**JOANNA BUGAJSKA**

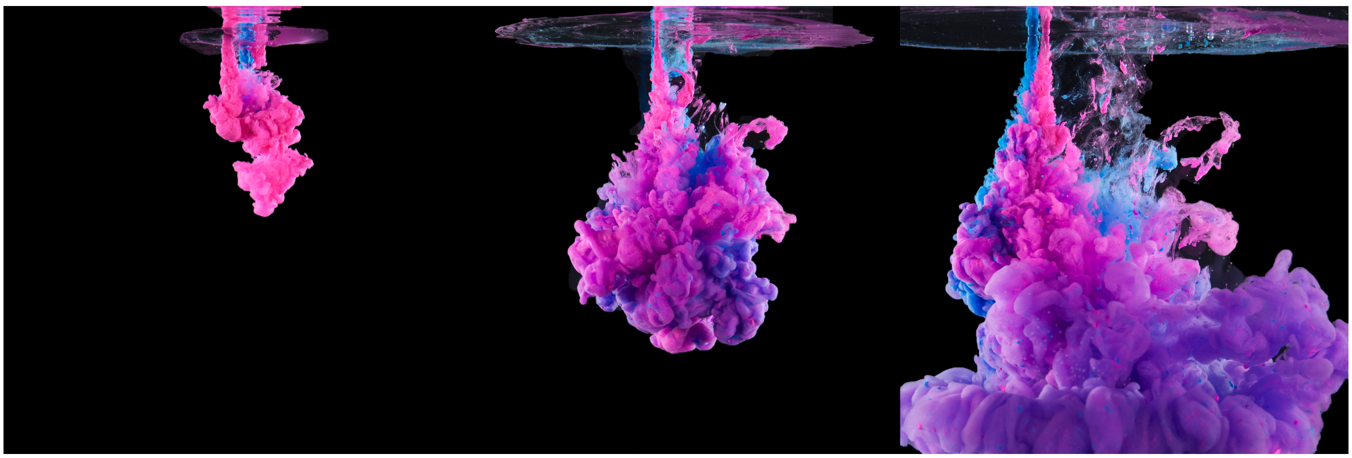
**ARTF 5200 FA15**

**TEAM PROJECT 2**

**DESCRIPTION**

This project was inspired by the creative work of Alberto Seveso (www.burdu976.com). We chose to recreate his famous photographs showing the dispersions of multicolor paint in water. Inspired by the beautiful video work of the artist we have attempted to work with slow-motion video using GoPro Hero3 camera but with poor results due to limits of technology we decided to use high burst photography to try to capture the moment. Still nostalgic for the time-based element of Seveso's work I choose to show the captured images as an image sequence.

**PROJECT OUTCOME**



Using images from the13th of the 14 takes of the same experiment I chose to show the progression over time from the moment the jet of two streams of paint pierces water to when said two jets hit the bottom of the 1-gallon tank of water we were using,

The images were captured using high-speed BURST MODE shooting at 4 fps. The selected images showing the progress of the expansion two color paint in water and reference 1.5 seconds of the actual process.

The precise durations between the individual images are:

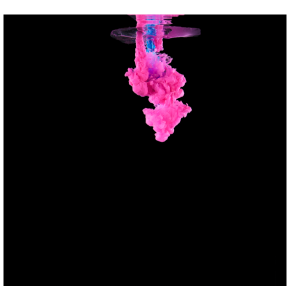


**Image 1 (0.5 sec)**

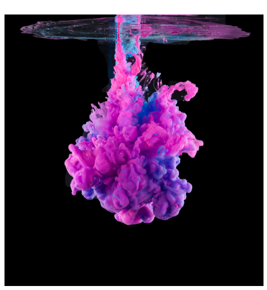


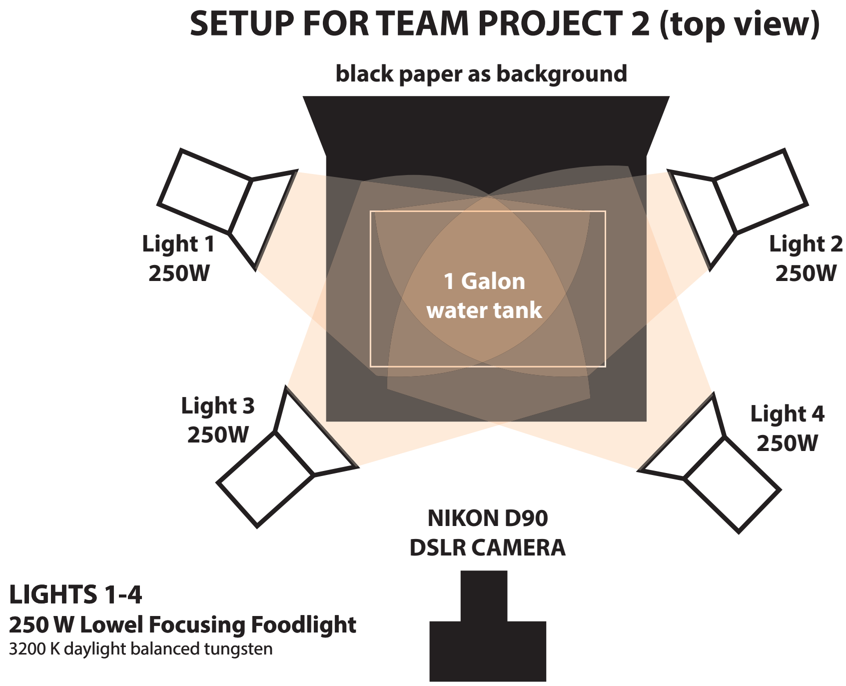
**Image 2 (1 sec)**

**Image 3 (2 sec)**

## SETUP

### MATERIALS USED

- Pro Art Liquid Tempera Poster Paint (Water Soluble)
- SoloTM Cups (Clear/Plastic)
- Approximately 1 Gallon of Water
- 1 Gallon Fish Tank
- Black Paper/Poster for Back-drop
- Tri-pod
- 250 Watt Lowel Pro-Light Focusing Floodlights (4) (Tungsten Balanced)




## CAMERA SETTINGS

**Camera Information**

| | |
|---|---|
| Make: | NIKON CORPORATION |
| Model: | NIKON D90; S/N: 3448413 |
| Owner: | |
| Lens: | 18.0–105.0 mm f/3.5–5.6 |

**Shot Information**

| | |
|---|---|
| Focal Length: | 18.00 mm (in 35mm: 27 mm) |
| Exposure: | 1/1000 sec; f/3.5; ISO 400; Manual; Spot metering |
| Image Size: | 4288 x 2848 |
| Orientation: | |
| Resolution: | 300.00 Pixel per Inch |
| Flash: | Did not fire |

Camera: Nikon D90 DSLR camera 12 MP

Lens: Nikkor 18-105mm 1:3.5-5.6

Aperture: 3.5 f-stop

Shutter speed: 1/1000

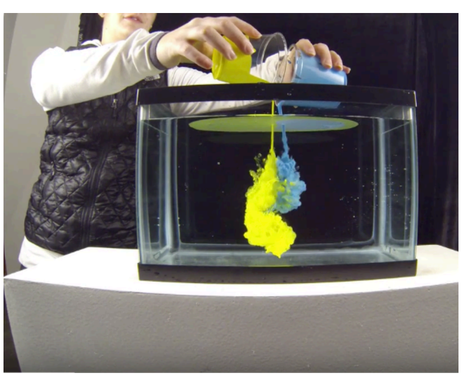
Focus was set manually

BURST MODE: 4 fps

## PROCEDURE


We used Pro Art Liquid Tempura paints choosing for each take one, two or three colors from the five we had available.

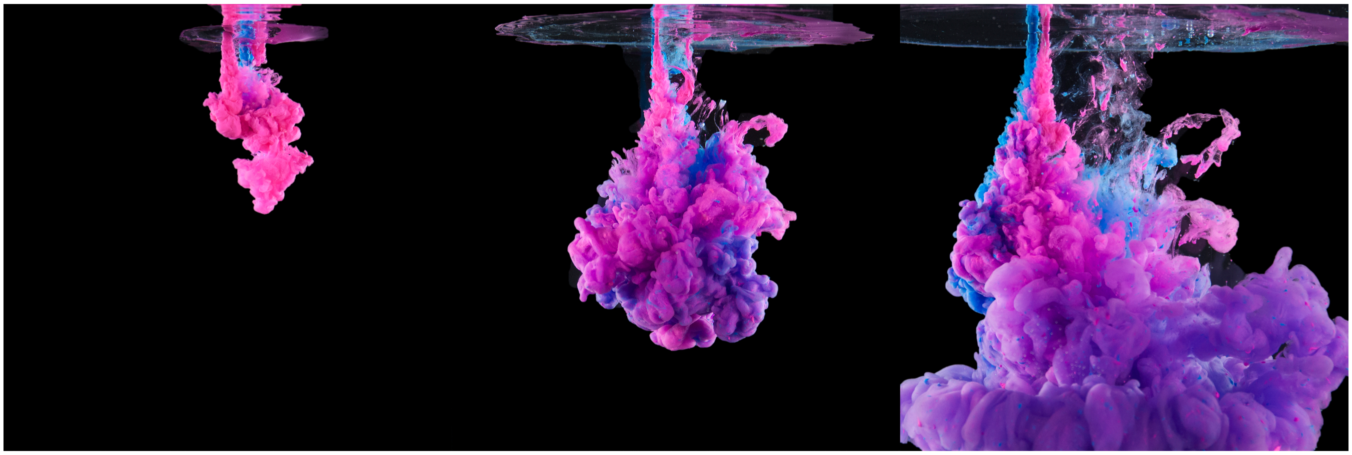
Next the paint was mixed with water.



In the final step the paint was poured into the 1-gallon tank of water and action was shot captured with the Nikon camera using BURST MODE (4 fps).

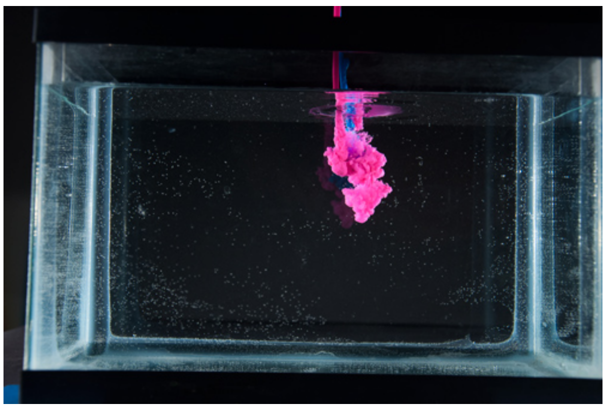
**POSTPRODUCTION**

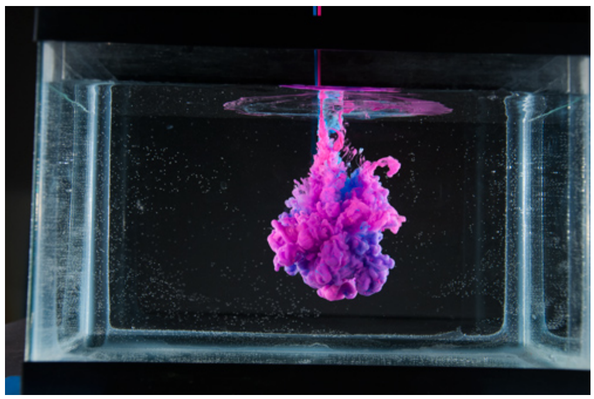
Final Edited Image

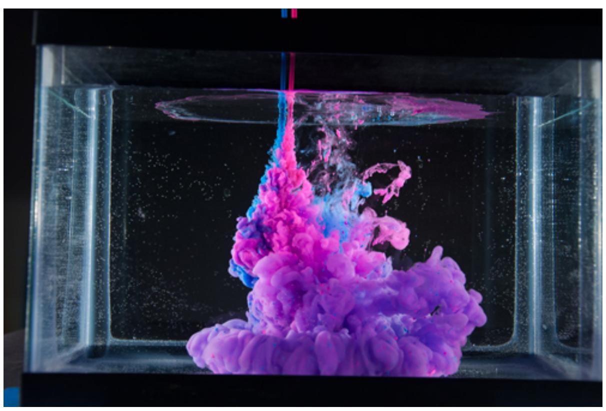


The final image was created in Adobe Photoshop CC.

**Original Images**







The original images (show above) were imported into a single document (4500x1500px) and using guides and Layer Masks cropped and then distributed in space in order they were taken.

Only other correction was done to the background, which was isolated using Color Selection and then filled black to create a solid color background and allow seamless stitching of three images.

**PHYSICS OF THE PHENOMEMNA**

*NOTE: I leave physics for last, because this section has been written by my teammate Rob VanCleave. This intentional division of work is a choice based on our field of study; mine being ART.*

There are a few interesting phenomena occurring in this interaction. The first and most obvious being the transition of laminar to turbulent flow. Laminar flow is defined as "flow of a fluid when each particle of fluid follows a smooth path in which those paths do not interfere with one another." [2] Turbulent flow is flow on which "the fluid undergoes irregular fluctuations, or mixing." "In turbulent flow the speed of the fluid at a [given] point is continuously undergoing changes in both magnitude and direction." [3] As the paint is dropped into water tank, the laminar flow of paint slowly being poured into water changes dramatically into a turbulent flow of visible proportions. Other than by inspection, flow can be categorized into these two areas by the Reynolds number. The Reynolds number is defined as Re = ρVL/ μ, where ρ is the density of the fluid, V is the characteristic velocity scale, L is the system length scale, and μ is the fluid viscosity. [4,5] However, Reynolds number is usually applied in either a flow in a pipe or over a flat plate, so the analysis does grow in complexity when applied to these constraints.

To determine an appropriate Reynolds number, one must look further into the fluid viscosities of both mediums. In basic terms, a fluids viscosity is the thickness of the fluid. It tells you how much force you would need to apply to move that fluid or keep it moving. [6] This can be mentally visualized by comparing honey and water. Honey is much more viscous liquid that requires more effort to move than normal tap water. Paint is not a simple single-molecular that can easily be identified to determine viscosity. Rather, it is a complex conglomeration of chemical ingredients that can range from rather oil paint to water colors. Through experiment we found that if the paint was too viscous, the water wouldn't diffuse the paint and the result would be less that atheistically pleasing. We found by lowering the paint's viscosity by a slight dilution with water, we were able achieve the desired output.

At room temperature, μ for water is approximately $1x10^{-3}$ (Pa-s) and paint is approximately $1x10^{-1}$(Pa-s). Given these values, the following calculations for each were made.

Figure 2: Reynolds Number Approximation

$$Re_{water} = \frac{1000\left(\frac{kg}{m^3}\right)*5\left(\frac{m}{s}\right)*.05(m)}{1x10^{-3}(Pa*s)} = 250000$$

$$Re_{paint} = \frac{1200\left(\frac{kg}{m^3}\right)*5\left(\frac{m}{s}\right)*.05(m)}{1x10^{-1}(Pa*s)} = 3000$$

The combination of these two liquids presents further complication in attempting to find a Reynolds number to classify this particular flow. With further guidance I am confident one could prove this flow is turbulent in the given fluid medium of water. After much independent research it appears this classification is currently still under heavy research as the literature was sparse at best.

I believe the other main physical phenomena that is occurring here is that of surface tension. The paint we used before diluting had a high surface tension. This encouraged the liquid to bead once it hit the water rather than being spread out through the water. [7] We even saw this early on when the paint had not been diluted as we poured it into the water. By diluting the paint with water, the water acted as a surfactant by lowering the paint's overall surface tension. I believe water worked as well as it did because the paint was water-soluble. Had the paint not been water-soluble I don't believe we would have achieved the result we were searching for. Other applications of surfactants can be seen in nature with semi-aquatic insects and in the energy industry with enhanced oil recovery. [7,8]

**Sources Used**

[1] http://www.burdu976.com/phs/portfolio/sony-xperia-z-tablet-z-o2-guru-tv/

[2] http://www.physlink.com/Education/AskExperts/ae464.cfm

[3] http://www.britannica.com/science/turbulent-flow

[4] http://www.mit.edu/course/1/1.061/www/dream/SEVEN/SEVENTHEORY.PDF

[5] http://www.daviddarling.info/encyclopedia/R/Reynolds_number.html

[6] http://nerdlypainter.blogspot.com/2011/01/viscosity-why-does-it-matter.html

[7] https://www.teachengineering.org/view_lesson.php?url=collection/duk_/lessons/duk_surfacetensionunit_lessons/duk_surfacetensionunit_less1.xml

[8] Sandersen, Sara B. "Enhanced Oil Recovery with Surfactant Flooding." (2012): iii-iv. Technical University of Denmark. Web. 20 Sept. 2015. < http://www.cere.dtu.dk/-/media/Centre/CERE/Publications/PhD%20Thesis/2012/Sara%20Sandersen%20phd.ashx?la=da>.