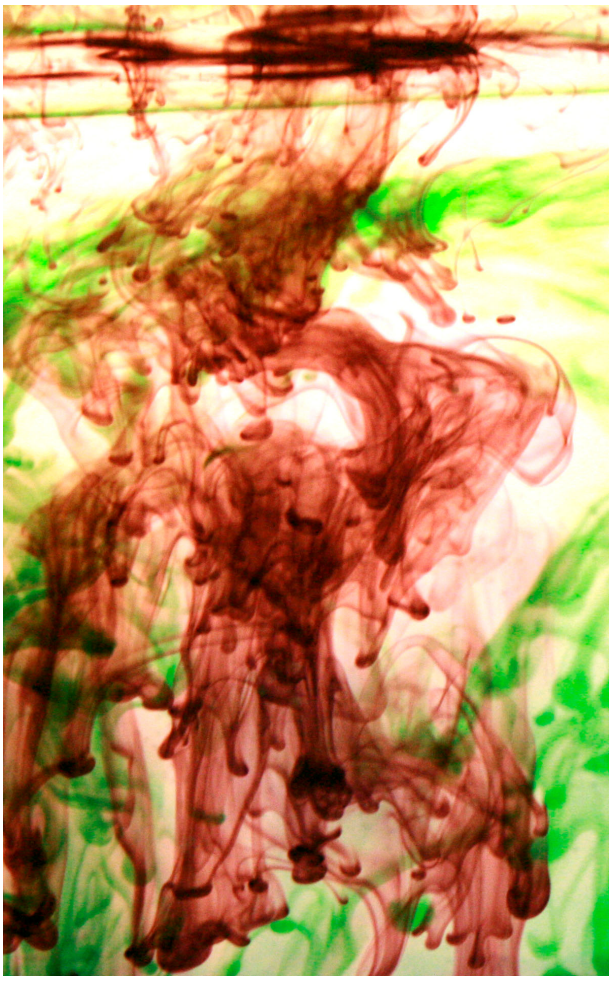


Team Delta
Project #2
Philip Bollam

The purpose of this image was to capture the Rayleigh-Taylor instability of a fluid flow. Rayleigh-Taylor mixing occurs in diverse applications ranging from supernova explosions to temperature inversions in the atmosphere. A deeper understanding of the mechanisms of such flows shed light on the many processes that underpin fully developed turbulent flows. This image is not simply dye in water; it represents the flow of our atmosphere to the flow of the cosmos.

This image demonstrates the interaction of fluids with different viscosities. The interaction that occurs is the Rayleigh-Taylor instability phenomena. This instability occurs when "a dense, heavy fluid is being accelerated by light fluid. As the heavier fluid moves down under the gravitational field, the lighter fluid is displaced upwards. As the instability develops, downward-moving irregularities are quickly magnified into sets of inter-penetrating Rayleigh-Taylor fingers." (1).

Calculations of the fluid flow were calculated using water as the fluid medium. The values associated with the water for the image are given in the table below.

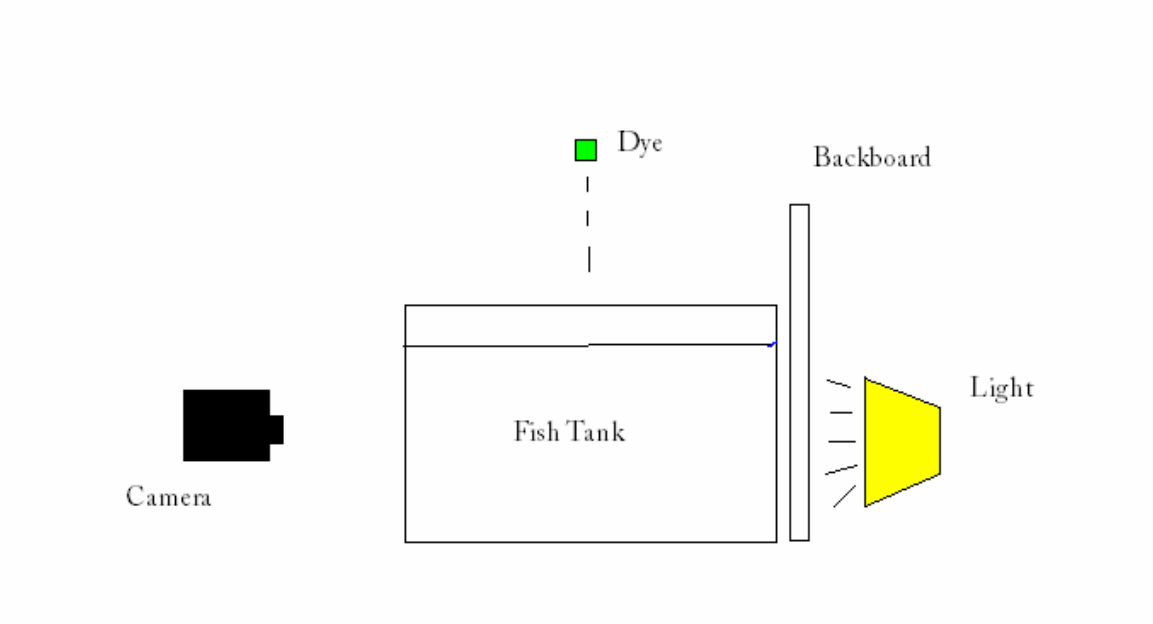
Density, ρ	998.29 kg/m^3
Dynamic Viscosity, μ	.001003 kg/m*s
Mean Fluid Velocity, v_s	.05 m/s
Characteristic Length, l	.25 m

The Reynolds number is the ratio of inertial forces to viscous forces and consequently it quantifies the importance of these two types of forces by providing the criterion for laminar or turbulent flow. The Reynolds number was calculated using the equation:

$$Re = \frac{\rho v_s^2/L}{\mu v_s/L^2} = \frac{\rho v_s L}{\mu} = \frac{v_s L}{\nu} = \frac{\text{Inertial forces}}{\text{Viscous forces}}$$

The Reynolds number for this flow is estimated to be 12,475 which identifies the flow as turbulent.

This image was taken in a fish tank with a 100W light bulb lighting the background. The figure below illustrates the setup.



After the setup was completed, undiluted green and red food dyes were dropped from several feet above the fish tank.

Image Summary:

- Field of View: 3 inches
- Distance from object to lens: 10 inches
- Lens Focal Length: 70 mm
- Camera: Canon EOS Digital Rebel XTi
- Shutter Speed: 1/180 sec
- Aperture: f/9
- Manipulation: Lightened background

This image captures the Rayleigh-Taylor instability of a fluid flow. Rayleigh-Taylor mixing occurs in diverse applications ranging from supernova explosions to temperature inversions in the atmosphere. This image fulfills my intent by capturing an extremely complicated flow into an aesthetically pleasing picture. I dislike that there were many drops of dye already in the tank when this picture was taken. This was due to the fact that the fish tank was quite large and would have taken a long time to empty and refill after every drop. This would have been very time consuming and wasteful on our part.

References:

http://en.wikipedia.org/wiki/Rayleigh-Taylor_instability