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Image-Video Report 2
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Image-Video 2 Report: Worthington Jet

This image is taken of a water droplet as it hits the surface of water in a cup. This photo was taken to explore the phenomenon, Worthington Jet. The Worthington jet explains why there is splash back or why the droplets bounces back up after it hits and is absorbed into the surface.

The apparatus that was used to create the image was very simple. A plastic water bottle was used, and a small hole was punctured in the cap to be able to form a droplet. A glass cup was filled to the rim with water and set on a countertop. The water bottle was then held above the center of the cup and squeezed so that individual drops of water would fall out and hit the center of the glass cup. The glass cup stands at eight inches with a diameter of four inches. The water bottle used was any regular plaster water bottle.

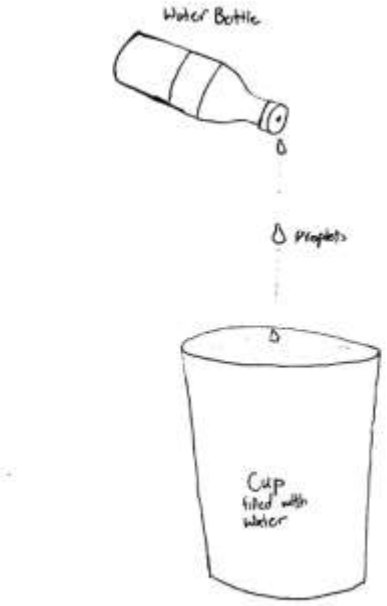

Figure 1: A simple sketch of the apparatus set up.

The phenomena shown in the image displays behaviors described by the Worthington Jet. As droplets fall and make contact with the fluid surface, the droplets ca neither float, bounce, coalesce with the reservoir, or splash. Each instance requires different variables in droplet velocity as well as fluid surface properties. For example, the liquid surface cleanliness contributes to the case at which the droplets will float. If the droplet falls with a higher Weber number (with greater energy), it can produce splashing. In the case a Worthington Jet, it is formed when a droplet falls with high enough velocity on a liquid surface. When the droplet hits

the surface, it forms a crater. Following this, a crown forms around the crater. The crater, however, doesn't last long. When the water rushes back into place, a central jet is created at the center of the crater. If the impact energy is high enough, the jet rises to a point where it pinches off and thus sends droplets upward. This can be observed in the image as there are two droplets flown upward above the liquid surface. Those two droplets are the result of a Worthington Jet. Also depicted in the image is the crater that is formed after the droplet hits the surface of the water and the crown that formed around the crater.

In the image, no visualization techniques were used to help better visualize the phenomenon. Both the droplets and the liquid surface are clean water. The experiment was performed in a controlled environment eliminating the possibility of wind or other external interferences. As for lighting for the image, natural light was the main source. The natural light was provided through a window in the room. An additional lamp light was used to provide a little more light on the opposite side from the window.

This image was captured using a Nikon D810 with a variable zoom lens. To be able to capture the subject/phenomenon very closely, the camera was set up on a tripod at the minimum focal length. Along with this, the lens was extended out to it's maximum zoom length which was 120mm. To create a shallow depth of field, the cup was pushed a foot away from the wall behind it and the camera was set to the lens' minimum aperture. With the aperture set at f/4.0, this allows the most amount of light to be detects from the camera's sensor as well as creating a more shallow depth of field. Since the Worthington Jet can only be seen for a very short instance, a higher shutter speed was required to be able to capture it with a good amount of clarity and minimal motion blur. For the image, a shutter speed of 1/1000 was used to accomplish these requirements. However, since the lighting was very limited, the ISO had to be increased to allow enough light into the image for proper exposure. With this in mind, the camera ISO was set to 500.

Original Image

Edited Image

For post-production, Adobe Lightroom was used to make adjustments to the image so that the Worthington Jet can be seen. Simple changes were made to the original raw image such as increasing the exposure and cropping the image closer to the mouth of the cup. The image was also cropped to fix the position of the cup since the original image captured the cup slightly skewed and off center. As seen in the original image above, the exposure was too low and the details were not clearly shown. Thus, the exposure was increased to display the details in the phenomena better. The original image was also warmer in tones with a slight orange tint to the majority of the image. Due to this, an edit was made to make the image cooler with more blue tones.

To me, this image reveals the beauty and simplicity of the Worthington Jet. As simple as the experiment is to recreate, the image is still amazing to look at. As it's a common occurrence to see water droplets falling and landing into puddles or other surfaces, it's still an amazing sight to be able to freeze the moment in an up-close image. In my image, I like how clearly focused the two droplets created from the jet are. They're perfectly focused and even perfectly positioned. However, in the future I would like add more light to the image to create more defined shadows and highlights. More lighting would also allow me to decrease the ISO which would decrease the amount of noise in the image. I may also consider using different colors of droplets with food dye. This may be interesting to be able to examine how the droplets spread into the liquid surface. Despite these adjustments for future iterations, I believe the physics examined and the Worthington Jet are perfectly depicted in the image shown above.

References:

Wikipedia contributors. (2020, August 18). Drop impact. In *Wikipedia, The Free Encyclopedia*. Retrieved 07:27, October 12, 2020, from https://en.wikipedia.org/w/index.php?title=Drop_impact&oldid=973640762