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Team Second

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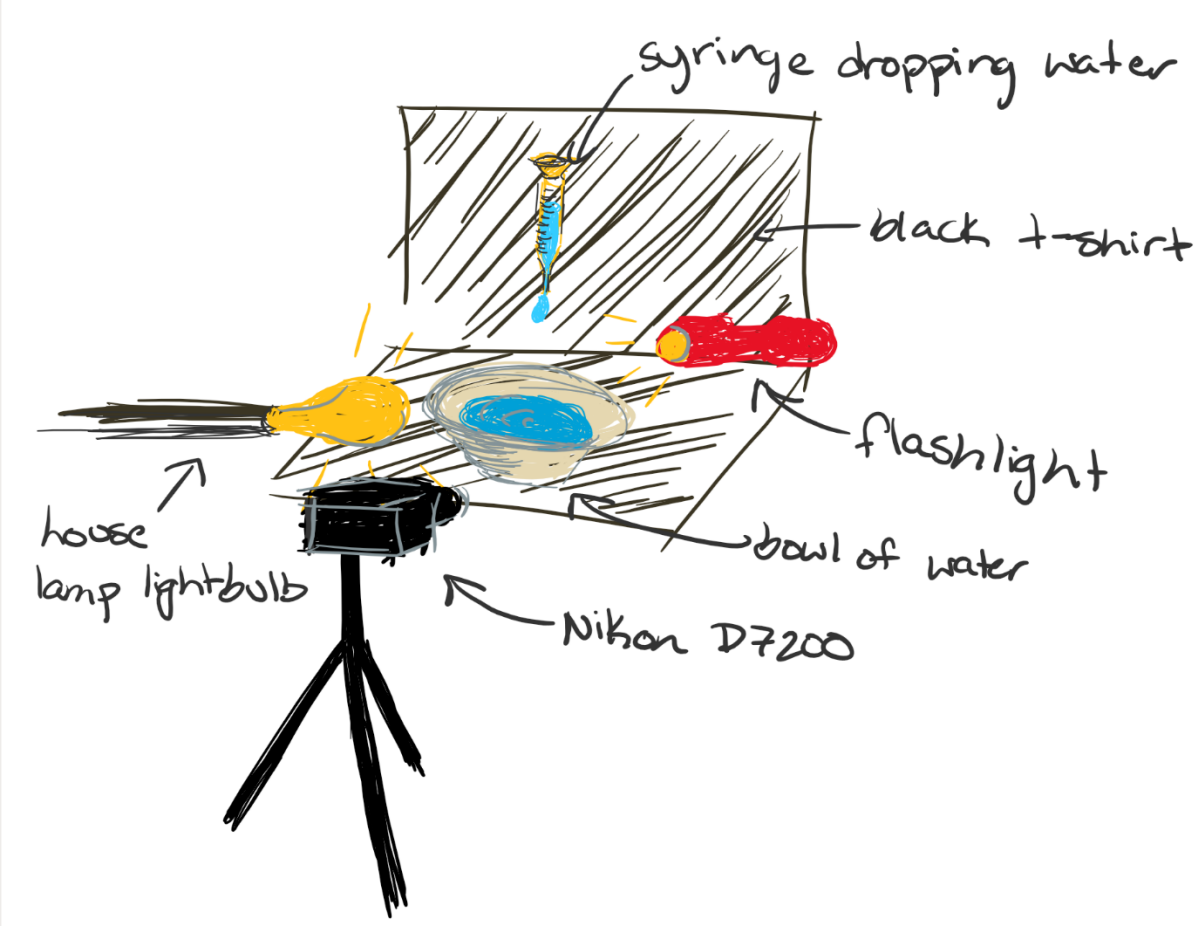
# Droplet

For the Team Second project, my team and I decided to experiment with capturing water droplets. We wanted to capture the drop impact that occurs when water is dropped into more water. When a droplet of liquid hits another liquid, many things can happen dependent upon the properties of the two liquids being experimented with and the velocity that the droplet hits the surface at. We set out to specifically capture a Worthington jet through drop impact, as we felt this phenomenon was the most interesting visualization to capture in drop impacting. When a liquid is dropped into another liquid at a higher velocity and greater energy, the droplet will create a crater in the fluid's surface that is surrounded by a crown. Inside this crater a central jet, known as a Worthington jet or a Rayleigh jet, forms and protrudes liquid from the surface upwards. If the energy of the droplet is high enough, the jet can rise to a point where it "pinches off" and sends one or more droplets upwards. We successfully captured this Worthington Jet as a team, which included Kensue Kiatoukaysy, Kailey Shara and Shalil Jain. I managed the camera, Shalil managed the droplet flow, Kensue managed the lighting and Kailey managed the scene; placing of the bowl, lights and where the droplets should fall.

To capture this jet phenomenon, we first needed two liquids. We decided to use tap water dropping into tap water. This was easy to get access to and visualized the phenomenon well. We filled a white bowl with tap water and placed it on a black t-shirt, so our background was not distracting. We then filled a cup with tap water to feed our syringe which we used to form droplets to fall on the surface of the water in the bowl. We decided to die this water with blue food coloring in hopes of visualizing where the initial droplet was in the impact more clearly. The water in the bowl was not died, so the viewer could differentiate the droplet water from the surface water. To produce a Worthington jet, we needed the droplet to have a high amount of energy and hit the

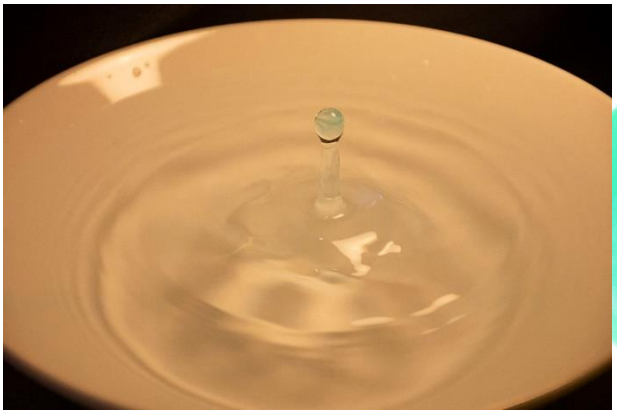
surface at a high velocity. To create this effect, we held the syringe about a foot above the bowl. This caused the droplets to hit the surface and create the jet effect we were looking for. The jet I captured in my final image protruded about one inch off the surface of the water. You can see the blue food coloring in the pinched off droplet, signifying that the initial droplet hit the surface of the water, bounced upwards, created a jet trail behind it which then pinched off, before it all splashed down.

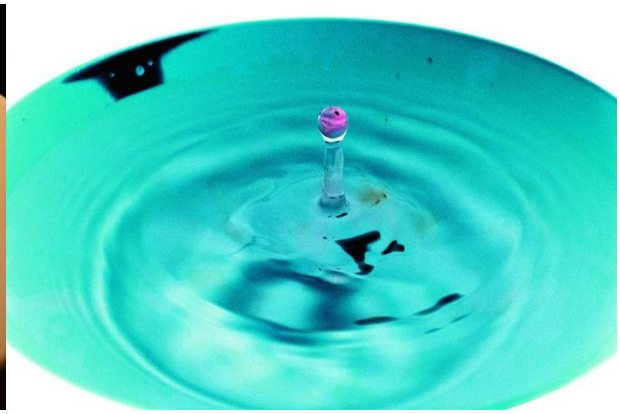



As stated before, our main visualization technique was dying the droplet water, so it was easily differentiated from the surface water. We also needed to make sure the shutter speed of the camera was high to freeze the motion of the droplet. Timing the picture taking with releasing the droplet was the hardest part of capturing this image. We had to do many run throughs and experimentation with dropping the liquid and holding down the camera to rapidly shoot pictures to time it right. There were many run throughs where the timing was just slightly off and we didn't capture anything we intended to. We probably only got three droplet series in which the timing

worked out and we were able to capture the jet in multiple stages. It was also hard to get the droplet to fall in the exact, small focal field of the camera when dropping it form a foot above the bowl. The final picture I chose was the most in focus and I felt visualized the jet the most beautifully. To light the scene, we used one 60-Watt bulb from a desk lamp with the lampshade taken off and a small flashlight. The desk lamp was being held on one side of the scene, while the flashlight was being held on the other. The desk lamp's bulb was a warmer bulb, casting an orange glow onto the scene. The flashlight has a cooler tint, casting a bluer light onto the scene. We used these two different tints in hopes of evening out the color of the scene, but in the end the lamp light was brighter, and our scene turned out very orange in the final images. I fixed this in post-processing by color correcting and messing with the white balance.

To take these pictures, I used my Nikon D7200 camera with my kit lens: a 18.0-140.0mm with f/3.5 lens. Since we intended to capture water droplets frozen when hitting the surface of water, we needed to use a high shutter speed to freeze the droplet's movement. I set the camera to have a shutter speed of 1/2500 to freeze the movement. To compensate for this high shutter speed, I had to set the ISO to 4000, which caused the image to be noisy, which I corrected to the best of my ability in post-processing. The f-stop was set at f/5.6 so I could let as much light as possible into the camera, and also focus the observer's attention on the droplet by having the droplet in focus while the rest of the image was slightly out of focus. The focal length was 140mm. The original and edited image were both 6000x4000 pixels. The only editing I did in post-processing was general contrast, exposure, color balance corrections and inverting the image's colors. I inverted the image to help visualize the droplet more clearly. I thought the inverted colors had a greater contrast between the water's colors verse the droplet's color. The pink draws the eye of the viewer immediately to the droplet. I also think it makes the water in the bowl stand out more from the background. The inversion helped the visualization and doesn't make the image look overly edited, which is always a danger when inverting an image's colors.





I was very happy with how the final picture turned out and loved how the color inversion made the Worthington jet phenomenon much clearer. It is cool to compare all the jet images we captured to see how each jet is different. Something I would improve if I did this experiment again would be to get ahold of a macro lens, so we could have captured the jet in even more detail. I would also have liked to try shooting the droplet from the side to get a different angle. Overall, we captured exactly what we intended to, so I say this project was a success!