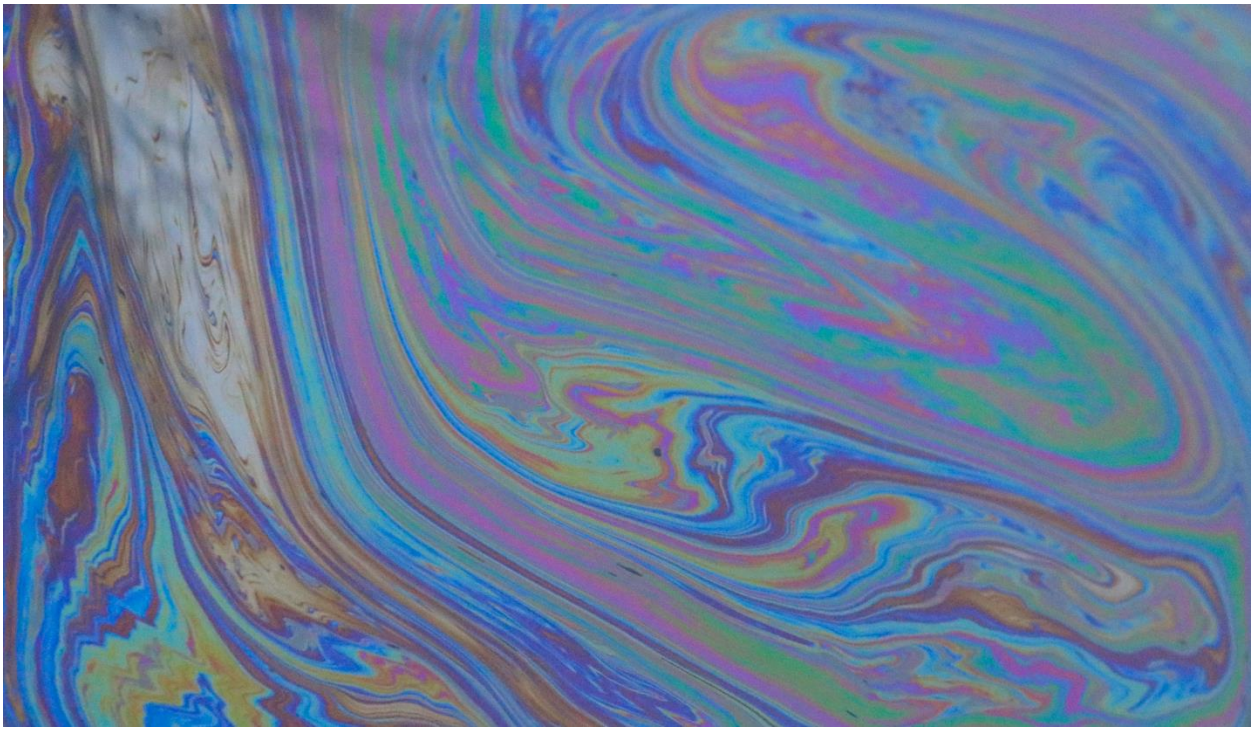

# Magical Colors Visible in Soap, Sugar and Water

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Team Third Assignment
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## *Introduction*

For the third team photo, our team decided we wanted to experiment with the color spectrum visible from combining soap, sugar and water. This phenomenon is similar to those colors generated by oil spills. The team really wanted to capture some incredible images with various color patterns and setups. Our team consisted of Michael Karns, Charles Keeley, Jeremy Aparicio and Myself. For the image in this report, the photo was captured by Michael while I was holding the experimental setup.

## *Experimental Setup*

The experimental setup can be seen in Figure 1. This image did not require a background because the soap file was not transparent. The team utilized a black fitness mat as a background just in case any portion of the soap film was transparent. Reflections within the soap film proved to be slightly challenging. The pictures were captured during an overcast sky which created a nice bland reflection that did not create distracting elements. The team used a wire coat hanger bent into a rectangle to suspend the soap film. Creating the soap film was not challenging, the

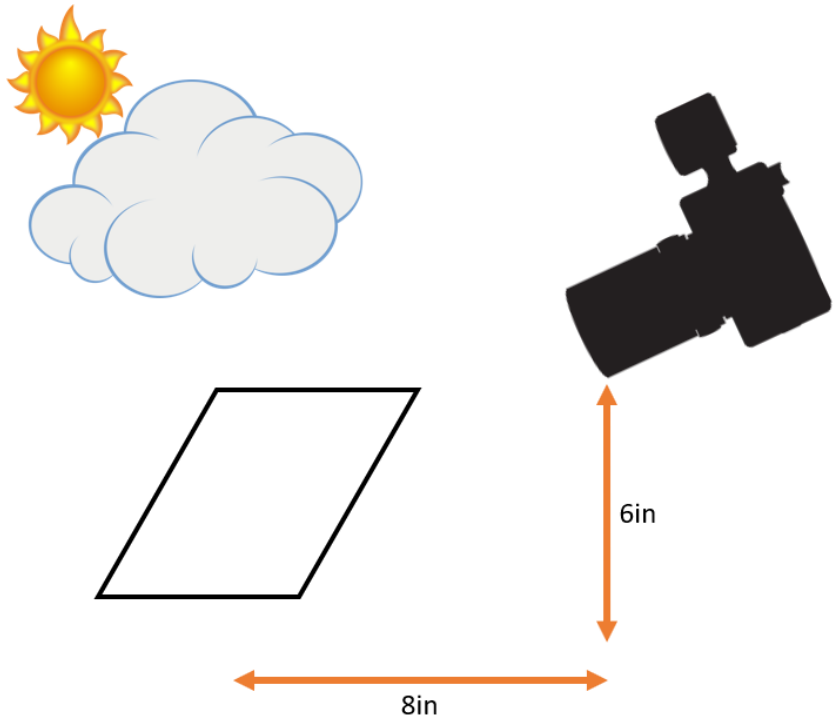


***Figure 1:*** *Experimental Setup*

team mixed approximately 3 cups water, 3 cups Dawn dish soap and 1 cup sugar into a large baking sheet. The coat hanger was then dipped into the mixture and carefully lifted out. The team had a hard time getting the film to suspend with the wind but it was doable. The film was then rotated accordingly to minimize outside reflections and/or distractions.

## *Flow Physics*

The flow physics revolving around this soap film phenomenon is a very interesting case of light reflection as well as constructive and destructive interference. As many people know, light is broken down into various colors based on their respective wavelengths. This breakdown can be seen in Figure 2.

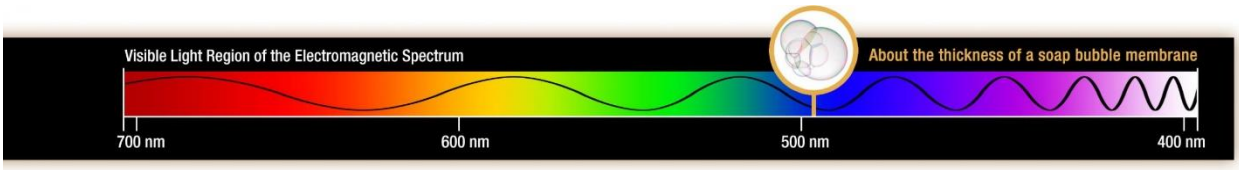


***Figure 2:*** *Visible Light Spectrum and Wavelengths*[1]

The sun projects white light, a combination of every color, onto the soap film. Once the soap film is suspended over the coat hanger, various portions of the soap film will be thicker or thinner. As the different wavelengths of light impact different locations on the soap film, they will react differently and subsequently generate different colors of light. Light waves are sinusoidal waves that have both crests (the highest portion of the wave) and troughs (the lowest portion of the wave). Constructive and destructive interference occur when two (or more) waves are placed on-top of one another. If their crests line up with one another, they will generate a constructive pattern that amplifies the intensity of that color; if a crest lines up with a trough, the intensity of the wave will essentially go to zero. See Figure 3 for a visual explanation of this effect.

[1] "Visible Light." NASA. https://science.nasa.gov/ems/09_visiblelight.

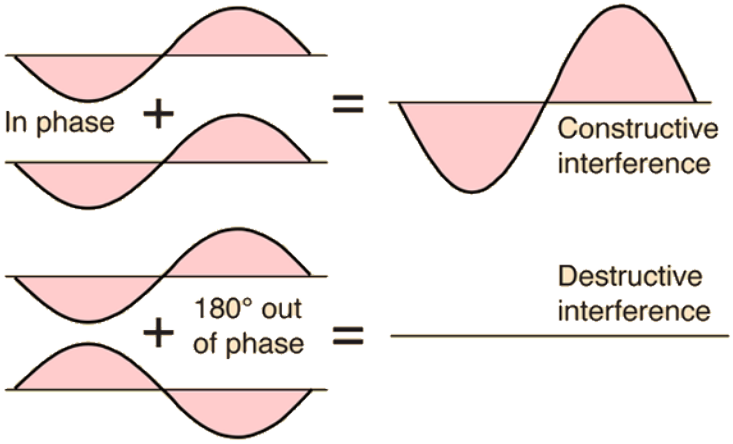


***Figure 3:*** *Visual representation of interference*[2]

Any combination of the two of these will generate different types of colors because the wavelength of light will be changed throughout the soap film.

### *Photographic Technique & Post Processing*

The camera that was used to take this photograph was a Canon EOS Rebel T6. This experiment did not require an extremely fast shutter-speed because over time the color patterns became almost stationary. The overcast lighting created a very nice lighting situation that allowed the team to increase the shutter-speed when necessary while not having to crank the ISO to a grainy level. The camera settings used were as follows:

| | |
|---|---|
| **Photo Dimensions** | 6000 x 4000 Pixels |
| **ISO Speed** | ISO - 800 |
| **F-Stop** | f / 5 |
| **Exposure Time** | 1 / 25 sec |
| **Flash Mode** | No Flash |
| **Focal Length** | 45 mm |

***Table 1:*** *Camera Settings*

[2] "Interference Patterns." Total Internal Reflection. http://hyperphysics.phy-astr.gsu.edu/hbase/Sound/interf.html.

The raw image came out very nicely; however, I wanted to really focus on the color patterns within the image. I preformed my post-capture editing through Gimp. Figure 4 shows the progression through the editing process. As seen in the raw image, the color contrast was not super great and the image contained various distracting elements. To resolve the issue of the distracting background, I rotated the image in a manner that the right and left edges became parallel to the coat hanger. Additionally, I cropped the image to focus on a very busy and colorful portion of the image. I also adjusted the saturation level (+1.5) of the image to really make the color contrast pop.

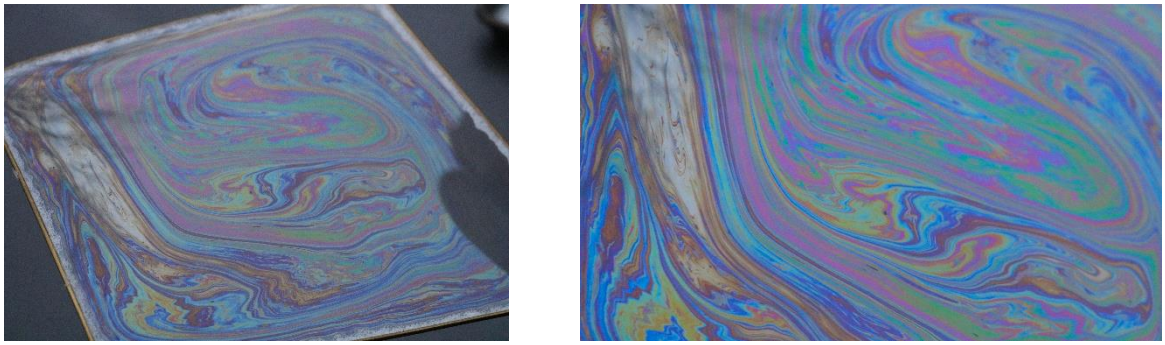

***Figure 4:*** *Image progression after editing. Raw file is shown on the left, final edited photo on the right.*

## *Visualization Technique*

This image required no visualization techniques except for the proper angle to get a nice reflection off of the overcast sky.

## *Results*

The team was extremely surprised with how well this experiment worked. After solving our issues with having the soap film pop upon lifting the hanger out of the mixture, we were able to generate unique and colorful images each time we attempted the experiment. After compiling all of our shoots we were able to pick and chose from different images that all had extremely nice colors and patterns. If we were to do this experiment again, I would love to attempt to form a large bubble with these colors and patterns.