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Flow Visualization  
Team Image 3

### Team Image 3 Report

For the third team assignment my intent was to capture the color dynamics of a blowing bubble as it increased in size. Simple blowing bubbles were used to create the image and demonstrate the varying colors from the bubble and the sun. The final image that I chose for this assignment shows the color dynamics of a blowing bubble in the bottom portion of the frame covering approximately 1/3 of the bubble.

The set up for this photograph is simple and can be easily repeated by anyone trying to capture the fluid flow of a soap bubble. The materials used in this setup were a black poster board, a straw, soap blowing bubbles, a tripod and a camera.

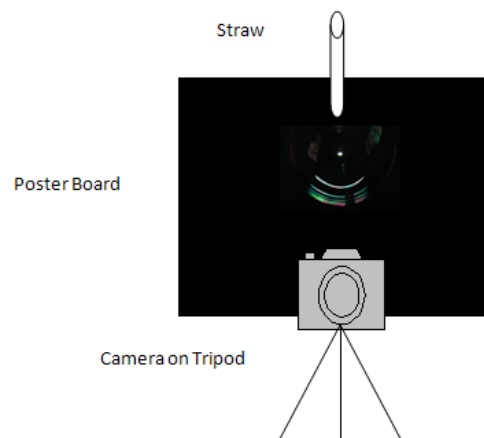


Figure 1. Photographic Setup

The poster board was set up about 12 inches from the camera and tripod near a window where the sun was coming in. It is crucial to have sun or a light source present in the setup in order to show the multiple colors created by the variation of thickness of the soap bubble. A drinking straw is used to create the soap bubble and the bubble is blown from above the black poster board. The soap bubble needs to be blown up very slowly in order to maintain the shape and the thickness of the soap layer. The bubble in the image was approximately 3 inches in diameter and located about 12 inches from the camera. The field of view in the image was 4"x6".

*Flow Phenomenon:*

A soap bubble is formed by two layers of foam surrounding a thin sheet of water. The soap bubble has a spherical shape due to surface tension. This shape gives the lowest ratio of surface area to volume and is the reason that a sphere has minimum surface energy.

The thickness of the soap film determines whether the colors in the bubble will be apparent or not. Light is reflected from the inner and outer surface of the bubble parallel to the direction the light entered the bubble. The varying colors are created by the interference and the color intensity is determined whether the wavelengths are in phase or out of phase with each other. When the wavelengths are in phase it means that

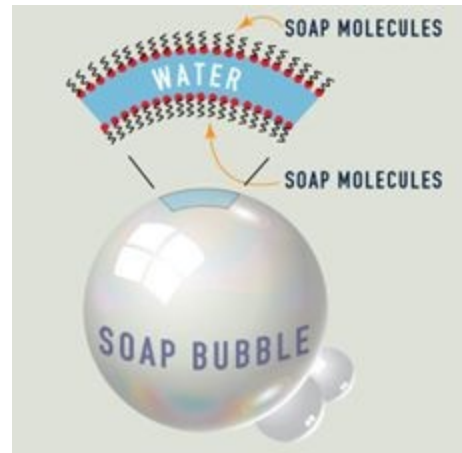


Figure 2. Soap Bubble Composition

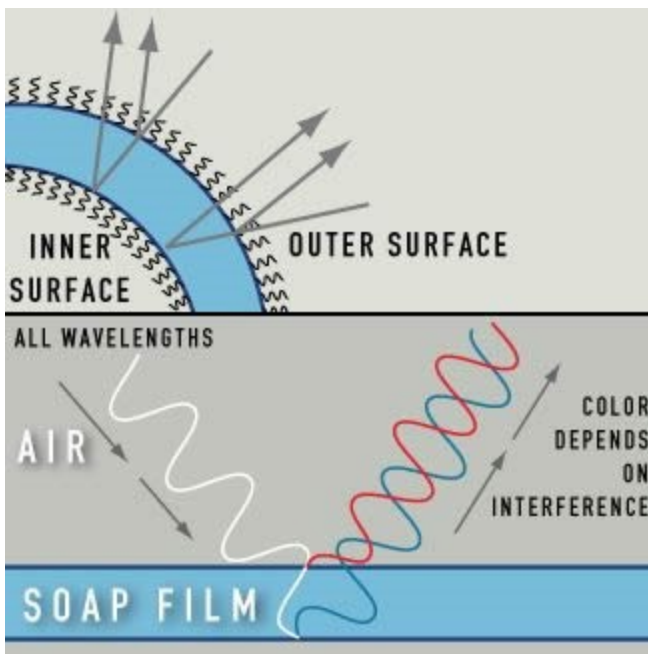
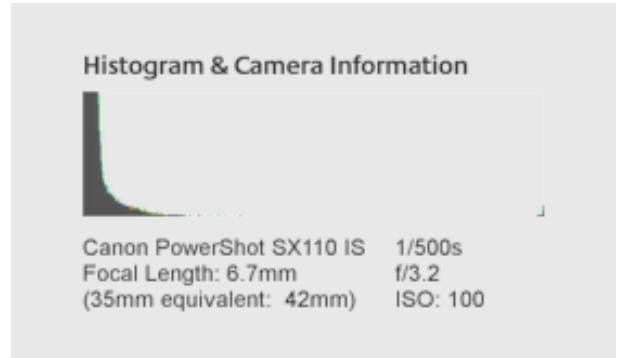
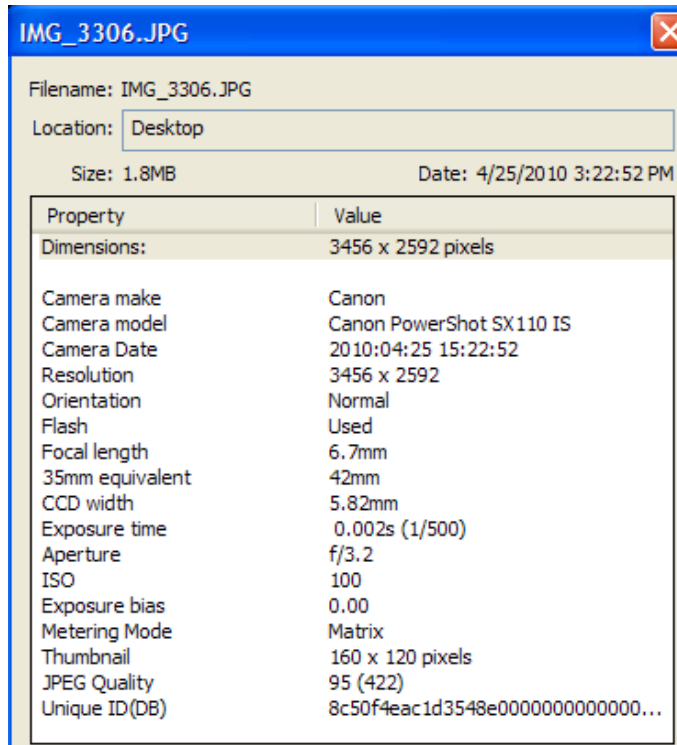


Figure 3. Soap Film Light Interaction

there is constructive interference which enhances the color intensity in the bubble, when they are out of phase it is destructive interference which will cancel out the colors. The varying thickness of the soap film creates the varying wavelengths of light that are reflected from the bubble because of the distance the light must travel through the bubble. The angle the light enters also has an effect of the colors as the light entering the bubble perpendicular will have a shorter path than light entering at a wider angle. The thickness of the bubble and the angle the light enters are responsible for the color variation within a soap bubble.

*Photographic Technique:*

In order to create a detailed and focused image it is crucial to use a high shutter speed and lots of light. Light is necessary to capture many colors in the bubble. The image I was able to capture only has light on the bottom portion because the light in my image was not direct and it was somewhat cloudy outside.



### Suggestions:

It would be beneficial to make your own bubble mix instead of using store bought blowing bubbles to increase the thickness of the soap film layer. The store bought bubbles contain a small amount of soap and the color intensity would be greatly improved with a thicker layer of soap.

More information on soap bubble can be found here:

<http://www.webexhibits.org/causesofcolor/15E.html>

[http://en.wikipedia.org/wiki/Soap\\_bubble](http://en.wikipedia.org/wiki/Soap_bubble)