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Get Wet
Flow Visualization 2023
9/25/2023

This image was taken for the first assignment of Flow Visualization, Get Wet. The purpose was to picture some sort of fluid flow phenomenon. I chose to picture density differences in liquids as well as diffusion.

The image was created by dropping red and blue concentrated food coloring into a glass of water. The glass was a 14 ounce cup that was filled with about 12 ounces of water. The glass is 4 inches tall and has a diameter of 3.5 inches on top and a diameter of 2.75 inches on the bottom. Two drops of red and blue food coloring were then dropped into the water from about 2 inches above the water's surface. Shortly after the drops had reached the bottom of the glass, I took the photo from approximately 6 inches above the surface of the water.

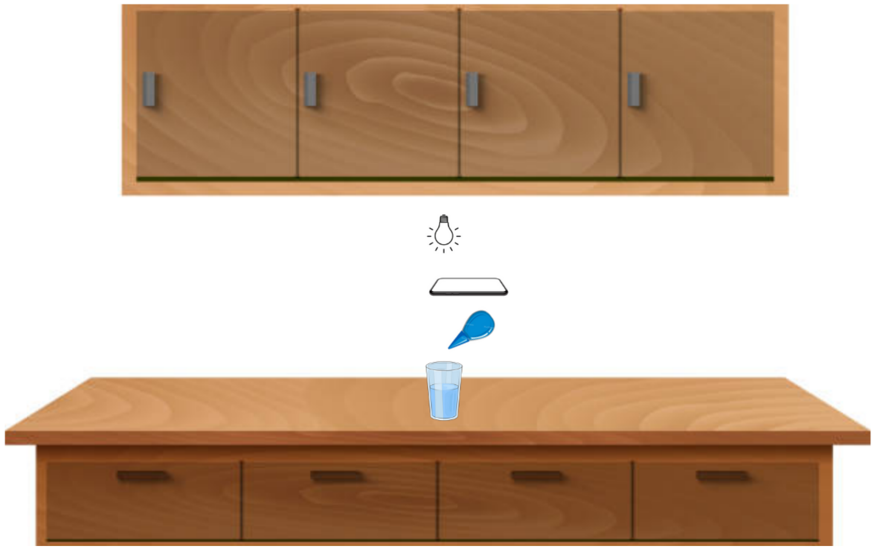

Diagram of how the photo was taken

The primary force acting on the food coloring was gravity. This caused the droplets to fall onto the bottom of the glass. In addition, gravity also caused the coloring to spread out on the bottom of the glass. Surface tension also played a role in the visual as we can see the streams of color that the droplets left behind that were caused by the friction between the droplet and the water from breaking the water's surface tension.

The droplets of food coloring traveled 4 inches in 1.37 seconds. Converting inches to meters that is 0.102 meters. From this we get, $.102/1.37 = .0745\ \frac{m}{s}$. This can then be plugged into the equation, $Re = \frac{\rho v L}{\mu}$ along with our viscosity $\mu = .001\ Pa * s$ (Engineers Edge), flow diameter $L = .003m$, and $\rho = 1000 \frac{kg}{m^3}$.

$$Re = \frac{1000*.003*.0745}{.001} = 224$$

The Reynolds number being much less than 2000 indicates that this was a laminar flow (Engineering Library). This result is not surprising as the streaks of color left by the food coloring did not distort drastically.

The phenomena previously mentioned were visualized through the aid of food dye. This food dye was Wilton Color Right Concentrated Food Coloring. The food coloring was bought from Walmart. The lighting was under lighting from a cabinet in the kitchen where the picture was taken. This light allowed for appropriate detail to be shown.

Since this photograph was taken very close to the object, I decided to use my Google Pixel 7 Pro to take this picture. This phone camera has an aperture of 1.9 and ISO 99. Since the lenses are smaller, they could get a much better focus and detail on food dye in the water. As stated earlier, the picture was taken from about 6 inches above the water's surface. I used Google's photo editing software to edit the photo. I removed droplets on the side of the glass with the magic eraser and made the colors more vivid in the color setting. Additionally, I cropped the edges of the photo so that the focus was solely on the glass. The original photo's size is 2268 x 4032 and the edited photo is 2145 x 2684. The before photo can be seen below.

Original Photo

I am really happy with the way that the image turned out. I think the colors are vibrant and the picture has a lot of detail. Since the picture is taken from above, it makes it a little bit more difficult to see some of the physics at play. In the future, I would like to use an actual camera to compare results as well as choosing a better angle to be able to more clearly show the fluid flow.

Citations:

Engineers Edge
https://www.engineersedge.com/physics/water__density_viscosity_specific_weight_13146.htm

Engineering Library
https://engineeringlibrary.org/reference/laminar-and-turbulent-fluid-flow-doe-handbook