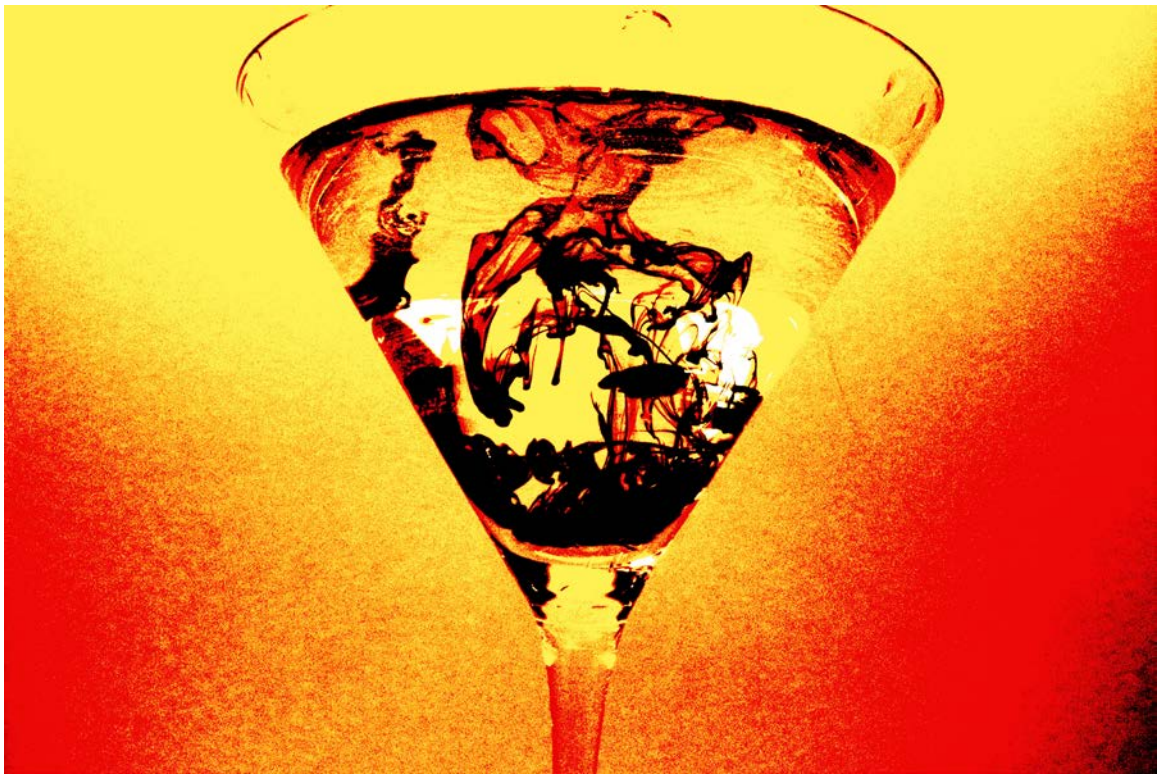

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The purpose of the first group project is to demonstrate the physics of Rayleigh-Taylor Instability. Emily Kolenbrander was present and assisted in the creation of the original image. This report is intended for Flow Visualization 2014 course at the University of Colorado.

A martini glass was filled with water to create the container to contain the Rayleigh-Taylor Instability. To ensure that the lighting was not blocked by the dispersing Indian ink resulting from surface tension, a droplet of hand soap was applied to a finger and then moved across the surface of the water. A diagram of the set-up can be seen below.

Figure 1. Shows the Flow Apparatus

Indian ink was dropped with the dropper 1 cm above the surface of the water to create consistent droplets into the water. As the Indian ink enters the water, gravity takes over and accelerates the denser ink towards the bottom of the fluid in a finger-like pattern. Due to the different densities of the fluids, water and ink, fingering occurs. Cold water was used in the martini glass as it causes a slower mixing. The flow can be described with the Reynolds number:

$$\mathrm{Re} = \frac{\rho V D}{\nu} = \frac{V D}{\upsilon}$$

where:

$$V = \sqrt{2 * 9.8 \frac{m}{s^2} * 0.01 m} = 0.443 \frac{m}{s}$$

D = 0.001m

$$\upsilon = 4.7E-5\frac{m^2}{s}$$

$$\mathrm{Re} = \frac{(0.443\frac{m}{s})(0.001m)}{4.7E-5\frac{m^2}{s}} = 9.42$$

The low Reynolds number explains why the fingering can be seen so well. The low Reynolds number allows the fingering to occur slowly.

The lighting used was from fluorescent lighting. A achieve a white background, white poster board was placed behind the glass. The photo was taken with a Nikon Coolpix P80. To capture the instabilities seen in the picture, a shutter speed of 1/34 was used. An aperture of f/8 was used as there was ample lighting for the photo. The focal length was 4.7 mm. The distance from the martini was about 5 inches away. Photo editing was done with Photoshop, where sharpness was increased along with the brightness. The tint and temperature were adjusted to achieve a yellow-red glow. The yellow-red glow created a background to which the black ink showed great detail.

Figure 2. Shows the fingering before and after the photo editing

The group 1 image shows the flow patterns associated with the Rayleigh-Taylor Instability. The image could have been improved by eliminating the glare from the fluorescent light. Experimenting with different light sources could have helped eliminate this glare. The photo editing allowed the fluid physics to have better definition. Further images could be created with glasses of different shapes. In addition, the fluid physics could be better demonstrated using ink with a color other than black. The black ink made it slightly difficult to see the different fluid physics.

References:

Kull, H.J. *Theroy of Rayleigh-Taylor Instability.* March 1991. April 20 2014. <http://www.ann.jussieu.fr/~frey/papers/instabilities/Kull%20H.J.,%20Theory%20of%20the%20Rayleigh-Taylor%20instability.pdf>.

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