Viscous Mosaic

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Purpose

This image was created for the 'Team Second Visual' assignment. The image was created in collaboration with Matthew Murray and Sami Algoosi, and even though all the images we submitted were different, their contributions were essential in the creation of the image. This image was inspired by pretty_little_lens work on Instagram [1]. While the photos are quite different, the process and ideas were similar. The intent was to capture a non-Newtonian fluid in a colorful manner and capture the behavior as the two interact with each other. While experimenting with the fluid, many different patterns were attempted such as linear lines or circular lines. While those images were also impressive, this photo was ultimately chosen for its detail and patterns.

Setup & Procedure

To perform this flow, experiment the following material will be needed: 12 Oz bottle of Aloe Vera Gel, bag of 6 colored translucent bingo counting chips, two 12 by 6 by quarter inch clear acrylic sheets, and a garlic crusher with many small holes which can be found in kitchens. Those are the three essential items for this flow experiment. Beyond that, some sort of lighting setup is necessary. In our case, we used an iPad Air with full brightness with a completely white screen. Other lighting options will work as well, but the light will need to be diffused to get this exact effect. It would also help to be in a dark room with no other light source; however, it is not necessary. Some sorts of objects to layer the setup will be needed to differentiate the layers in the experiment.

The following is in reference to the image diagrams below. The top acrylic layer is where the Aloe Vera gel goes where you make your pattern of choice. Then make a 1-inch gap below to the next acrylic sheet where you put your desired density of counter chips. In our case, we used books to separate the layers. Then another 3 inches below on the ground from the table is where your lightling source will go. The pattern shown below on the image was one of many attempts, and it is encouraged to play around with the gel to get different interesting results. Then take the photo from any angle or distance. In this photos case the picture was taken from directly above the flow and as close as possible that the lens would allow which was approximately 1 and a half feet.

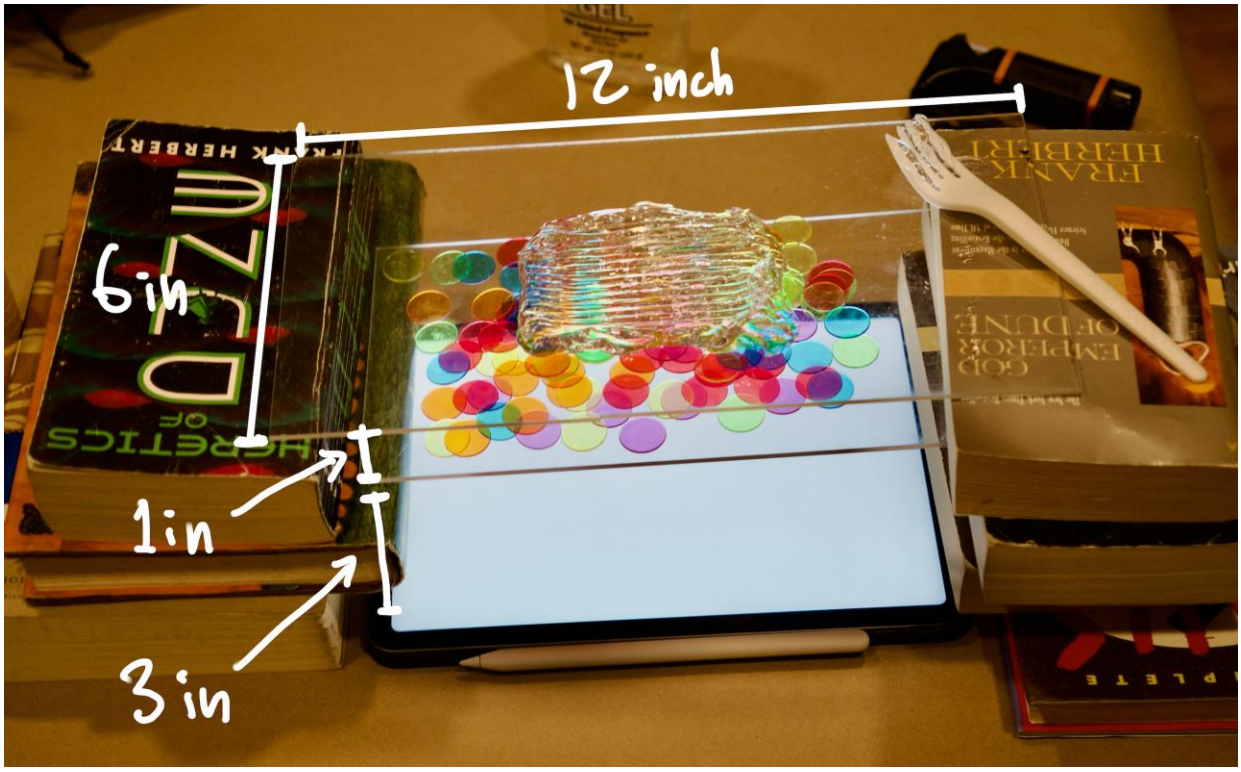

Figure 1. Setup Diagram Image

Photography Specs

This image was shot on a Sony Alpha 6300 Mirrorless camera system with a 24.2-megapixel APS-C sensor. The lens used was a Sigma 18-50mm f/2.8 DC DN Contemporary lens. The lens was approximately 1.5 feet away from the top acrylic sheet while being directly above the setup. While being set at a focal length of 50mm, which translates to a 75mm focal length with the APS-C sensor used. The final image was a size of 4224 pixels by 3021 pixels, and the original RAW photo was a size of 6000 pixels by 4000 pixels. The goal of the shot was to capture the flow as close as possible in as much detail as possible. The listed specifications are mainly a byproduct of the camera I used. However, the settings I did actively choose with a purpose are listed as follows. An aperture of f/2.8, a shutter speed of 1/80, and an ISO of 125. Some of which were set by me in the camera's aperture priority mode with the camera also being manually focused. It should also be noted that aperture was at its lowest setting possible, and ISO was almost at its lowest setting.

In terms of post processing of the image, there was not an extensive amount of work done. The first big change was cropping it down in all directions in order to frame the image such that only the textured gel was in frame. On top of this, the exposure was also slightly increased, as were the shadows. Then there was some slight tweaking of the different color channels, however, the colors captured by the camera were more than sufficient. The

photo editing software used to make all of these changes was Darktable. All these editing choices made were to fulfill the intent of the photo, which is to visualize the flow.



Figure 2. Before Image



Figure 3. Final Image

Science Behind the Flow

The flow has the texture and shapes it does in the image because it is a non-Newtonian fluid. This means that the flow has a high viscosity, which means it holds its shape well and does not flow easily like water. This means that the flow is not changing all that much if at all in time. More so, we should be asking the question why it is holding its shape. In turn, the forces acting on this fluid keeping it in its shape are viscous stresses, surface tension, interfacial forces, gravity, pressure gradients, and the fluids yield stress. While most of those forces are keeping the fluid in place, gravity and the pressure gradient are what would give it movement in certain conditions.

Important non-dimensional numbers to find for this non-Newtonian fluid are the Reynolds number (inertia versus viscous forces), Capillary number (viscous forces versus surface tension) and the most important the Bingham number (yield stress versus viscous stress). To find these values, we need to make some assumptions for the Aloe Vera gel fluid. Below in the table are order-of-magnitude literature values rather than exact measurements for this specific sample [2,3,4].

Density, ρ	Plastic Viscosity, η	Surface Tension, γ	Yield Stress, τ_0	Characteristic Length, L	Characteristic Velocity, V
1,000 kg/m^3	0.1 Pa·s	0.05 N/m	2 Pa	0.1 m (10 cm)	1×10^{-4} m/s

Reynolds Number can now be found below. The value tells us that the flow is deep in the laminar, viscous-dominated regime.

$$Re = \frac{\rho V L}{\eta} = \frac{1000(1 \cdot 10^{-4})(0.1)}{(0.1)} = 0.1$$

Capillary Number can now be found below. The value tells us that the flow has surface tension dominated over viscous forces at this creep rate.

$$Ca = \frac{\eta V}{\gamma} = \frac{0.1(1 \cdot 10^{-4})}{0.05} = 2 \cdot 10^{-4}$$

Bingham Number can now be found below. The value tells us that the flow has a yield stress completely dominated by viscous stress, consistent with the gel showing no visible flow.

$$Bi = \frac{\tau_0 L}{\eta V} = \frac{2(0.1)}{0.1(1 \cdot 10^{-4})} = 2 \cdot 10^{4}$$

Future Discussion

This image reveals the beauty and color in chaos. The self-contained cells all have their own story to tell, and it's the audience's job to go out there and seek it. That aspect, the texture, and the vibrant range of colors are what I personally like most about this image. There is nothing in particular that I do not like about this image. However, I think some parts of the image could be better in focus, and that would make the photo perfect. It would also be interesting to get an even brighter light under the flow as I think this would make the colors even more vivid and pop even better. There is much more that could be done with this set up in terms of how you shape the Aloe Vera gel as it is such a friendly fluid to work with. How the image is frozen in time highlights the physics going on in this image with the gel being a highly viscous fluid. I do wonder what this setup would look like even closer up? I think using a macro lens would be a worthwhile venture for this experiment. Overall, I am very happy with the results I captured and do think I completed my intent.

Works Cited

1. P., Katie [@pretty_little_lens]. "Aloe - Good for: Sunburns and Macro Experiments!" *Instagram*, 24 Aug. 2026, https://www.instagram.com/p/DccN1B7RQ8D/.
2. Guetarni, H., N. Ziar, and R. Khedda. "In Vitro Study of the Physicochemical and Biological Properties of Aloe Vera Gel and Its Use for the Development of a Cream." *Agriscientia*, vol. 42, no. 2, 2025, pp. 37–44, doi:10.31047/1668.298x.v42.n2.44552.
3. Opazo-Navarrete, M., et al. "Effects of High Hydrostatic Pressure (HHP) on the Rheological Properties of Aloe Vera Suspensions (Aloe Barbadensis Miller)."

Innovative Food Science & Emerging Technologies, vol. 16, 2012, pp. 243–250, doi:10.1016/j.ifset.2012.06.006.

4. “Beyond Thickening: Aloe Vera Gel as a Soft-Textured Hydrocolloid with High Water Absorption for Tailored Food Design.” *International Journal of Food Properties*, 2026, doi:10.1080/10942912.2026.2679799.