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Team First
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## Water Drops on a Toy Car

For this image, I wanted to see what the effects of dropping water on a strange surface looked like. I decided to go with a toy car for the surface, which ended up being used my myself and my teammate, Travis. The toy car had lots of curves and irregular geometry, which made for a chaotic and unpredictable experiment. One thing about the image that I found to be particularly interesting was the gravity wave that emanated from the water drop. I will be exploring gravity waves later in this report. I took several images in rapid succession, but I settled on one because it showed a lot of motion without much blur. Most of my images had either a lot of still water or a lot of blurry moving water. The image that I ended up with shows effects that any water drop would have and others that are due to the curved surface.

The apparatus that our team used for the experiment was fairly simple. It consisted of a clear plastic tub, 3 squares of lasercut acrylic, a toy car, water, and food coloring. We were initially going to cut a hole in the side of the plastic tub, so we could get a better view of the toy car, but we decided that it would be better to elevate the car. That way, we could fill the tub with more water and not have it spill out of the open area. In our final version, we cut out 3 pieces of acrylic with lasercutter in the ITLL and hot glued them to the bottom of the plastic tub. We then placed the car on top of the acrylic and poured dyed water over it. This is all shown in **Figure 1**. I chose red food coloring for my images because I thought it would look pink on the car. I believe this could have worked if I had used more food coloring, but in my images, the color kind of disappears on the surface. That being said, the effect of the water turning from red to clear on the car does look interesting.

**Figure 1** shows the our experimental setup in the ITLL basement.

Initially, I thought that the wave emanating from the from the drop on the car's roof was a capillary wave, but this is not true because wavelengths over 1.73 centimeters are gravity waves (Encyclopaedia Britannica). A quantity that can be estimated from my image is the wavenumber which is the magnitude of the wave vector (Paschotta). This quantity can be used to find the waves velocity. I estimate that the wavelength of the wave that is about 2 centimeters. Using this value we can estimate the wavenumber with **Equation 1** where k is the wavenumber and λ is the wavelength (Encyclopaedia Britannica).

$$k = \frac{2\pi}{\lambda}$$

**Equation 1**: Wavenumber

The wavenumber for the flow is approximately 314 $m^{-1}$.

The visualization techniques that I used were very simple. I did not dye the water or alcohol, but I may perform the experiment again with dyed water. This would not demonstrate volume contraction any better, but it might look more visually interesting on camera. I chose to use the lighting from my kitchen and nothing else because I thought that the backlighting from the LEDs above my counter gave a calm feel to the video.

I shot my image on my Canon 77D with a 15-35mm lens. This setup allowed me to get my camera in very close and still have a decent image. I used an f-stop of 5.6, shutter speed of 1/100, and ISO of 6400. We lit the shot with Travis's headlamp and my phone's flashlight. If I were to do this again, I would probably use my macro lens and hold my camera farther back. This would have allowed my to push my f-stop much lower and use a lower ISO. I ended up using Adobe Lightroom's AI denoise feature to correct the noise in my image, but I think I could have gotten it right from the get-go with a lower f-stop.

I think my image does a good job demonstrating the gravity wave that appears when water hits a surface. I really like the chaos of the water going in all directions from the source droplet. That said, I could have done several things better. First, I wish that I would have added more dye to the water. I think this would have made the water on the car more noticeable. I also could have taken the image with a macro lens, so I could have used a lower f stop.

Works Cited

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