Team Image 1 Report

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This photograph is the first team image assignment for the class Flow Visualization at the University of Colorado at Boulder. The entire image and set-up was taken using the help of my assigned team, which is comprised of four teammates including myself. We were inspired from a blog titled “Planetary Bubbles” [1] which photographs the soap film of a bubble in such a way that it looks like one of the gas planets in our solar system (Figure 1). Hoping to produce a similar image, we set out to create the effect by mixing our own bubble solution using dish soap, water and glycerin. Although the lighting set-up and bubble solution made for a very difficult image to capture, I believe that our images turned out to be as colorful and fascinating as we hoped. We were all proud of each image because of the unique and colorful results.

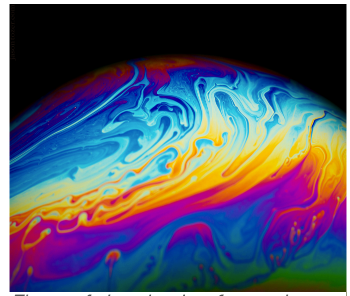

Figure 1. Inspiration for project: close up photographs of bubbles by Jason Tozer.

As can be seen in the diagram of the set up shown below in Figure 2, the set-up required many hands and very special lighting techniques. The photo was taken in a classroom in the Engineering Center on campus with the lights off. These classrooms have no windows so it was ideal for having one source of light for our imaging. The bubbles were composed of water, dish soap and liquid glycerin. The mixture was placed in a small, round, clear plastic tray and the bubbles were blown using a straw. The idea of the straw and the glycerin was gleaned from the photographic techniques of Jason Tozer[2], shown in Figure 1, which displays the images that inspired our team at the beginning of this project. While one team member took photos, others blew bubbles through the straw and held the light or light deflectors. The lighting was the hardest part, which really required a team effort to set-up correctly. Overall, the coordination of our eight hands allowed for some tricky photography with some beautiful results.

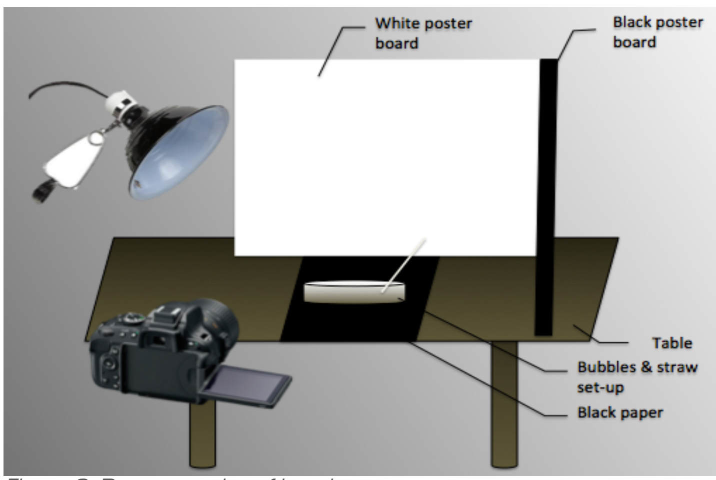

Figure 2. Demonstration of imaging set-up.

A combination of soap and water allow for the bubble phenomenon to occur from the surface tension of the film of soapy water that encloses air[3]. Surface tension is the main component that keeps bubbles together. This is due to the intermolecular forces of the molecules, which cause them to gravitate towards one another in equal directions[4]. The surface is the exception to the equality of the forces, where the force of the water is directed inwards. This is what causes the soap bubble to minimize surface area and form a spherical shape. The bubble pops when the pressure on the inside is no longer equal to the pressure on the outside. Liquid glycerin allows for the bubbles to last longer because of its interaction with the soap and water film. The glycerin remains on the top of the surface, which prevents the water molecules from

[1] "Planetary Bubbles." Weblog post. Artifacting. Artifacting.com, 13 Nov. 2012. Web. 19 Feb. 2014.

[2] Tozer, Jason. Bubbles. 2009. Close, London. Jason Tozer. Web. 27 Feb. 2014.

[3] Thaver, Emaan. "Bubbleology: All about Bubbles." Dawn.com. 31 Aug 2013. Web. 13 Feb. 2014.

[4] Soap Bubbles and Surface Tension. Tech. University of Michigan, LS&A Physics Department Demonstration Lab, 2006. Web. 12 Mar. 2014.

evaporating as quickly[5]. The bubbles create a soap film that reacts with light in a way that can create vibrant colors. A light beam of incident light hits the surface of the bubble and reflects off of the top and bottom surfaces of the soap film. These two beams can intersect with one another and this is what creates the vibrant and beautiful colors[6]. The colors that are visible on a soap film are also dependent on the thickness of the film. A soap film that is ½ of the wavelength of a specific color will not reflect that color. Therefore, I can assume that since the entire visible light spectrum is reflected from my bubble, that the soap film thickness is between 0.25 and 1.25 micrometers since those are the varying wavelengths on the visible light spectrum[7].

The visualization technique used was the effect of lighting on the soap film surface of soap-water-glycerin bubbles. To achieve this effect, lighting was key. We were able to construct a soft light using a cardboard box, a white sheet of paper and a lamp. With the lights off in a windowless room, the soft light allowed for the lighting in the room to be perfectly concentrated on the bubbles. The soap and glycerin used to create the bubbles were bought at a local convenience store (McGuckin Hardware). The liquid glycerin is the "Sensations" brand all natural, 100% vegetable glycerin. The dish soap was Dawn Ultra clear dishwashing liquid. To create the bubbles, a mixture of 1 part water, 1 part dish soap and ½ part of liquid glycerin was used.

To photograph the image, it was essential to use the manual focus to grab the photo of the bubble right at the height of its' color change. The bubbles lasted for a while, but the reflected colors did not. The camera being used was a Nikon D5200 at the manual setting. This allowed for the image to be taken with a shutter speed of 1/20, an aperture of f5.6, an ISO speed of 250 and a focal length of 55 mm. The longer shutter speed was essential to capture the lighting of all the color spectrum change and the small field of view of about 3 inches allowed for close-up imaging. The size of the original image was 4000x6000 pixels, and the edited image was cropped down to 5232x3520 pixels. I used Adobe Photoshop to post-process the photo, however there was not much post-processing done onto the final image. I slightly increased the contrast and exposure but mainly I cropped the image to center the colors of the bubble.

Figure 3. Original image before post-processing

Overall, the image reveals the beautiful spectrum of color that can be visible on a soap film or bubble. The physics of the visible light spectrum reflected off of a bubble are shown excellently because of the different colors and sizes of each of the bubbles in the image. I would have liked to replicate Jason Tozers images a little more closely, however I am satisfied with my unique and effective image. I think that as a team, we were able to fulfill our desire of achieving a picture of a colorful soap film.

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5 "Glycerin in Soap Bubble Mixtures." [Soapbubble.dk]. N.d. Web. 12 Mar. 2014. <http://www.soapbubble.dk/en/bubbles/glycerin.php>.

6 Soap Bubbles and Surface Tension. Tech. University of Michigan, LS&A Physics Department Demonstration Lab, 2006. Web. 12 Mar. 2014.

7 Doherty, Paul. "Soap Film Colors." Exo.net. Exploratorium, 24 May 2000. Web. 12 Mar. 2014.