

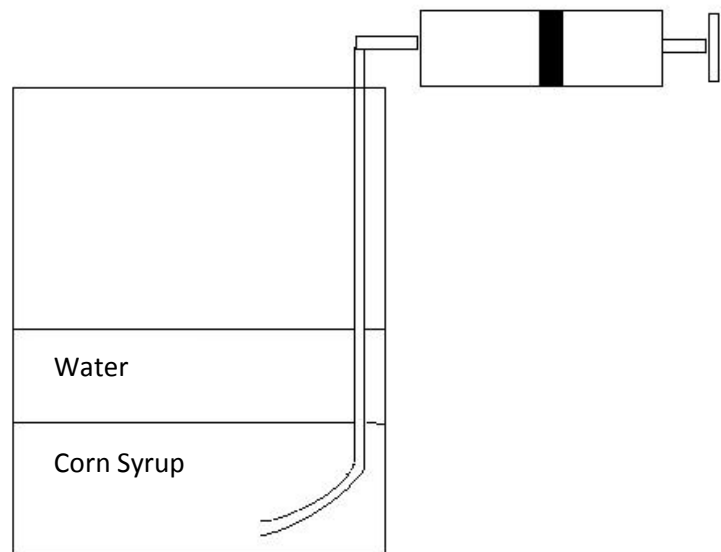
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Group Image 1

The image I submitted comes from the first group project. Our intent for this project was to view the way that different fluids interact with corn syrup and water. We hoped to see some interesting and beautiful flows come from the interaction of fluids whose viscosities are different. Using fluids with different viscosities allowed us to see a large change in motion as it moved through the corn syrup and/or water.

For this project we started out with a clear glass vase. The vase was approximately 8 inches tall, 4 inches wide and 3 inches deep. We first put in 2 to 3 inches of corn syrup in the bottom. On top of the corn syrup we put a layer of water another 2 to 3 inches tall. We then put a small tube approximately $\frac{1}{4}$ inch in diameter down into the corn syrup. See figure below. On the other end of the tube we attached a syringe. The syringe was used to force fluids through the tube and into the corn syrup. The different fluids that we pumped through the tube were done at a very slow rate.

The only exception to this was the image that I chose. This is one of the reasons why I chose the image that I did. The fluid that I pumped into the corn syrup was a mixture of Dawn blue dish soap mixed with blue food coloring. The reason I added the food coloring was because the dish soap was too light in color to get a good visual of the fluid as it flowed through the corn syrup. After pumping the majority of the dish soap through the tube, the dish soap had made its way



slowly through the corn syrup and into the water. The dish soap dragged a good amount of the corn syrup with it into the water. This created a channel that ran from the tip of the tube up into the water above the corn syrup. After pumping most of the dish soap through there was a small air bubble left in the syringe. This air bubble got pushed through the corn syrup as well. When the air reached the channel that had been created it shot up into the water and dish soap above and 'exploded' the dish soap bubble that had formed. This created the effect seen in my image. The force that was driving this process to happen was pressure. When the syringe was pushed on the fluid inside had to move. Also viscosity had a big effect on how the fluids moved. Viscosity is the measure of the resistance of a fluid¹. A more viscous fluid, like

the corn syrup, moves slowly while a less viscous fluid like the dish soap moves quicker. This flow was moving and changing with time, and as more soap was pumped through the tube. After I took the image the dish soap continued to move around and slowly fall down to the surface where the corn syrup and water touched.

As mentioned above, the main fluid used was dish soap mixed with blue food coloring. The corn syrup was a generic brand that I got from the local grocery store. It was kept at room temperature before being used to ensure that the properties of the corn syrup were not affected by temperature. The water was also at room temperature when we used it. For this image to look good the lighting had to be right. To ensure that we only saw what we wanted to in the image we set up a white sheet behind the vase. The vase was lit by two 100W desk lamps, one placed on either side of the vase. There was also ambient light from the lights in the ceiling that added to the mix. The camera was set up on a tripod about a foot in front of the vase. This ensured that there would be no blur or poor image quality due to human error. It was very important to have a steady base for the camera to see the precise lines of the moving fluid in the vase. A flash was not used on the camera because I didn't want to risk getting a glare off the glass.

The field of view in this image was kind of small. The flow covers an area about 4 inches wide and 2-3 inches tall. The camera was placed about 12 inches in front of the glass vase, and the vase is about 0.5 inches thick. The lens used was an 18-55mm lens with an f value of 3.5-5.6. The lens was attached to a digital Canon Rebel Xsi SLR camera. The image was 2484 x 1524 pixels in size. The shutter speed used for this image was 1/125 second with an f-stop of f/5.6. I used an ISO of 400. I didn't use any image enhancing software for this image.

The purpose of this image was to capture the interaction between fluids with varying viscosities. I had not originally planned on taking a picture that looked like this one. It was purely an accident that this image was created when the final air bubble was pushed through the tube following the dish soap. This being said, I still like the way that the image turned out. I think that it shows an instability and unknown chaos that does occur in real life situations. When studying fluid flows you can come across flows that don't turn out how you think they will. This doesn't mean that they are bad or incorrect, they are just different from what you expected. This image still shows how dish soap flows through a more viscous fluid like corn syrup because you can still see the bubble that was formed in the center of the image. One thing I would like to further explore is the same idea with multiple fluids coming from multiple tubes into the same corn syrup at the same time. This would be cool to see the interactions that the fluids have with each other as well as the corn syrup.

Reference: 1) <http://en.wikipedia.org/wiki/Viscosity>

