Max Kitay
ATLS 4151 - Flow Visualization
Image-Video #2
10/12/2020
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This image was captured for the second assignment in ATLS 4151, Flow Visualization. The purpose of this assignment was to capture an instance of physical interaction amongst some fluid to create a beautiful image as well as explain the physics occurring. My intent with the image was to capture the flow of glow stick fluid in a glass bottle filled with water. I was assisted by my friend, Josh, who helped pour glow stick fluid into the bottle as I was shooting the image.

The main physics captured in this image revolves around the density difference between the water and glow stick fluid. First off, I think it is important to discuss the inner workings of the glow stick and what causes its chemiluminescence. When a glow stick is bent, an inner tube containing hydrogen peroxide is cracked allowing it to react with the diphenyl oxalate and dye solution within the stick.[1] This reaction produces energy that is absorbed by electrons in the dye, causing them to fall back to their ground state, losing excess energy in the form of light. The density of diphenyl oxalate I found to be roughly 1.3 g/cm^3 [2]and the density of hydrogen peroxide to be about 1.45 g/cm^3 [3]. Because the glow stick fluid has a greater density than that of water, 1 g/cm^3 [4], it sinks to the bottom of the bottle.

The visualization technique I used to capture this flow phenomena is the use of dye. The bright orange color of the glow stick fluid is produced by the orange dye within the glow stick. The science of which is described above. I first filled a glass bottle with approximately 14 oz of tap water. I then cracked the *Hyde and Eek Boutique* glow stick and cut off the top with a pair of scissors. My partner, Josh, then poured the entire contents of the tube into the bottle as I shot the scene. The lighting was totally provided by the glow of the fluid as all of the lights in my room were off and windows closed with shades down to create an extremely dark environment. The bottle was placed about 3 feet from my camera tripod mounted at a roughly 20 degree angle from the table.

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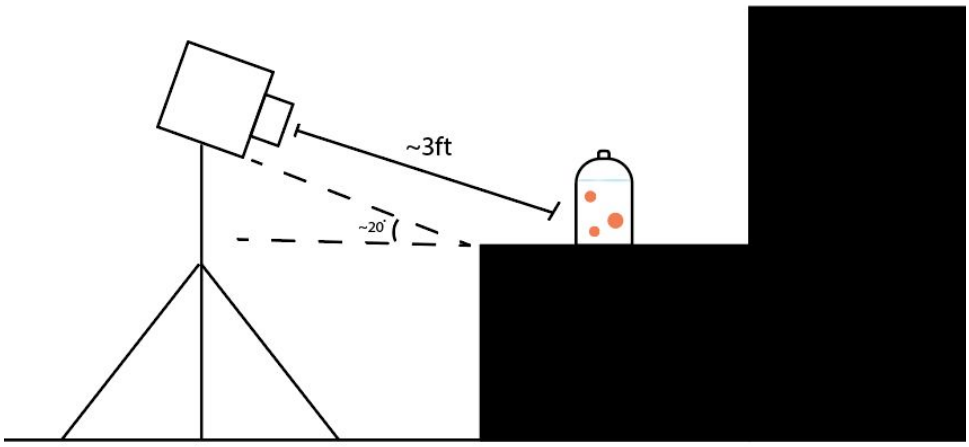
[1] Interest, C. (2016, November 09). The Chemistry of Glow Sticks. Retrieved October 06, 2020, from https://www.compoundchem.com/2014/10/14/glowsticks/

[2] Diphenyl oxalate. (n.d.). Retrieved October 06, 2020, from http://www.chemspider.com/Chemical-Structure.17449.html

[3] Hydrogen peroxide. (2020, September 28). Retrieved October 06, 2020, from https://en.wikipedia.org/wiki/Hydrogen_peroxide

[4] Water Density. (n.d.). Retrieved October 06, 2020, from https://www.usgs.gov/special-topic/water-science-school/science/water-density

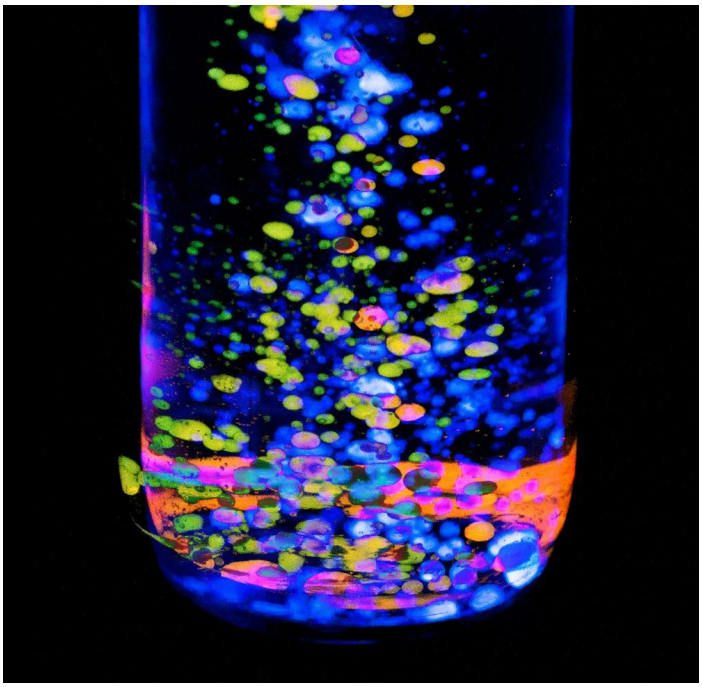


(Sketch of shot setup)

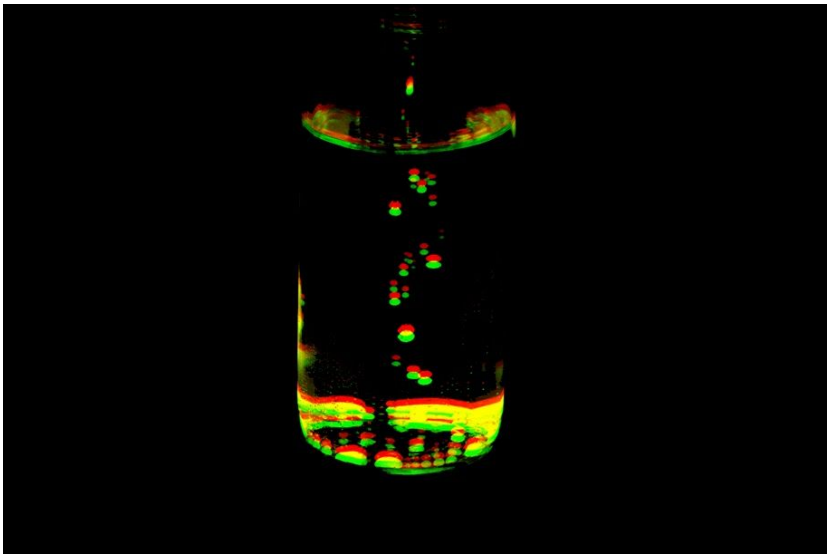
This shot was fairly difficult to capture as I needed to minimize motion blur in a very low light environment. Therefore I needed to keep my shutter speed fast but balance the ISO value to be able to pick up enough light while not creating too much noise. I played around a bit with different settings and finally settled on an ISO of 1600, shutter speed of 1/500s, at an aperture of f/4.5. The shot was taken with a Nikon D3500 camera set on a tripod with a 70-300mm lens set at a focal length of 70mm. I wanted to frame the shot as to center the bottle in the scene while also zooming in enough to capture details of the droplets. The original image size was 6000 x 4000 pixels and the final cropped JPEG measured 1300 x 867 pixels. In post production I did a bit of editing within Adobe Lightroom Classic including increasing the exposure and contrast, bringing up highlights and shadows, as well as increasing overall saturation. I also brought up the luminance value and slightly altered the hue of the orange color in the image to match the glowing color.

(original image before editing)

I do enjoy the final outcome of this image however I believe a lot could be improved as well. For one, I would have liked to have honed in on the focus a bit better to more clearly capture the falling droplets, however this was quite difficult to do given all the variables in the scene, such as moving parts, low lighting, and uneven distribution of the fluid. I do believe the fluid physics are demonstrated quite clearly and the image is overall visually interesting to look at. This image reveals to me the elegant depiction of smooth motion frozen in time, particularly emphasized by the immense contrast captured between the bright glow of the orange fluid and the pitch black of the backdrop. Included below I've inserted a few variations of this image I created, including an array of other shots of varying colors and glitched/mashed variations for artistic purposes.



(Blend of 3 different colored images into one)



(Glitched variation of original image)