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Assignment: Get Wet
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Flow of Milk Injected into Clear Gelatin

The purpose of this assignment was to “get our feet wet”, and explore a concept of fluid physics. I was interested in exploring how liquid shoots from a needle; my father is a veterinarian, so I grew up in a vet clinic watching people use needles. The flow of the liquid initially leaving the needle always fascinated me, so I tried to replicate that for this experiment. However, I ended up switching my focus to using the needle to inject milk into hardened gelatin. The inspiration for this switch came from remembering that some bakers had created clear gelatin cakes and used needles to create very visually appealing floral designs (an example video can be found here: <https://www.youtube.com/watch?v=wWcO27wDzeo>).

The setup for this experiment is quite simple: the container was 3 inches wide. The basic flow of this experiment demonstrates two-phase flow. There is a liquid and a solid (gelatin) separated by their phase – the reason the two substances don’t mix. There isn’t movement involved in this flow once the milk is in the gelatin. As time passes, the milk is held still by the gelatin. Clear gelatin powder was mixed according to instructions on the packet and hardened. A syringe was then used to inject whole milk into the gelatin. The syringe was inserted into the gelatin, and as the plunger was pushed, the needle was removed slowly, leaving behind a trail of the milk. A video of the milk being injected can be found here: <https://vimeo.com/292605733>.

The brand of gelatin used was Knox, and the brand of milk used was King Soopers. To light the image, I used a 60 watt bulb in a lamp (with lampshade removed). The bulb was placed right behind the container to provide a backlight to illuminate the strands of milk.

I decided to make the field of view as small as possible to maximize attention on the container and fluid flow at hand. The container is 3 inches wide, and therefore the final field of view is half of that. The distance from the object to the lens was roughly 5 inches. The lens focal length was 135mm. To take this image, I used a Nikon D80, and the original dimensions of the image are as follows: 3872×2592 . The shutter speed was $1/45$, the f stop was 5.6 (the aperture was $1/5.6$), and the ISO was 500. I used Photoshop to make several post-production edits of the image. I used



Original, unedited photo.

“levels” to adjust the whites and blacks of the image to add more contrast, making the milk streams stand out more from the background. I used “brightness and contrast” to make the image brighter (and have more contrast), again to clarify the milk streams. I also used “hue/saturation” to make the color less red than the original image. The last edit I made was to crop the image to focus in on the milk in the gelatin without having distracting information.

The image reveals how a liquid interacts with a gelatinous solid as it is injected into it. I like how this image turned out, and I think it looks like a specimen from a horror movie basement. I think the fluid physics are clearly shown, as you see the static nature of the interaction. I wonder how different liquids would interact with the gelatin – would they all produce similar effects or would the visualization be different depending on their different properties? I did fulfill my intent of exploring this phenomenon. If I were to re-do or enhance this project, I would play around with different colored milk in the clear gelatin to get a higher level of contrast or to add an element of interest. I would also explore different lighting options to maximize the visibility of the milk streams.