Laurel Swift
9/15/04
MCEN 4228
Get Wet Proj.

Rising and Falling

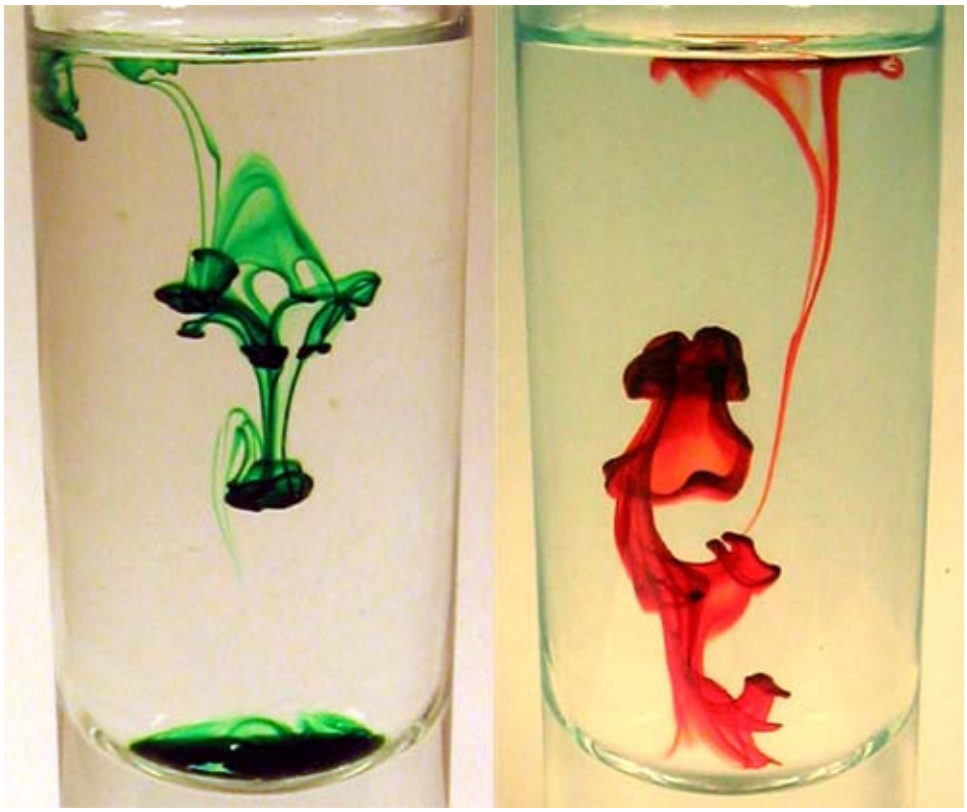


Figure 1. Rising and Falling: Green droplet is liquid food coloring in vinegar, red droplet is liquid food coloring in sugar syrup.

This image was created for the initial assignment, "Get Wet." My goal was to observe boundary effects that occur when a fluid is dropped into another fluid with a different density. I became interested in interactions between different liquids used in the kitchen when I noticed while mixing drinks that syrupy triple sec did not mix readily into watery liquids like juices. I performed the experiment with water, vinegar, triple sec (alcohol, water, and sugar), and diluted sugar syrup (one part sugar to one part water, one

part sugar to two parts water, three parts sugar to eight parts water, and one part sugar to four parts water).

One inch by three inch glass cylinders (shot glasses) were filled with liquids of differing densities. The first was filled with distilled white vinegar while the second was filled with sugar syrup containing one part sugar to four parts water. The cylinders were placed on a stand and allowed to stand to minimize movement of the base liquid in the glass. Dye was dropped directly from its bottle from ½ inch above the surface of the base liquid. Figure 2 shows the experimental schematic. Liquid food coloring is composed of water, propylene glycol, and dye. Water makes up the largest proportion of the coloring, so it was assumed that the coloring would behave like water when dropped into the base liquid. The density of vinegar is less than that of water, while the density of the sugar syrup is greater than that of water.

The food coloring was not diluted from its packaged state. To distinguish between photographs of the different base fluids, red dye was dropped into the sugar syrup and green dye was dropped into the vinegar. White paper was used as a background and an overhead light source was used to illuminate the glass while minimizing shadows. The light source was a two-bulb fixture using 13W compact fluorescent bulbs with an aluminum foil collar used to direct light down toward the experiment.

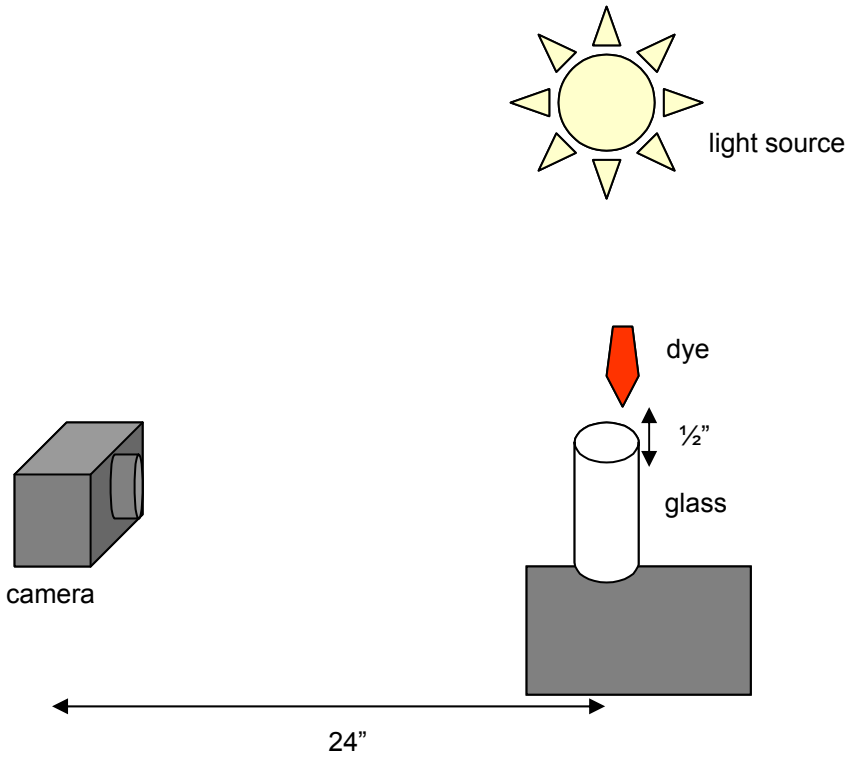


Figure 2. Experimental setup uses dye dropped from above a glass of liquid illuminated by an overhead light source.

The field of view was approximately 3.5 inches by 4.5 inches. The distance from the object to the lens was 24 inches. The camera used was a Canon A70 digital camera. The focal length used was 16.2mm, with a 3X optical zoom. The A70 also allows further digital zoom to 12X magnification. The green-drop-in-vinegar image was created using a 7.4X total zoom. The red-drop-in-syrup image was created using a 4.8X zoom. The A70's automatic setting for aperture and shutter speed were used in addition to the auto-focusing capability. The images were processed using Adobe Photoshop: for the green-drop-in-vinegar image the auto-levels adjustment was used and the image was cropped; for the red-drop-in-syrup image the brightness was increased, auto-contrast adjustment was made, color levels were adjusted to make the background as white as possible, and

the image was cropped and stretched to the same size as the green-drop image. The auto-levels adjustment tool was not used for the red-drop image because details in the red dye were lost with this tool. Unaltered images are shown in figure 3 at the end of this report.

The final image, titled "Rising and Falling" is shown in figure 1 (top of page 1). The image reveals that liquid droplets in a mixable liquid (i.e. not oil and water) of a different density do not mix immediately, but form plumes and vortices as the fluids mix. Food coloring (assumed to act like water) sinks in vinegar and pools at the bottom of the glass. The coloring first sinks in the sugar syrup due to gravitational acceleration, then rises due to its lower density. Over time, the dye will mix with both fluids. I felt that I fulfilled part of my intent to compare the effects of different density base liquids. However, I would have liked to have been able to show the progress of the drops over time. This is the direction I would choose in further developing this concept. In addition, I would like to improve my work with light sources. Some definition was lost in the heavily-dyed areas in the red-drop image when I corrected the yellow background in Photoshop. If the background appeared white in the image, this information would not be lost.

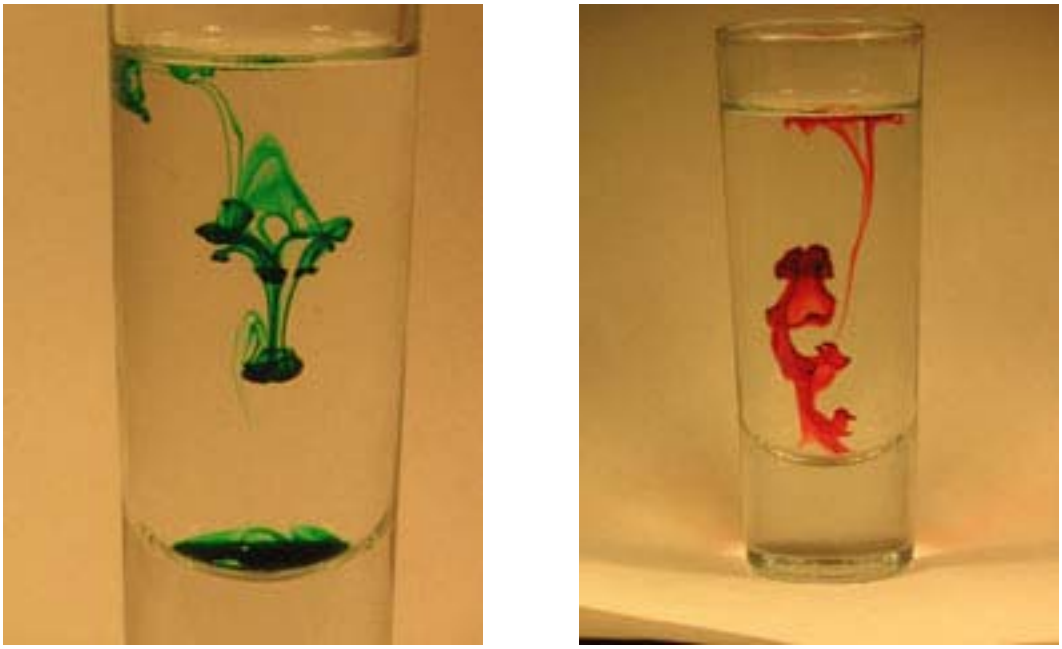
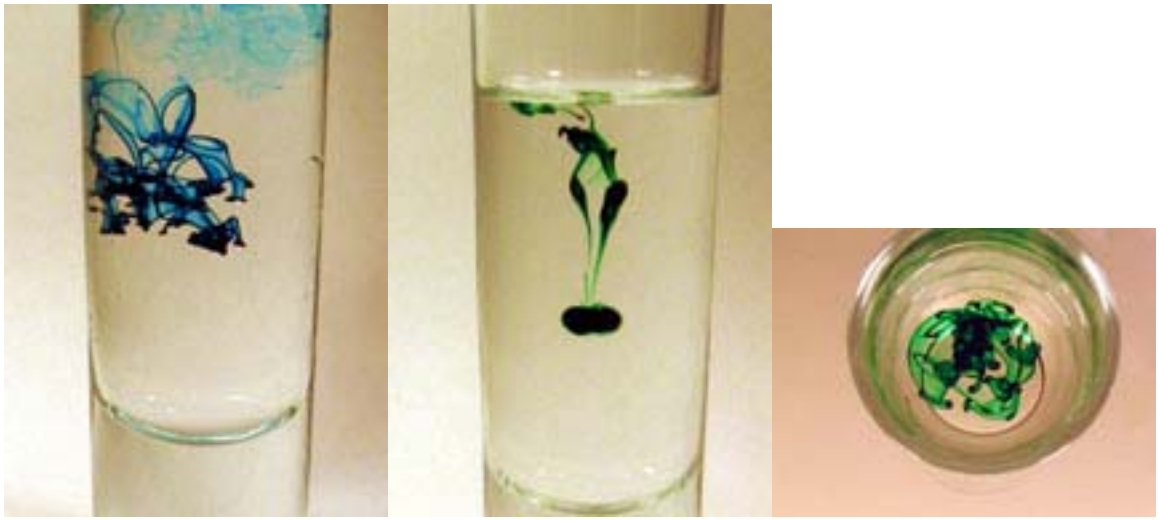


Figure 3. Unaltered images have yellowed backgrounds (from light source) and less contrast.



Addendum 1. Additional images included because I have extra space and they're nifty—the blue drop is food coloring in water. Green drops are food coloring in vinegar. The center image was taken approximately 5 seconds before the image in "Rising and Falling"