

Get Wet Report

Over the course of a week, I brainstormed and created my first image (figs. 1 and 2) of flow visualization in liquid. This piece was prompted by an assignment called “Get Wet”, which was an individually completed project meant for students to dive head-first into the world of flow visuals. Since fluid-flow analysis was new to me, I wanted to start small on this project whilst still creating an aesthetically and scientifically meaningful visualization. To do this, I started with the most accessible fluid I could think of—water. I chose to explore the density differences between near-boiling water and fridge-cooled water, and—for added complexity—a liquid food dye and a gel food dye were introduced and compared. This report will discuss the process, experimentation, and resulting flow that culminated from this project.

To create my visual, I used a handful of household items (fig. 3): a wide, cuboidal glass vase, liquid food dye, gel food dye, cold water, small bowls, a microwave, and pipettes (the least common household item of the list). The glass vase was filled close to the brim with hot-tap water that was microwaved for 2 minutes, and two small bowls were filled with cold fridge water and each dyed with either blue liquid dye or purple gel dye. I took two pipettes, one filled with blue water and one with purple and held them close to the surface of the water. I then squeezed the tops of the pipettes to rapidly inject the cold water into the hot water. What resulted from this action were two distinct flows within the hot water. On the left (figs. 1 and 2), a vortex-like flow is seen with distinct swirls and a plume close to the bottom of the vase. On the right, an almost blurry-looking mass of muted purple water that rapidly becomes formless, unlike its blue counterpart. The two plumes quickly dissipated into the bottom of the vessel.

What occurred here can be described by the Rayleigh-Taylor Instability and the Kelvin-Helmholtz Instability. The cold water can be estimated at $\sim 40^{\circ}\text{F}$ which has a density of approximately $.99999\text{ g/cm}^3$ while the hot water (estimated at 120°F) has an approximate density of 0.98870 g/cm^3 (Water Science School, table 1). The instability present is a “hydrodynamic effect that arises when a heavy fluid is accelerated into a light one...the heavier fluid, once perturbed, streams to the bottom, pushing the light fluid aside” (Smith, para. 1). Alongside the Rayleigh-Taylor instability, a velocity difference leads to a “shear layer...between

two parallel streams” (Marra, para. 1). This phenomenon occurs when a velocity difference in fluid leads to turbulence and/or the formation of vortices (Emergent Mind). This instability is visually apparent due to the use of colored dyes, which make the formation of vortices and the transition to turbulent flow visible.

Pivoting to examine the dye choice, density difference and a density similarity are present. The blue liquid dye, upon mixing with the cold water, was at a similar estimated density of 0.99907 g/cm^3 . This led to a consistent mix and injection into the hot water. Conversely, the gel dye exhibited a far more viscous makeup compared to its cold-water solvent. Upon mixing, the gel dye didn’t instantly dissolve. Upon injection, the purple-dyed water did not exhibit the same vortex-like tendencies of the blue-dyed water. This can be explained by the Reynolds Number (Re), which is the ratio of inertial forces (which keep the fluid moving) to viscous forces (which resist flow) (NASA, para. 3). The high viscosity of the gel dye leads to a low Re, and in turn the inertia of the fluid has a small effect on its flow. With the blue dye being a low viscosity fluid, it is estimated to have a higher Re and thus higher inertial forces which move the blue-dyed water in the formation seen.

Taking a step to consider mathematics, we can estimate the Re of the present fluids:

$Re = Ul/v$, where U is the injection velocity, l is the plume width, and v is the kinematic viscosity.

	Density (kg/m^3)	Plume Width (m)	U (m/s)	ν (μ/ρ)	Re
Hot Water	988.7	n/a	0 (static)	$5.644\text{e-}7 \text{ m}^2/\text{s}$	~ 0
Cold Water	999.9	.05	.04	$0.15486 \text{ E-}5 \text{ m}^2/\text{s}$	1291.49
Liquid Dye	999.07	.05	.04	$0.11218 \text{ E-}5 \text{ m}^2/\text{s}$	1782.85
Gel Dye	999.07	.05	.04	$.354 \times \text{E-}5 \text{ m}^2/\text{s}$	564.97

Table 1

**TheEngineeringToolbox used for kinematic viscosity values (see citations)

** Kinematic viscosity of gel dye estimated using water/glycerin ingredients

This flow visualization relied on household tools and a kitchen backdrop. An all-white background was not available, so paper towels were hung to create a neutral-tone background. I backlit the arrangement, turning on a white light behind where the paper towels hung. In terms of the photograph itself, I used my iPhone 15 Pro back cameras with a zoomed-in view. I took videos for each trial of the fluid injections and sorted through them to find the one that held the final image. The image itself required no cropping as my setup gave me the desired perspective. My purpose in the zoomed-in view was to create a no-distractions image for the audience. I wanted the audience to have the two plumes in direct view for analysis with no clear indication of what the surroundings or vessel used were. I had hoped this would direct attention to the aesthetics and the science of the flow rather than to the amateur setup. The raw image taken from the video was put in darktable, where I adjusted contrast, sharpness, and exposure to bring out the vortices and swirls.

My final image revealed a layered flow combining density differences, shear force, and turbulent flow. I was proud of the physical phenomena demonstrated, but the aesthetics of the image proved to be a hindrance to the overall effectiveness of the image. The combination of the hanging paper towels (which were not pulled taut) and the backlighting caused the left half of the image to be illuminated and the right half to be muted. Had I the chance to construct this experiment again, I would allot more of my time to setup and environment. Along with this, I would take longer with my image in darktable as editing a photograph is oftentimes what creates the most visually striking final image. In the future, it would be interesting to create a series of flows such as this one with fluid rearrangements. Next time, I could inject hot water into cold water or I might dye the hot water and instead inject clear water. Although lacking refinement, this Get Wet submission succeeded in demonstrating physical phenomena while maintaining an aesthetically engaging visual.

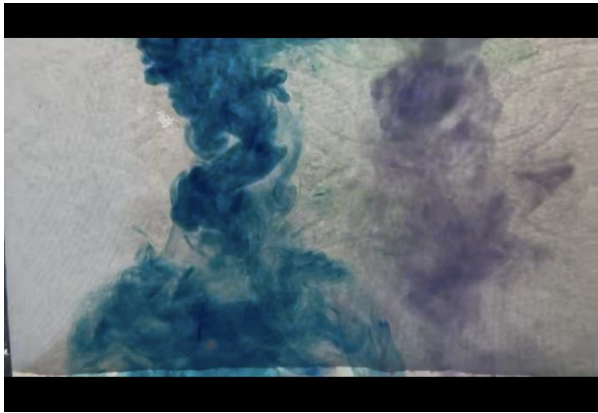


Figure 1

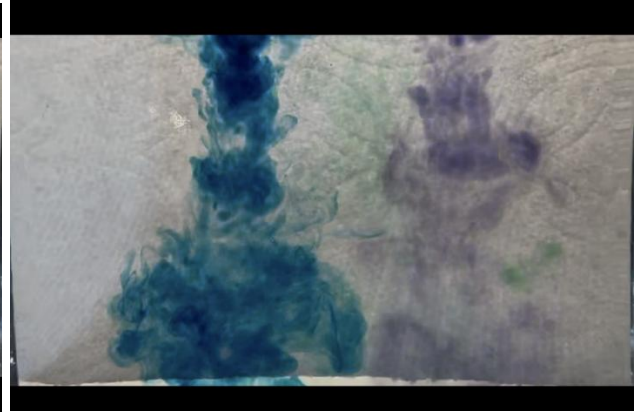


Figure 2

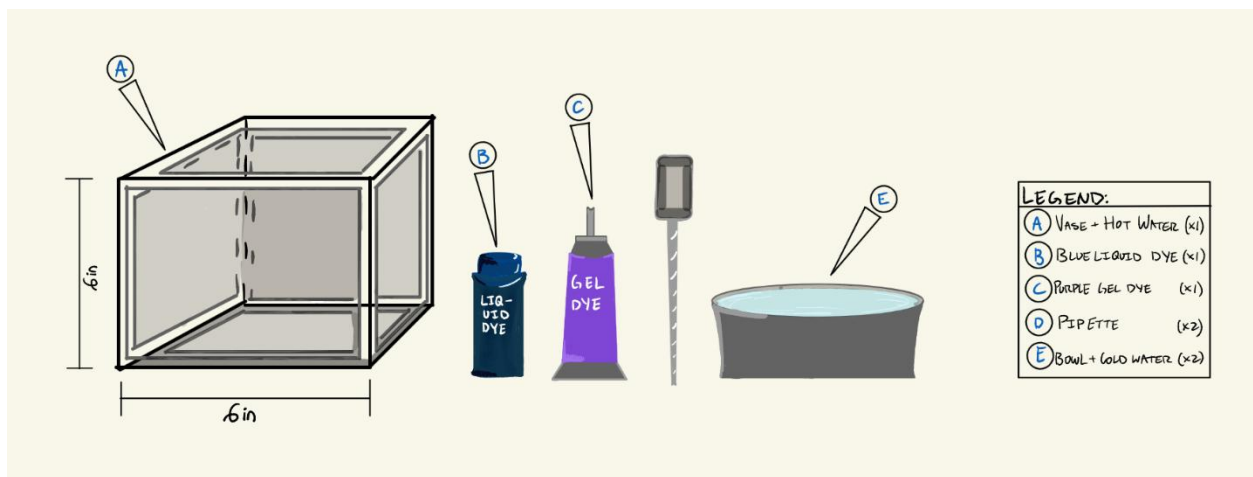


Figure 3

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www.emergentmind.com/topics/kelvin-helmholtz-instability-khi. Accessed 18 Sept. 2026.

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