

# TEAM IMAGE # 2

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**Flow Visualization**

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The experimentation which resulted with the image I selected was inspired by an in-class group demonstration. Another group in the course had used food dye and dish soap dropped into whole milk for their first group assignment, and they demonstrated their setup to the rest of the class. This demonstration was my motivation for trying my own version of this experiment. Although I had some success in using the food dye and dish soap in the milk, I was not overly pleased with the variety of shapes and colors that appeared. I tried using food dye into various beverages, but with limited success. As a final trial, I tried pouring some of the remaining whole milk into a half-finished glass of beer. This proved to create a very interesting and dynamic interaction. The set of images taken of the milk-in-beer subject became the favored set of photographs for this assignment, and my final selected image appears on the cover page of this document.

The physical setup used to capture this image was not complicated, as can be seen by the basic schematic in Figure 1. A pint glass filled approximately half its height with a translucent beer was placed on kitchen counter with a bright fluorescent light mounted above and slightly to the left of the glass. Whole milk was poured from the right side of the glass, but with the milk stream aimed at the left wall of the glass.

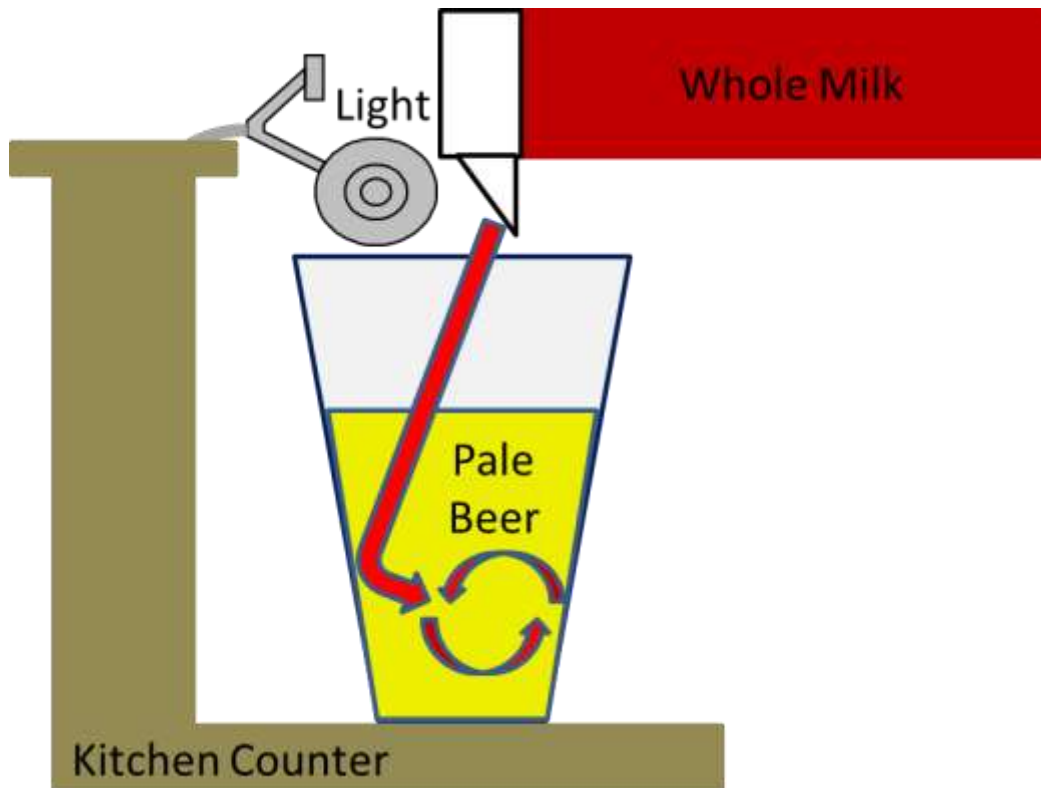


Figure 1: Diagram of setup, showing direction and path of milk stream into glass (red arrow)

This was done to ensure good visualization of mixing patterns that may not be shown if milk had been poured in a vertical stream at the center of the glass. The mixing observed appeared to be related to both the way in which the milk stream striking the side of the glass (creating horizontal vortices) and the contrast between the translucent beer and the smooth texture of the milk. I expect that some of the ‘geological’ features of the milk such as the stringy filaments and fibrous strands at the upper left and top of the final image are results of the relatively high fat content of the milk compared to the beer. US whole milk has a 3.25% butterfat content – per Wikipedia’s wealth of knowledge. With beer not having any fat content, the butterfat present in the milk distinctly alters the feel of the image, especially with the opaque property of the milk. The beer allows a large amount of light to pass through it, whereas the milk does not. This contrast in lighting and texture help to emphasize the flow physics present as the two fluids mix, such as the swirling and diffusion occurring during the mixing process.

The flow visualization technique used here is the use of an opaque fluid (whole milk) being slowly poured into a transparent fluid (beer). Flow velocity was introduced by rate of pouring and height of the milk container above the glass. The particular fluids used were whole milk purchased from a local King Soopers store, and a very unique beer brewed by the Twisted Pine Brewing Co. – “Billy’s Chiles Beer (Timberline Series)”. For this particular image, a conical pint glass was used, although any other style could be employed without a problem. The beer was cool, but warmer relative to the chilled temperature of the milk, which had been refrigerated until approx. 5 minutes prior to the mixing experiment. Lighting was provided by a standard commercial compact fluorescent light bulb.

This image was captured indoors at night on March 27, 2011 at 5:26pm MST, and is the second image in a sequential set of 4 photographs taken in rapid succession to capture different stages of the mixing process. The approximate field of view is 4 inches across by 5 inches high, with a distance from lens to the glass of approximately 2 inches. The digital camera used is a Canon PowerShot SD 500, with an F-stop of f/2.8, image focal length of 7.7 mm, and shutter speed of 1/200 sec. The flash was not used as part of the lighting conditions. The original image’s dimensions are 3072 x 2304 pixels, vs. the edited image’s size of 1923 x 1869 pixels. Editing was completed using Adobe Photoshop CS5, and included cropping, lowering brightness and contrast, as well as toning down the yellow color of the original image. The original image is shown as Figure 2 on page 3.

I am generally pleased with this image, but would like to attempt this experiment again with better focus and time resolution abilities. I would love to be able to see the detail present in the fibrous strands and on the pillow-like shapes at the center of the edited photograph. This may only be possible with a DSLR camera, which will allow me complete control of focus and aperture settings.



Figure 2: Original, unedited image taken on 27 Mar 2011.

## References

"Fat Content of Milk." *Wikipedia, the Free Encyclopedia*. Web. 06 Apr. 2011.  
<[http://en.wikipedia.org/wiki/Fat\\_content\\_of\\_milk](http://en.wikipedia.org/wiki/Fat_content_of_milk)>.

Jegtvig, Shereen. "Beer Nutrition - Nutritional Information for Beer." *Nutrition Facts and Diet Information*. Web. 06 Apr. 2011. <<http://nutrition.about.com/od/hydrationwater/p/regbeer.htm>>.