



Team Second Image Report

Lucas Garcia

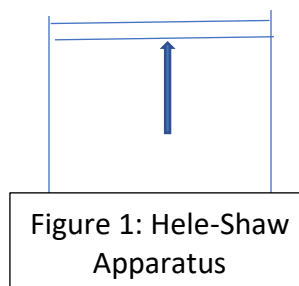
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For our Team Second Project we decided that we wanted to capture and observe the effect that of mixing two liquids with different viscosities would cause. This phenomenon is due to the Saffman-Taylor instability experienced in a Hele-Shaw cell. The formation of these finger-like shapes is due to shooting a less viscous fluid into a fluid with a higher viscosity by way of a syringe. In our experiment we used green color dyed water which we filled into a syringe and then shot into clear corn syrup. I believe our team a really good job of capturing the phenomenon reproducing a very interesting flow pattern.

To photograph our fluids with different viscosities we had to borrow the Hele-Shaw cell from Professor Hertzberg. The design of the cell was about 2 feet long 1.5 feet wide and 2 feet high. It was composed of a sheet glass with a hole in it where we would then attach the syringe into. On the 4 corners of the rectangle were screws which we used to adjust another piece of plexiglass. In between the two pieces of glass was our corn syrup which we placed down after we attached the syringe but before we compressed it with the second piece of plexiglass (figure 1). Although the set up worked well, it wasn't perfect. For example, there wasn't really a good spot for a light. Our group used all of our phone lights covered by a fogged piece of plastic underneath the cell to illuminate the glass and fluid. Secondly, we couldn't find a perfect fit for the hole, so the syringe fell out one time while we were taking photos and the fluid fell through the hole. Finally, the cleanup was fairly hard, but I attribute some of that to the fluids we used as opposed to the cell, but it didn't make the clean up any easier. The colored flow looks really cool and I wasn't expecting to get such a good result as it only took us 3 tries but I took this photo during our second try.



To discuss this flow it is important to discuss the Reynolds numbers of the fluid. This will help you understand how the intermolecular forces are acting and if you get the math right you can correctly predict how many of these fingerlike regions you can get, in our case since we used water our fluids acted not as a viscous fluid. The surface tension between the two fluids is what drives this flow to occur and allows this defined separation as opposed to a mixture. Also the difference in pressure gradient plays a big factor in how these shapes form as it causes to instability to occur between the fluids with different viscosities.

To get the best capture of this flow possible we made the room as dark as possible and light up a piece of foggy plastic underneath the cell. This can be seen clearly in my photo as the light source is clearly being projected from underneath it allows for this ominous looking picture. I tried taking this picture at many different angles to solely try and capture the flame allowing it to pop off the black background. We used water from the sink, color dye and corn syrup from the supermarket to complete this experiment.

I took this picture using a Canon Rebel T7i. The dimensions of the photo are 6000x4000 pixels. For this image I used an ISO of 800, an fstop of f/6.3 and had a shutter speed of $1/6^h$ of a second. It was very interesting taking pictures of this as it continued to spread as time went on and eventually the syringe would fall out causing the picture moment to end. I manually focused the camera with a focal length of 45 mm prior to injecting the fluid to make sure I was ready to take the picture.

I really enjoy how this image has a very like ominous feel to it and it feels as if the flow is almost coming out to grab onto you and cover you. Because of this, to me it resembled Venom from the Spiderman Series. I just took a picture of the flow and didn't really think about an

resemblance at the time but once I got into the post-processing changing the colors to black and white immediately stuck out to me. I believe the physics of this was captured very clearly and is something I've never seen before. Originally, I wanted to experience this by putting in different shapes and seeing how the flow would go around the shapes. But after experimenting with this first we all agreed that we liked the way this image came out. In terms of post processing obviously I made the photo black and then messed with exposure a bit to get the light to really shine.

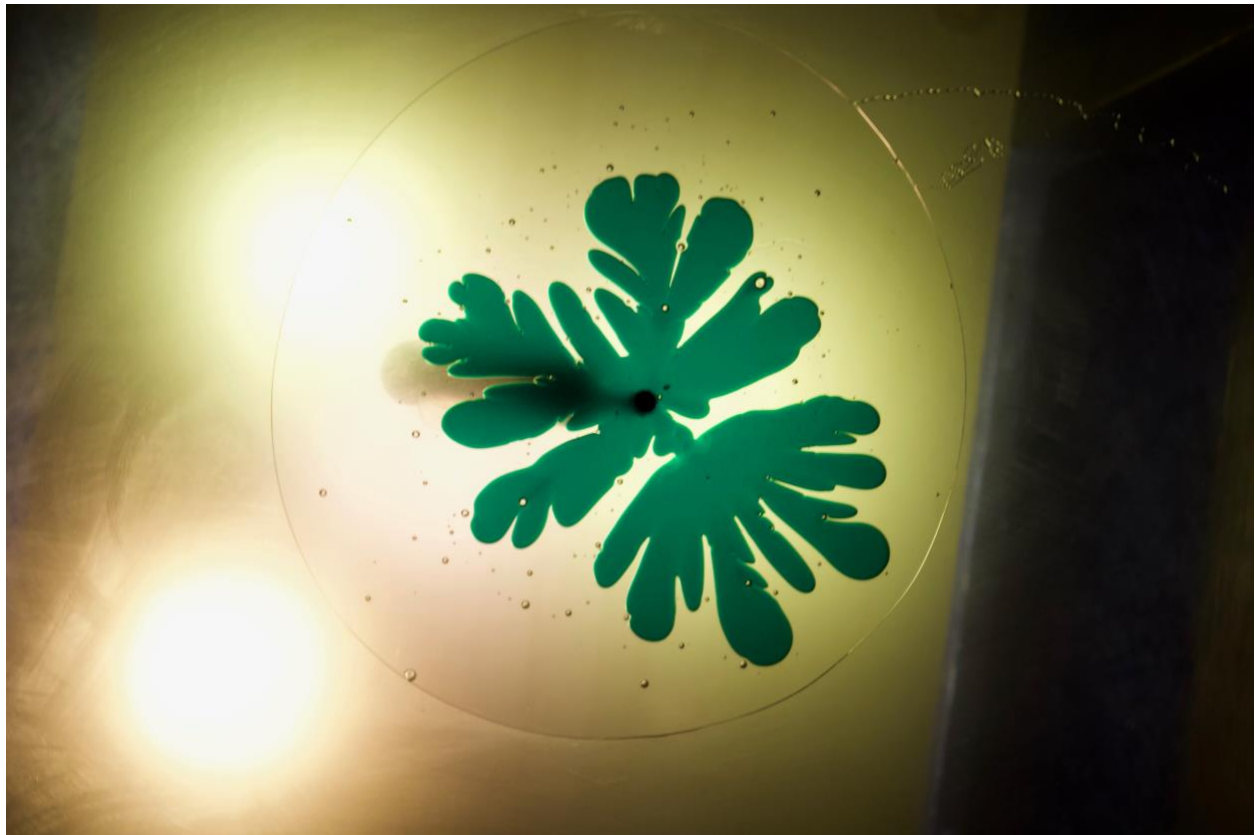


Figure 2: Unedited picture