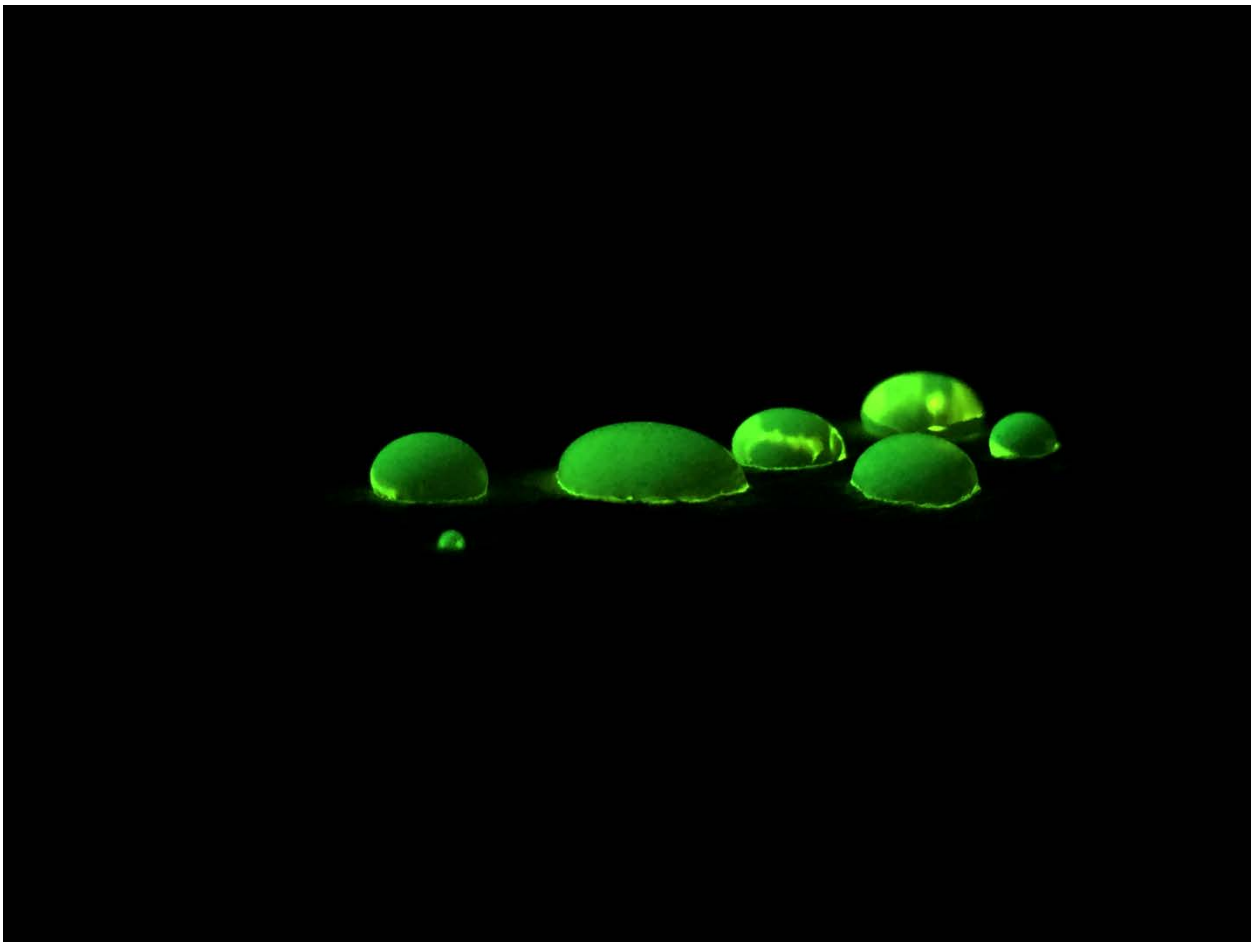
Hydrophobic Surfaces

Third Team Photo



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The purpose of this assignment is to work with a group to create and photograph an image of what occurs when a liquid is put on a hydrophobic surface. Some hydrophobic surfaces can be found in nature, but we can simply create one by using a variety of hydrophobic sprays that are available out in the market. These sprays usually require drying times that can be up to a day. Devin Sakamoto was part of the group and he volunteered to purchase the hydrophobic spray. He purchased NeverWet which is one of the most popular sprays and it is commonly used to repel water and heavy oils. Everyone in the team decided to spray something different to add variety. Some sprayed paper, others a table top surface; I decided to spray some thick tree branch pieces found outside as well as the flat surface of a hat.

After I sprayed my materials I had to wait for the NeverWet spray to dry. From the beginning of this assignment I knew that I wanted to incorporate using highlighter fluid and a black light but I wanted to practice on a few other surfaces before trying this. To practice setting up and taking some pictures, I initially dropped some water droplets on the flat surface of the hat that I sprayed. I was able to capture the surfaces repelling the water droplets pretty well, as seen below in Figure 1. The water droplets do not absorb into the surface of the hat like expected. Sometimes a small water droplet separates from the larger droplet but for the most part, the droplet stays together. When taking these images, I was not a big fan of the thread lines in the image, so I decided to move on the working with the wood. Before moving towards the highlighter fluid, I decided to place a water droplet on the piece of wood. I picked a piece of wood that had a flat surface so that the liquids would have a flat surface to sit in. I was expecting for the wood to be a little less repellent because of its tendency to absorb liquids. By looking at Figure 2, we can see that the wood is pretty hydrophobic.

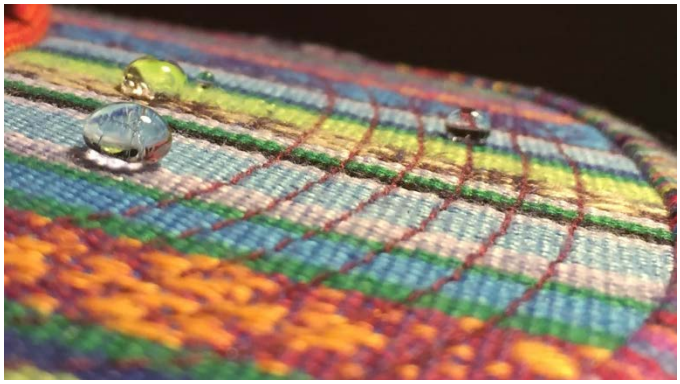


Figure 1: Droplets on Hydrophobic Hat

Figure 2: Droplet on Hydrophobic Wood

After these two trials, I decided to move on the highlighter fluid and the black light. I watched some YouTube videos on how to remove highlighter fluid from a highlighter [1]. The highlighter is diluted with water. I dropped some of my highlighter mixture on the wood and took some pictures. The light that I used was a 24 inch long 20 Watt Black Light Tube. The black light did not need to be very close to the experiment to make the high lighter fluid look fluorescent. The

light was standing up vertically and it was 8 inches from the droplets. I placed the piece of wood on a notebook with a completely black cover that was about an inch thick to raise it off of the ground. You can see in my image (on the cover page) that the angle between the inside of the bubble and the surface (known as the contact angle) is not as large as the one in the trials where just water was used. This smaller contact angle means that there is a smaller surface tension in the highlighter fluid than in the water by itself [2]. This decrease in surface tension is caused by the highlighter fluid. Highlighter fluid is made to absorb into pages very easy and because of this, the surface tension is very small.

The hydrophobicity occurs when the spray tries on the surface. The spray creates a thin non-polar layer, sort of like a shield, on the surface. When a polar liquid, like water or a highlighter water mixture is dropped on the surface, there is a repelling force from the surface to the droplet. Because all of the water molecules are polar, they are more attracted to each other the closer that they get, causing the contact angle to increase.

The camera that I used was the camera on the iPhone 6. I attempted using my Nikon P510 but I was unable to focus on such a small area. The iPhone6 camera is an 8-megapixel iSight camera with 1.5µ pixels. It has a set aperture of f/2.2. For my image , the focal length was 4.15. The ISO was 250 and the exposure time was 0.067 seconds. The size of the original image is 3264x2448 pixels. Additionally in post-processing, I adjusted the level a bit to get rid of the “glowing” effect on the surface of the wood and make the droplets look more separate. Because I was so close to the droplets (3 inches) the focus on the image was not the best. There was one droplet that was closest to the camera that was really out of focus. Initially I left this in when I did the level adjustments but I realized that it was a little distracting so I decided to black out that droplet. The image looks a bit grainy but I do think that the post-processing improves it. The original image can be seen below in Figure 3.

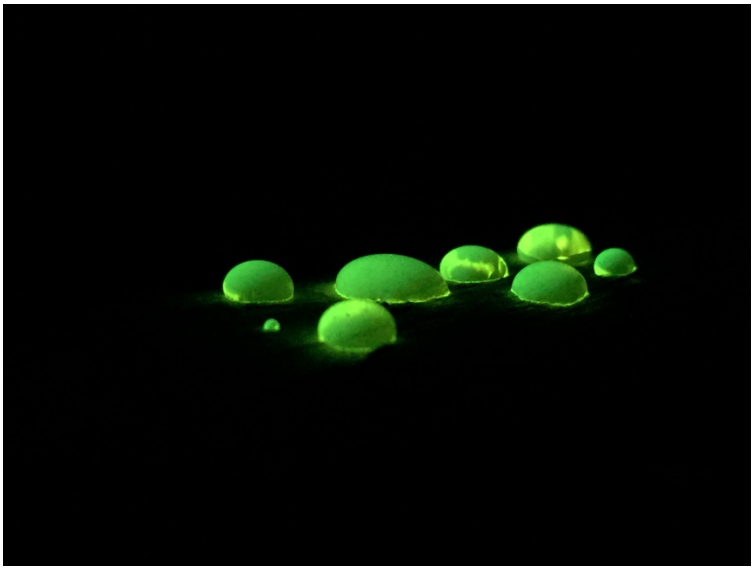
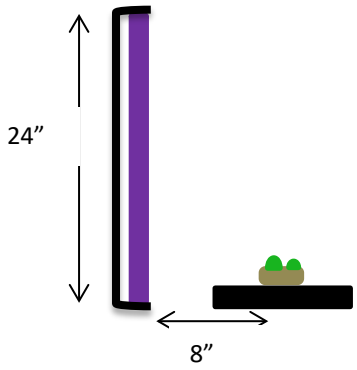


Figure 3: Unedited image

I believe that my method of using highlighter fluid and a black light made for a very definite image. This setup allowed for the highlighter droplets to be very visible and really make it easier to see the contact angle in the droplet due to the hydrophobic surface. Although the surface tension in the highlighter water mixture is less than that of just water, we are still able to get a nice representation of what a hydrophobic surface looks like. I really like the feel of my image, many mentioned that it looked radioactive. If I could do this again, I would try it with a different surface. The wood seemed to have absorbed some of the highlighter fluid, which meant that I was unable to use the same surface more than once. Other than that, this was a fun and interesting experiment.

Set Up:



[1] "How to Make Glow Water." YouTube. YouTube, n.d. Web. 17 Dec. 2015. <https://www.youtube.com/watch?v=eTsgPLmli8E>.

[2] "Wetting." Wetting. N.p., n.d. Web. 12 Dec. 2015. <http://www.adhesives.org/adhesives-sealants/science-of-adhesion/wetting>.