Soap Film Reflection

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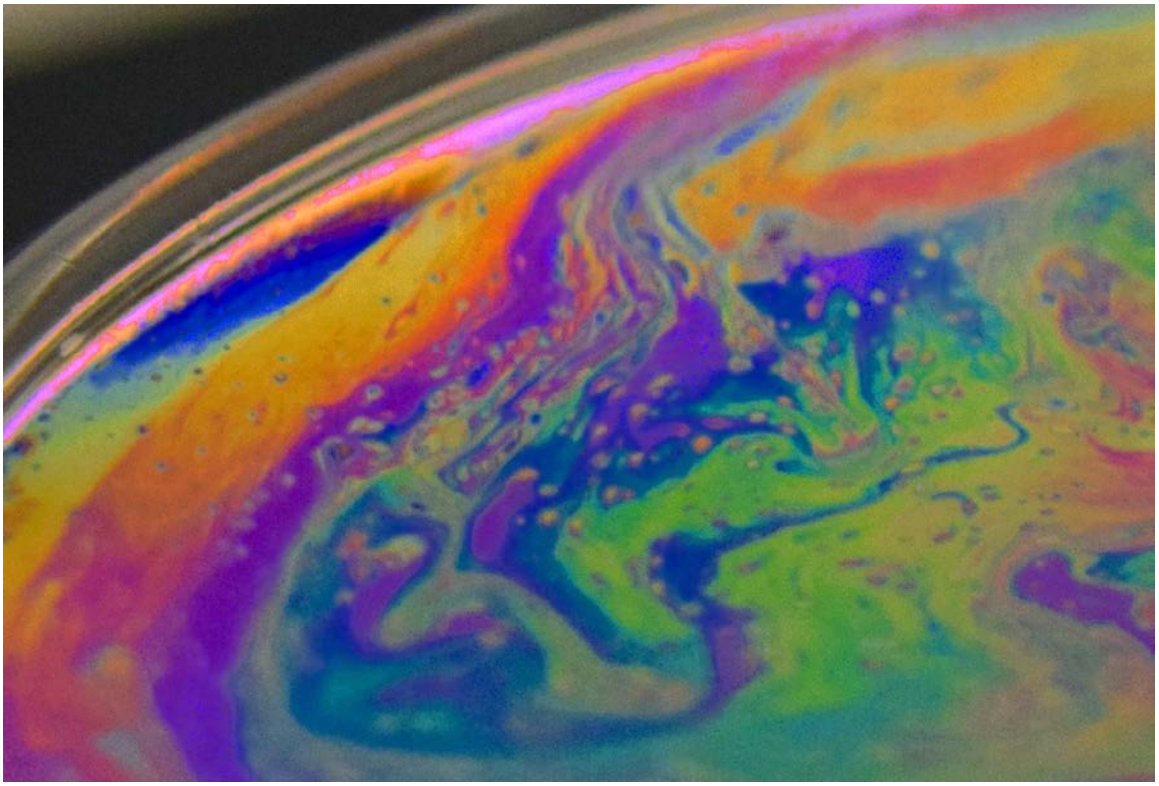

Introduction

For the first team project in the course, my team chose to take images of soap film. My teammates that worked on the film with me are Dennis Can and Fiona Wohlfrath. We initially tried Dr. Hertzberg's soap film device that allowed the film to flow constantly. However, we were unable to make the film last long enough to capture a great photo. We then began dipping different shaped glasses in a glycerin and soap diluted mix. The glycerin allowed for the soap film to last several minutes. We played around with several different types of lighting and background until we were finally able to see the best layer of colors on top of the glass. We also tried different shaped glasses to see if that affected any reflections on the film. We chose a glass that had a round top, but developed toward the bottom to form a square. This diverted most undesired reflection from the background, and the opening was smaller than other glasses that were tried, about 3 inches in diameter. The soap film on the glass gave an index of refraction that allowed for the rainbow to show through very clearly. It is shown by the interference of light reflecting off of the inside and outside surfaces of the soap film.

Methods

To develop a thick and long-lasting soap film, my team and I used dish soap diluted in water and then added glycerin to increase the strength. Many studies have been conducted on soap film using glycerin for this purpose. The glass had a diameter of 3 inches, and the film covered the entire diameter at the top of the glass. It was easily seen that the longer the soap film lasted, the more vibrant the colors would be. I took my photo after letting the soap film sit for about two and a half minutes. The light rays that are reflected off of the surface of the bubble, giving us the rainbow appearance, are waves that travel different distances. The distance that the wave travels

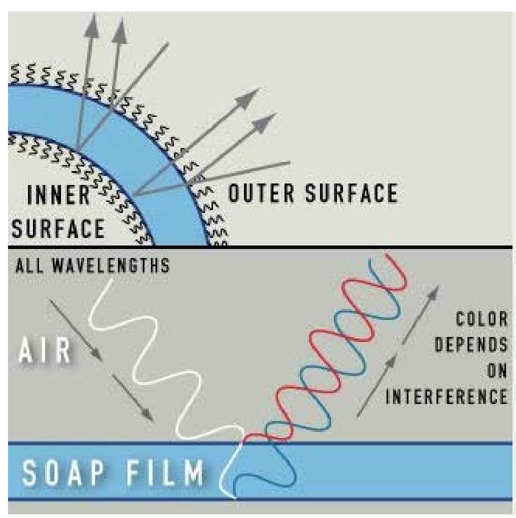

Figure 1: Light Reflections Off Soap Film[1]

will give the color. As the light hits the bubble, it will reflect off of the outside and the inside layer of the soap. If the reflected waves are the same length, the color will be very intense, called constructive interference. If they are not the same length it will be duller colored, called destructive interference[2]. An example of the light reflection can be seen in Figure 1. Because the film thickness of the soap is constantly changing, the distance that the wave is traveling also changes. The colors also change because light is hitting the film at so many different angles. Each angle gives your eyes a different color as it reflects back. Also, as the soap film sits, it begins to evaporate, which causes the thickness of the soap film to change over time. Blues and greens will last the longest because they have shorter wavelengths. So when looking at the soap film, there was a constant motion of the different colors[1]. Eventually, the soap film will have no color, if nothing interferes and pops it first.

Visual Technique

For the best possible image, a black background was used beneath the glass with soap film. The black allowed for the colors to be seen more vibrantly. Several large black sheets of paper were put on the floor beneath the glass. A white sheet was then used as a reflection. It was hung behind the glass opposite the camera so that any distracting backgrounds were removed. Several different types of lighting were tried to see the best results. Initially, an LED flashlight was used, but this provided more reflection than we wanted. The regular fluorescent kitchen lighting was used in the final picture. A flash was not used on the camera either.

Photographic Technique

The camera used for these photos was a Nikon D3300. The shutter speed was left at the speed of 1/60 of a second. The aperture of the camera was f/4.5. The ISO was set at 1250. These settings provided for the clearest image that did not have much motion blur. A smaller aperture would have given more motion blur because the shutter speed would have been longer. The focal length was 34mm. The camera was held twelve inches from the edge of the glass and pointed 45 degrees down towards the top of the film. The original photo is 6000x4000 pixels. The final image is 1874x1260 pixels.

The original photo was cropped slightly so that the clearest part of the soap film would be seen. The edge of the glass was left in the final photo so that the round edge of the soap film could be shown. The comparison of the original and final photos can be seen in Figures 2 and 3 below. Once the photo was cropped, it was enhanced. Enhancing the photo brought out many of the colors. Many of the colors could not be adjusted however because it would be taking away information from the photo. The colors on the film depend on the wavelength and thickness of the film. Altering the colors would not allow the viewer to see what thickness was where. The program used to edit this photo was Gimp.

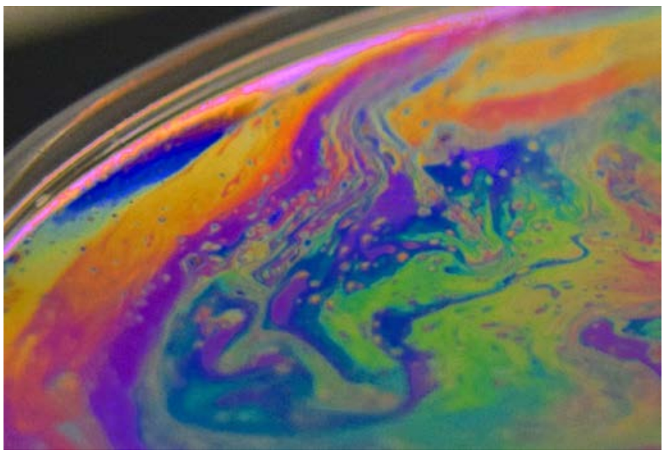

Figure 2: Final Soap Film Photo

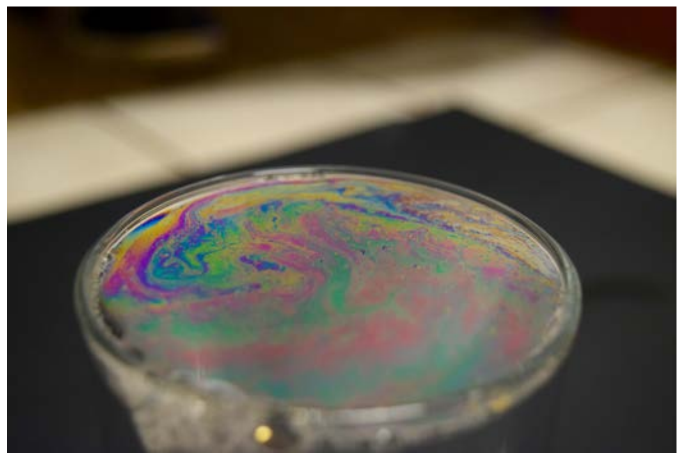

Figure 3: Original Soap Film Photo

Conclusion

This image very clearly displays the soap film phenomenon. The different colors display the thickness of the film at each point. Because the film had been sitting for so long, many of the colors left were darker colors such as blues, greens, and purples; all of which have shorter wavelengths. It was difficult to capture a completely clear film. In the original photo in Figure 3, most of the glass is blurry. It was difficult to get the camera to focus on the entire top of the glass. In the future, I believe it would be best to try to capture more clear soap film in the image.

References

[1]"Bubbles | Causes of Color." *Bubbles | Causes of Color*. N.p., n.d. Web. 04 Nov. 2015.

[2]Tompkins, Eric. "Understanding Interference Patterns in Soap Films." Stony Brook Laser Teaching Center, n.d. Web. 04 Nov. 2015.