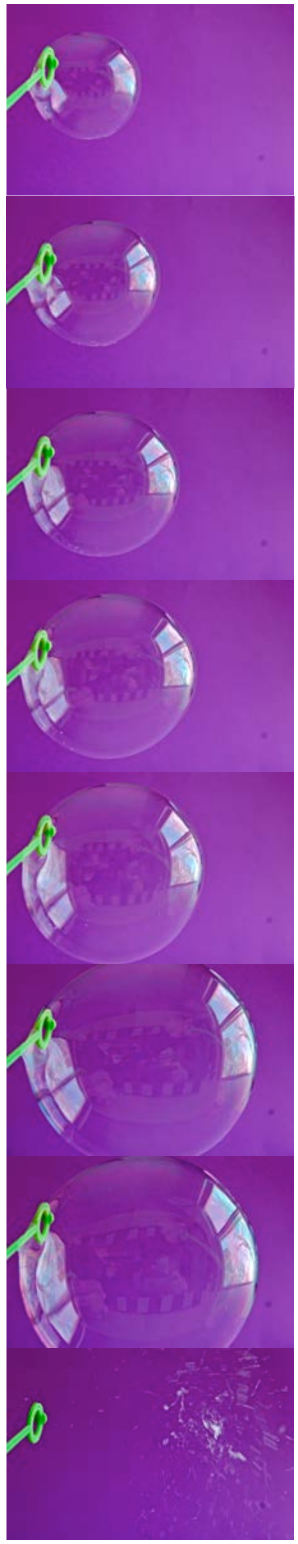
Get Wet Image Report

Allie Banks



https://vimeo.com/85772114

This series of images I chose to compile into a video is the first assignment titled *Get Wet*, which it is an introduction to the art of fluid flow and photography. For this introductory assignment I chose to capture the fluid mechanics and dynamics of the progression of blowing of bubbles (soap and water). I had previously found an interesting image of frozen bubbles (figure 1) and the beauty that was captured inspired me to create a bubble image of my own. However, since the temperatures during the assignment were not quite cold enough to create a frozen bubble, I experimented with different ways to capture the phenomenon of the surface tension that a soap and water mixture can create. My intent was to capture a bubble in a way that cannot normally be seen by simply blowing up a bubble in "real-time". I produced many interesting and unique images while experimenting, but in the end I chose the series of eight photos to create a video because I enjoyed uncovering the progression of the bubble that is usually too quick to see.

Figure 1. Freezing bubble by Angela Kelly http://kellyimagesandphotography.webs.c

To capture the image of a bubble in action I set up the camera settings and apparatus prior to blowing up the bubble. Then, I employed the use of my brother to press the button on the camera so that I could blow up the bubble while he takes multiple pictures. As can be seen in figure 2, I used the natural lighting of the window in my bedroom to reflect light off of the bubble and placed a block of purple paper perpendicular to the window to create a colored background. I chose the color purple behind the photograph because I liked the contrast of the lime green bubble wand against the purple and I wanted to include the entire bubble-blowing process. The camera lens was positioned about 18 inches from the purple background and the bubble was blown about 14-15 inches away from the camera lens. This allowed for the bubble to be captured completely, yet still focus on the details of the bubble reflection.

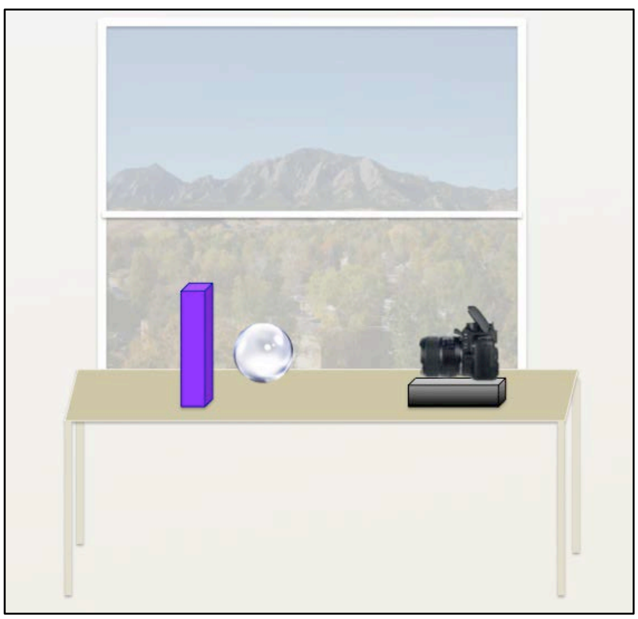


Figure 2. Set-up of photo apparatus in my bedroom.

The bubble images were photographed using a Nikon D40 camera. The field of view contained the entire background that I had set-up, which was composed of an 8½ by 11 inch sheet of purple paper propped upright. The focal length was 42mm and the images were shot with a shutter speed of 1/200 second at f4.8 and ISO 800. I chose a fast shutter speed so that I could capture the bubble as it is being blown up but then I also needed a lot of light in the image so that the reflection of the bubble could be seen.

Once I had captured many bubble photos, I analyzed the images to determine which one was the most visually enticing and had the best illustration of the fluid physics phenomena involved. There were many interesting images I captured, including images that showed a deformed bubble, but I ended up choosing the eight photos because it showed the progression of a bubble expanding and then the pop. Each of the original eight photos had a size of 3008x2000 pixels. I edited the photos using iPhoto software because the editing was minimal. For every image I first cropped out any of the ingenuities (ie. my fingers holding the wand) and then increased the contrast (+100), saturation (+64), definition (+65), highlights (+23) and finally I reduced the noise of the images (+24). Figure 3 shows a side-by-side view of the original image versus the edited image of the 3rd frame of the video.

Figure 3. Third bubble photo, original 3008x2000 (left) and edited 2707x1800 (right).

The fluid dynamics of bubbles involves mostly surface tension and pressure. The surface tension of the water in the bubbles allow for the formation of the bubble into a spherical shape[1]. Surface tension is due to the intermolecular forces that cause the water molecules to stick tightly together. Unfortunately, the bubble mix used by Imperial's "Super Miracle Bubbles" which I used in this case has a proprietary mixture that is not disclosed on the web. However, imperial does list that the bubble mixture contains 0.4% Glycerin, which does indeed affect the surface tension value and traditionally bubble juice is composed of 1 part soap and 4 parts water. Glycerin strengthens bubbles because it allows for the water to evaporate slower therefore making the bubbles last longer. The shape of bubbles is also due to surface tension. A bubble is what is considered a "minimal surface structure" which means that they are designed to hold air within at the least possible surface structure area, which in this case is a round sphere[2]. Pressure is also major contributing force acting on the bubble. A bubble forms due to the fact that the pressure on the inside is greater than that of the pressure on the outside. The equation to represent

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[1] "Surface Tension and Bubbles." *Surface Tension*. N.p., n.d. Web. 11 Feb. 2014.

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

the pressure relationship of bubbles is given as $P_i - P_o = \frac{4\gamma}{R}$. This equation, also known as the Laplace pressure[3], is used to determine the pressure difference on the inside and outside of a curved surface. P_i represents the inner pressure, P_o represents the outer pressure, R is the radius of the sphere of the bubble and gamma (γ) is the surface tension value. Since the composition of "Super Miracle Bubbles" liquid is unknown and the radius of the bubbles is changing from image to image, it is difficult to determine this pressure difference that is present. However, using an estimated surface tension value of 0.73 N/m for water at 20°C from the Scripps Surface Tension article and a range of radii of the bubbles from 2 – 5 inches, the pressure difference can be estimated. Table 1 lists a rough estimate of the change in pressure for the 8 different sizes of bubbles. It can be seen that as bubble gets bigger the pressure difference decreases. This means that the pressure inside the bubble decreases as the bubble gets bigger. This makes sense because the theory of a bubble popping states that the water is evaporating. If the water is evaporating that means that the pressure is dropping which proves to be true based on the estimation of the pressure difference in the table.

Radius (m)	P_i - P_o (Pa)
0.0508	5.75
0.0635	4.60
0.0762	3.83
0.0889	3.28
0.1016	2.87
0.1143	2.55
0.127	2.30
0.1397	2.09

Table 1. Radius, pressure table

Overall, this image reveals the progression of a bubble popping that cannot be seen in a normal setting. I think the fluid physics are displayed well because it shows the surface tension in action and the pressure dissipation that eventually leads the bubble to popping. I did not fulfill my intent of capturing an image of a frozen bubble, but I created a video from a series of images that entertained me and still taught me about surface tension and pressure. I would have liked to capture more images to see the bubble progressing and an even better image of the pop. To develop my idea further, I also would added glycerin to the bubble formula so that more light could be reflected off of the bubble and create a more colorful image. I am also determined to eventually capture a photo of a frozen bubble!

[3] "Surface Tension." *Scripps.ucsc.edu*. 1-9, n.d. Web. 12 Feb. 2014.