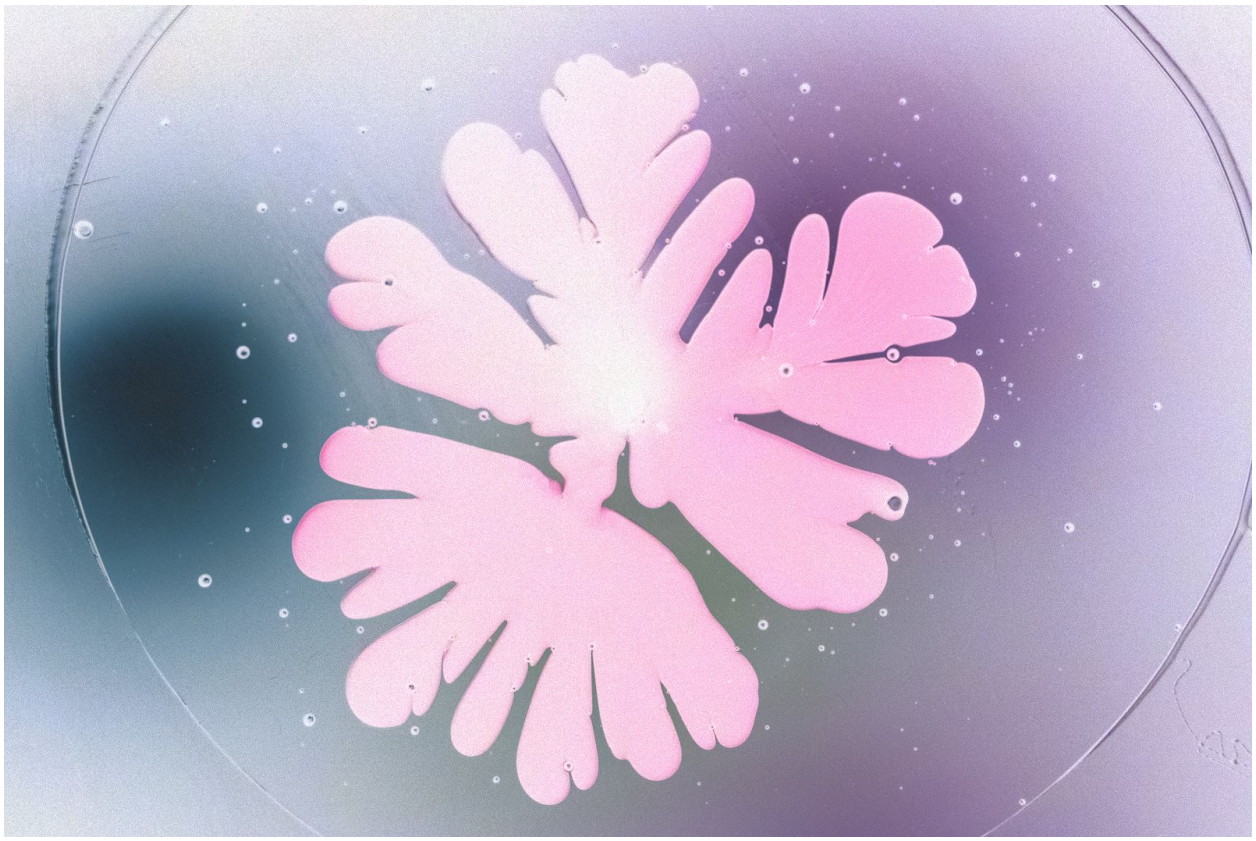
Abby Rinerson
Team Second
ATLS 4151-001
10/10/19
Assisted by Lucas Garcia, Nick Scott, Brooke Shade and Brian Gomez



This image was created for the second team assignment for Flow Visualization. My team was interested in using a Hele Shaw cell to create an interesting image displaying fingering of two different liquids. Our team tried a few trials and had some trouble creating the perfectly symmetrical lobes that were desired. This was because the syringe underneath the glass was not perfectly sealed. Due to this problem the inserted liquid, in this case colored water, kept leaking out. This left us with little time to capture a good image. The water that was injected was mixed with a few good squirts of gel food coloring. My team took turns pushing the liquid into the cell, while the others stood around and took pictures. When adding the water, each member injected the liquid slowly so as to achieve the desired fingers.

The flow apparatus in this experiment was a Hele Shaw cell. This consisted of two layers of glass, one with a small hole in the center. The glass with the hole is connected to a stand, with the filled syringe and tube already connected, and the first liquid is placed over the hole. The second piece of glass is placed over the other and then the second liquid is expelled from the syringe in order to create the flow. In this specific experiment we used corn syrup as the first

Abby Rinerson
Team Second
ATLS 4151-001
10/10/19
Assisted by Lucas Garcia, Nick Scott, Brooke Shade and Brian Gomez

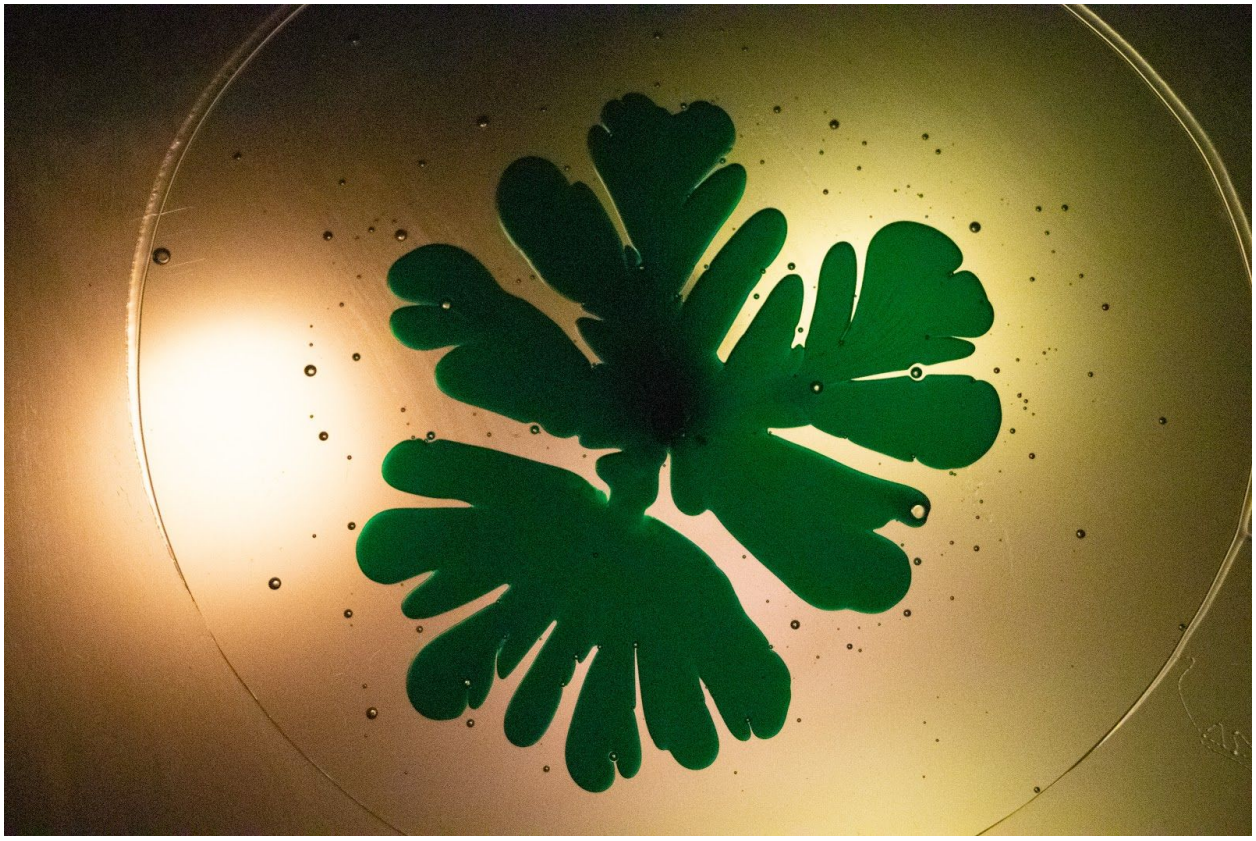
liquid and inserted food-colored water as the second liquid. The size of the whole flow, at its maximum, was about 6 inches in diameter. The viscosities of the two liquids are different which creates the fingers in the water. This is known as the Saffman-Taylor instability. The fingering occurs when the less viscous liquid displaces the more viscous liquid ("Viscous Fingering").

The visualization techniques used were the corn syrup and water. The materials were gathered from the house of one of the team members. The lighting was created from the use of every member's smart phone. They were all placed on the floor, underneath the Hele Shaw cell. A piece of plastic with an opaque finish was then placed over the phones to soften and spread the light. Therefore, as seen in the image, the lighting is coming from below the flow and underneath the glass.

The field of view for this image is approximately 7 - 10 inches. It includes the flow itself plus some room around the actual flow. The object was about 2 - 3 feet away from the camera and the focal length was 62, the aperture was 5.6, the shutter speed was 1/640 and the ISO was 16,000. This was taken on a Canon EOS 80D. The original image is 6,000 x 4,000 pixels and the final image is 5,594 x 3,729 pixels. Originally, I was planning to leave the image close to the original. I adjusted the lighting and contrast in Lightroom to try to make the image easier to see, as the lighting was not great and the ISO was very high. This created a very grainy image. I then got the idea to invert the image from Brooke. I inverted the image in Photoshop and chose to use that as the final image.

The image reveals how the Saffman-Taylor Instability works and demonstrates it through a visually appealing image. Overall, I am happy with my final image. I think the framing is good and the overall symmetry and composition is decent. I like that the image is inverted because it makes it easier to see the flow, however I do wish the lighting was better so I had the option to use the original colors without the grain. I would be interested in further developing this idea by adding more colors and by using different liquids.

Abby Rinerson
Team Second
ATLS 4151-001
10/10/19
Assisted by Lucas Garcia, Nick Scott, Brooke Shade and Brian Gomez



Original Image

Abby Rinerson
Team Second
ATLS 4151-001
10/10/19
Assisted by Lucas Garcia, Nick Scott, Brooke Shade and Brian Gomez

Citations

"Viscous Fingering - Center for Nonlinear Dynamics." *Archive.is*, 11 Aug. 2007, archive.is/20070811230145/http://chaos.utexas.edu/research/viscous.html.