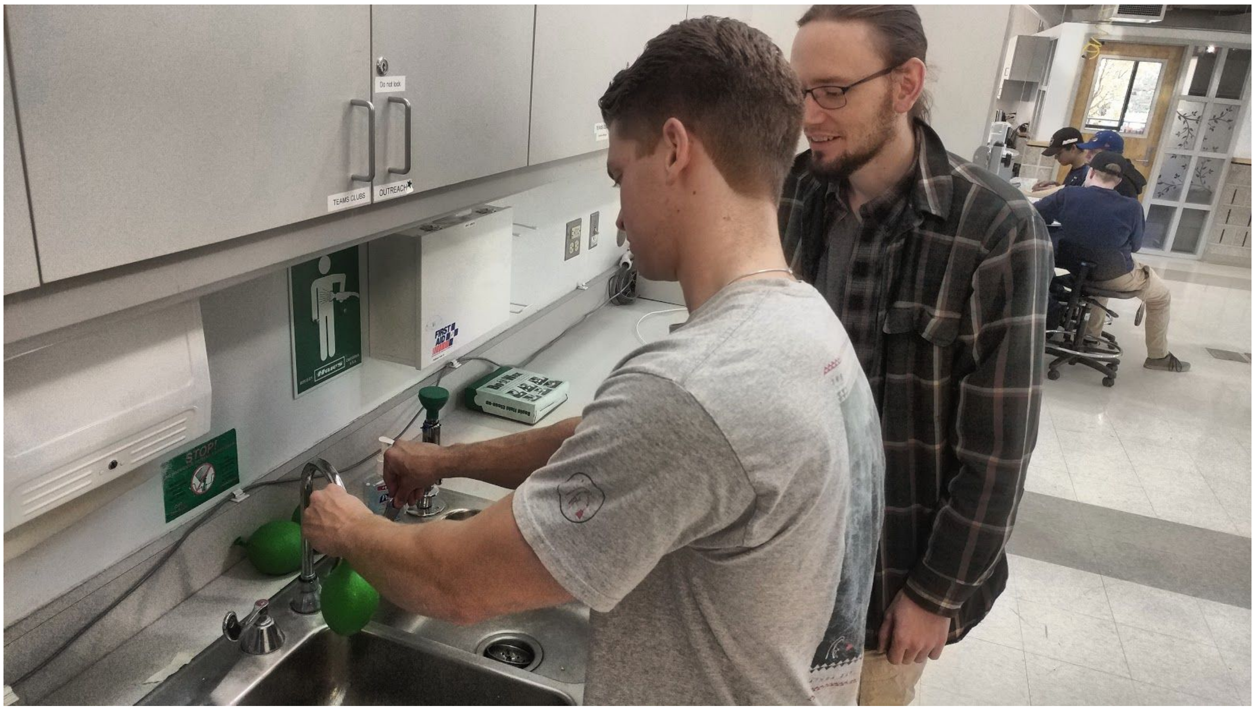
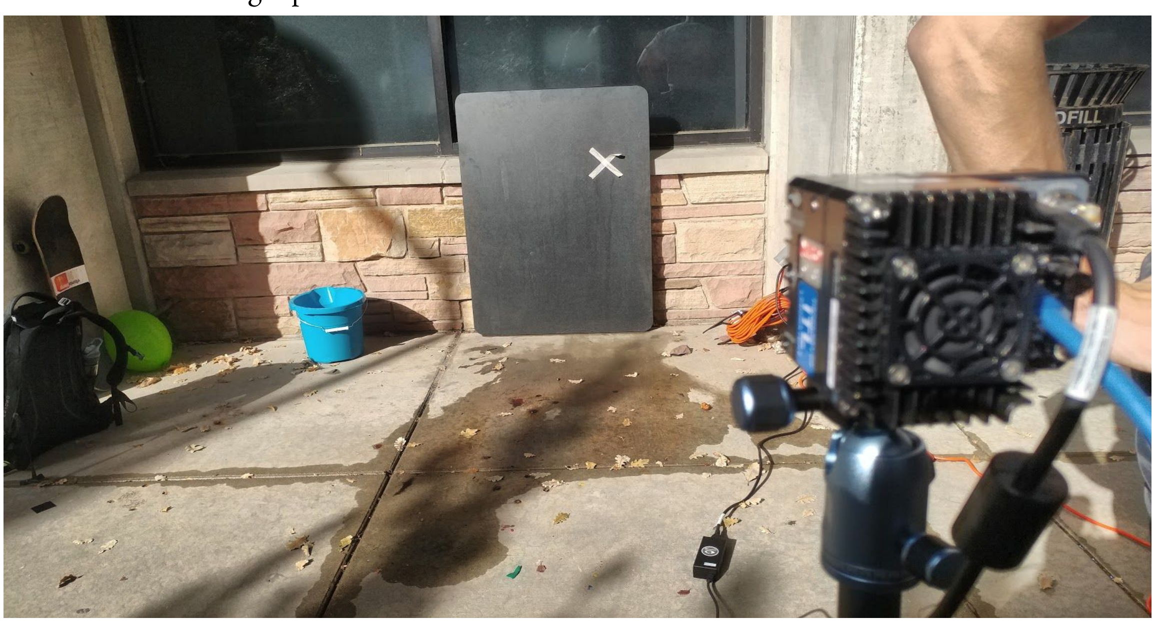
Duncan Lowery - 10/21/2018
With the Help of Greg Collins, Bradley Busek, and Brent Eckles
FILM 4200-001 - Group Second Visualization Report

For this project, our group enjoyed the privilege of getting to use a Miro C110 high-speed camera from Vision Research to document our flow. We decided to see what happens when a balloon full of water bursts at 2500 frames per second, as normally the action happens so quickly that it is hard to observe the physics going on.



To prepare, we filled green balloons with approximately a cup of water each, along with 10 drops of red or green food coloring. We took the balloons and camera to the lower patio outside of the ITLL building, where the sun was shining directly onto walls. A black table top was propped against one of the walls to serve as a solid color backdrop, and we marked the camera's field of view with an "X" made of masking tape.



Greg Collins held the balloon in front of the "X", and punctured it with his pocket knife when I gave the signal that the camera had begun capturing. After the balloon had popped and the water inside had fell out of frame, I quickly stopped the capture function of the camera, so we could all review the shot. Brent Eckles assisted with reframing the camera and operating the capture controls, and Bradley Busek helped stage the next shot to be taken, all the while managing the camera's power cables to keep them out of the growing puddle of water we were creating.

The videos we took reveal the amazing physics that apply when the balloon is burst. Because the water forced into these balloons when filling them exceeds their relaxed and deflated volume, there is even force applied across the walls the balloon, causing it to stretch. When Greg's pocket knife created a point of failure in the wall of a balloon, the tension held is enough to rip the balloon further, causing a violent elastic retraction that leaves the water in a state of free fall. Gravity than takes over, and the water falls away from the frame, and properties of surface tension are displayed as the water sticks to the sides of the elastic balloon material and to the pocket knife itself. The balloon exhibits the properties of a no-slip condition, as evidenced by the way the balloon seems to "wrap" around the mass of water, leaving the original shape of the water before the balloon was burst, except for some splashes that travelled with the balloon material because of friction.

To achieve a useful timescale of the fluid flow event, we recorded at 2500 frames per second, which resulted in maximum resolution of 256 x 256 pixels. The lens we used had a 50mm focal length, and the aperture was either f/11 or f/22 for the shots we took. The balloons we used were roughly four inches in diameter before bursting.

In the editing of the clips, I took the creative liberty of desaturating the colors dissimilar to the color of the dye used inside the balloon, increasing the visibility of the fluid itself. While the framerate of the camera allowed us to see the physics in a time scale we thought appropriate, the sacrifice in resolution destroyed a lot of beauty in the images. In the future, knowing that the video is encoded and played back at 60 frames per second, I would have wanted to halve the framerate to gain some of the resolution back, and re-encoded the video to play at an acceptable 30 frames per second.