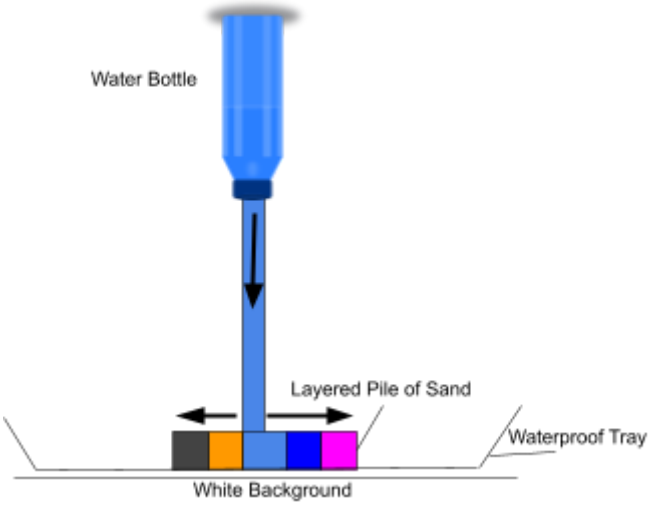
Get Wet Fall 2025
Colored Particles Dispersed by Pouring Water

Nathaniel Wheaton, Flow Visualization 5151-001, 9/23/2025



For this image, I was inspired by the complex geometries in erosion patterns found naturally in locations where fast flowing water flows over a bed of sand. The goal was to capture these fine geometric shapes. Several of the initial attempts suffered from blurriness due to my inexperience with my camera.

To create this flow I held a squeezable water bottle 1 meters (3.28 feet) above a tray with a layered pile of sand in the center. To initiate the flow I squeezed the bottle creating a high velocity flow which impacted the sand at a high speed. I then waited for the sand to slow to rest before taking a photo. Different layering patterns lead to unique flow patterns.

When the fluid impacts the particles the flow is ~1.5 cm wide. And by assuming the fluid starts at rest, the velocity at the time of impact can be estimated to be 4.43 m/s. Given these parameters and the material properties we can estimate the Reynolds number (in water):

$$Re = \frac{\rho UL}{\mu} = \frac{1.5*10^{-2}*4.43}{1*10^{-6}} = 66450$$

Since the Reynolds number is ~66000 the fluid is highly turbulent at the time of impact. In a highly turbulent flow eddies are common, when an eddy impacts onto the particles the imparted force changes depending on the direction of rotation, these eddies can cause the net force on a grain to reach a “critical” point at which the fluid force can overcome the force of gravity causing the grain to be lifted into the flow [1]. Additionally, once these particles have been elevated into the fluid these eddies are also the method by which these particles are

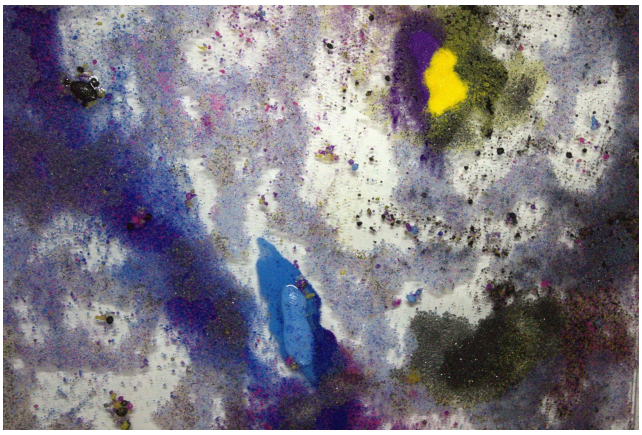
distributed throughout the interior of the fluid which carries them until the flow slows and allows the sediment to settle [2].

In some locations the particles traveled against the flow of the water, this may be due to the driving buoyancy interacting with advection effects causing deposited particles to move against the flow in some locations [3].

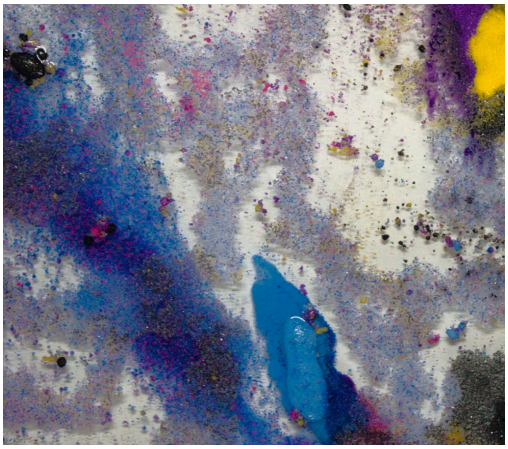
The sand, the white background, and the waterproof tray were all purchased from Hobby Lobby. The fluid used was room temperature water with a small amount of dish soap added to reduce surface tension. The area I used for the setup is illuminated uniformly by overhead fluorescent light.

The unedited photo has a field of view of about 1 ft x 1 ft. The distance to the lens is about 1.5 ft. I used a DSLR camera, specifically the Canon Eos Rebel T3i. The original dimensions of the image are 5202 x 3464. The F-stop used was f/5, the exposure time was 1/60 sec, the ISO speed was 2000, the focal length was 37mm. The original image is shown below:

Before:



After:



The final image has a resolution of 3167 x 2774. Few changes were made to the image besides cropping and making the colors more vivid.

[1] Sutherland, A. J. (1967), Proposed mechanism for sediment entrainment by turbulent flows, J. Geophys. Res., 72(24), 6183–6194, doi:10.1029/JZ072i024p06183

[2] O'Brien, M. P. (1933), Review of the theory of turbulent flow and its relation to sediment-transportation, Eos Trans. AGU, 14(1), 487–491, doi:10.1029/TR014i001p00487

[3] Hogg, A. J., & Huppert, H. E. (2001). Spreading and deposition of particulate matter in uniform flows. Journal of Hydraulic Research, 39(5), 505–518. https://doi.org/10.1080/00221686.2001.9628275