant differences between food coloring and corn syrup is that the food coloring is a Newtonian fluid and the corn syrup is non-Newtonian. A Newtonian fluid is one in which the viscous stresses are related to the strain rate. Due to the high viscosity of the corn syrup, the flow of the liquid food coloring was static when interacting with the corn syrup. It was much easier to take an image of still fluid than fluid in motion. For this image, I collaborated with Liam Murphy, who assisted in the lighting and experimental set-up.

Image Description:

The set-up for this image is very simple and reproducible. I placed a clear, glass cup on top of a clear surface, which in this case was glass bowl placed upside down. I then filled the glass completely full with high fructose corn syrup. I dropped different colored food coloring on top of the surface of the corn syrup and separated the three different colors (red, green, and blue). I visually separated the surface into three equal sections and then filled those sections with the colored dyes, ensuring that the dye edges touched each other but tried not to mix them. I then took a q-tip and inserted it in the center of each color, pushing the dye to the bottom surface of the glass cup. I repeated this multiple times until I was satisfied with the shape the dye made within the corn syrup. The viscosity of the corn syrup allowed the dye to maintain its shape. The lighting used was overhead fluorescent lighting in my kitchen. The rest of the house was fairly dark and there was no natural light because it was nighttime.

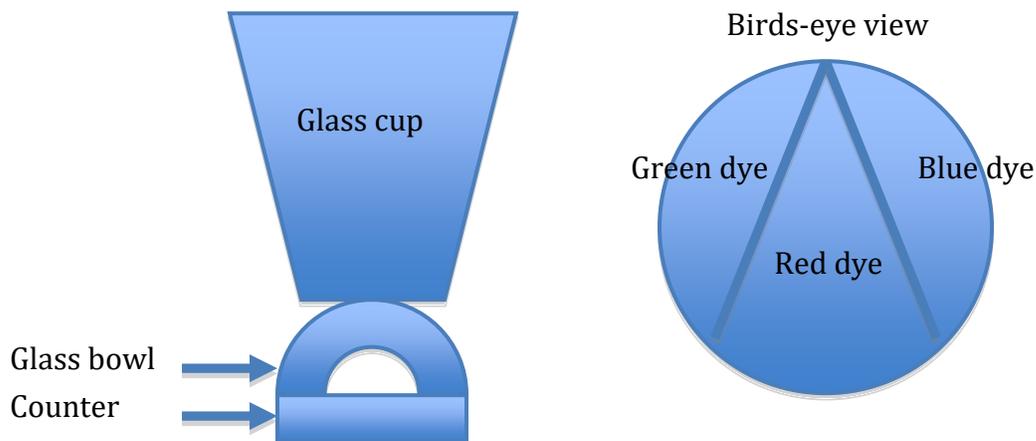


Figure 1: Photographic Set-Up

Photographic Technique:

The camera used to take this image was a Canon EOS 20D DSLR. The dimensions of the original image are 3504 x 2336 pixels and the edited image dimensions are 1233 x 1345 pixels. The focal length is 38 with an f-number of 5. Because there was no motion in the image, the shutter speed chosen was not as important. I found that the shutter speed used (1/60 s) was sufficient to capture a crisp, clean image. I needed good focus, and the high ISO allowed for a large enough exposure time. I estimate that the subject was approximately 12 inches away from my camera. The editing technique used was iPhoto. I did not do a great deal of editing. I increased the saturation to get brighter colors and cropped the image so that only the glass and the corn syrup/dye interaction were in the image. I also lowered the shadows setting to lighten it. Figure 2 below shows the original image.



Figure 2: Original Image

Physics:

Corn syrup has an extremely high viscosity and food coloring has a very low viscosity, so the interaction between the two fluids is unique. When the food coloring is initially dropped into the cup, it is not dense enough to break through the heavy and thick layer of corn syrup. With force, which was the q-tip pressing on the dye; the dye is able to break through the thick corn syrup. Because the dye is now beneath the corn syrup and due to the high viscosity of the non-Newtonian corn

syrup, the dye is able to hold its shape within the corn syrup because there are no other forces acting on it. The small air bubbles seen in the top of the image are inherent to the dynamics of the corn syrup.

Conclusion:

In conclusion, I am very pleased with the result of my image. The way the colors begin blended and dark at the top of the image and lighten and separate towards the bottom provides a visually appealing and unique aspect to the image. I also enjoy the way the shape of the bottom of the dye parallels the shape of the glass cup used because it provides a sense of symmetry and adds an artistic element. If I could repeat this experiment, I would have used less corn syrup so that the dye was the primary focus of the image and there wasn't so much clear, blank space in the photo. I also would have ensured that none of the colors blended toward the top to get rid of the dark musky color. Overall, I find that the image is unique and accurately displays the dynamics of corn syrup and dye, while also offering a beautiful and visually appealing photograph to look at.

Works Cited:

[1] <http://arxiv.org/pdf/1203.2682.pdf>