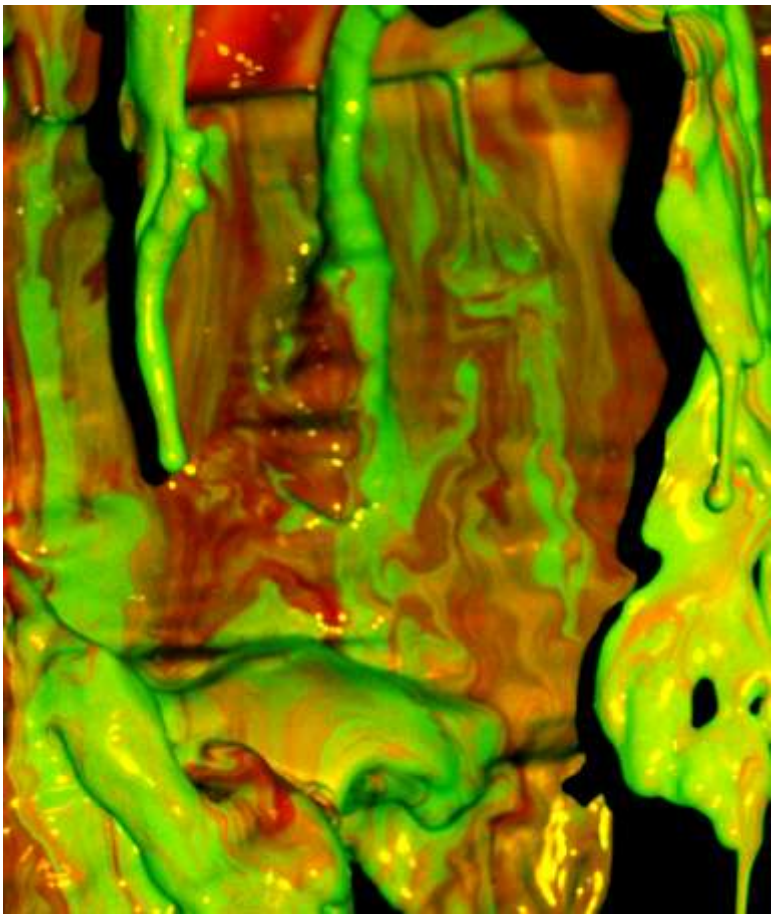
Team Project 1
Non-Newtonian Fluids



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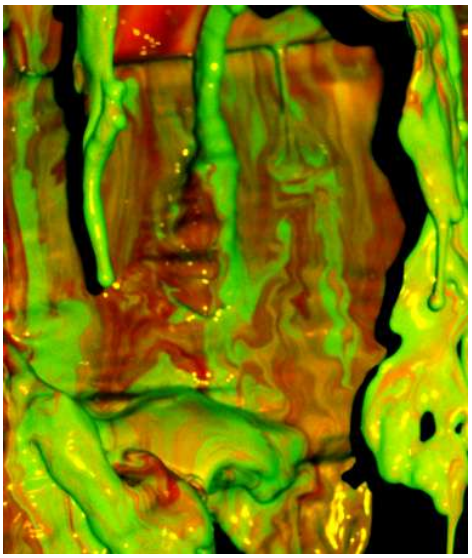
This is the photo for the first group project. For the project, our team created and experimented with non-Newtonian fluids. Throughout our trials, we were trying to demonstrate how non-Newtonian fluids will resist shear force. Our experiments were diverse, everything from spinning a beaker of the fluid on a pottery wheel to just pouring it out of a bucket. During the trials mostly video was taken; however I found this image very intriguing. My intent with this image was to simply show something that the rest of my team didn't. I know that a lot of my team went with beautiful pictures of the fluid rolling or being poured, but my image is a bit more surreal. The original image was just a quick shot that was completely a spur of the moment when dumping fluid we no longer wanted to use. My final looks like something from a nuclear plant, but that is what makes it unique, and why I like it.

In the image, the fluid is being poured from a rectangular container. The fluid columns in the foreground are created because the fluid is too viscous to evacuate the top portion of the container when the fluid is being poured out. Once the container is tilted to a steep angle quickly, the fluid will start to fall instead of flow down the container. The icicle like structures are created because non-Newtonian fluid flowing over itself creates shear forces in the fluid that are strong enough to support the entire structure. As a reference, the structure to the left in the foreground is probably about the size of a pen. In the background, the fluid can be seen flowing down the back of the container. In this fluid flow, multiple layers are stacked on top of each other. This happens because the shear forces between the moving fluid layers increase as the velocity difference increases. Thus when a layer starts moving fast, the shear forces grow to be very large; this will slow that layer down and allow another layer to move past it. These large shear forces are what make non-Newtonian fluids special; they are what make them interesting. Gravity is the body force that is pulling all the fluid down, and shear force is the only force resisting gravity. The shear force will never be larger than the force due to gravity, but at times the shear force will be equal to the force of gravity for this type of fluid.

In order to visualize the non-Newtonian fluid, we first needed to create a non-Newtonian fluid to use. This was done by mixing corn starch and water (the mixture was about 2 parts corn starch to one part water). Once an acceptable fluid was created, food dye was added to the top of the fluid. Since the dye had nearly the same properties as water, it should not have affected the flow at all. After a couple trials, the dye was mixed in and would no longer stand out; now a new color of dye was added. By mixing colors of dye, we extended the use of one batch of fluid, and also created some interesting colors. When my image was taken, the camera's flash provided most of the light (ambient lights in the lab were on, but didn't really light up the flow). As previously mentioned, this was simply a spur of the moment photo, so the powerful lights we had been using were not illuminating the flow. Despite the lack of ambient light, the image turned out fairly bright with good focus.

A Casio EX-FC150 shot the image. This camera is my friend's camera, and I was using it to shoot high speed for the videos, and took only a few photos. The camera was about ten inches away from the flow when the photo was snapped. The image is 2316x2736 pixels after

cropping. I had the camera on the auto setting and just snapped the photo. The camera chose an F-stop of f/4.2 and an exposure time of 1/60 seconds. I probably would have used a bit longer of an exposure time since the fluid was flowing so slowly. The max aperture was 3.7 with a focal length of 17mm. Once the original image was imported into Photoshop, I immediately cropped out the sides of the container so only the flow was present. Next I played around with the color curves; after a while, I started to hone in on the colors in the final image. As soon as I saw the image with these colors, I loved it. Next I needed to make the shadow on the right a bit sharper so I used the clone tool to sharpen up the edge of the shadow. Looking at a side by side comparison, the final image looks completely different.



To me, this image shows something impractical. Nearly all the fluids a person sees in a year are significantly closer to Newtonian fluids than this one. So when observing a fluid like, it is awesome to see the weird stuff that it will do. The one thing I dislike about my image is that the fluid in the background is slightly out of focus. The physics are shown well in that this image, in that it is fairly obvious what is special about a non-Newtonian fluid. I really like the colors of the final image, and I definitely created a unique product. In order to develop this idea further, it would be interesting to see the flow of a non-Newtonian fluid over a surface with holes in it. This could create a very interesting flow; however, I feel as if it would be very difficult to get a good image of the flow. Overall, I am very pleased with non-Newtonian fluids and my image.