Drip Chamber

Cool Caustics!

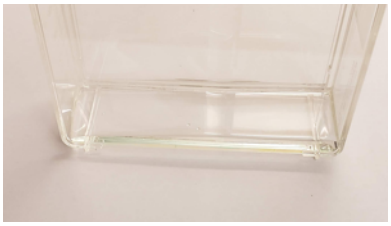
Viscous liquid drips down, creating unique shapes and shadow patterns.

Tools and materials:

- Flat Culture flask
- Point-source flashlight (the one on your phone should work fine)
- Thick clear viscos fluid such as: Glycerin, thick mineral oil, corn syrup, etc.…
- White paper (to act as a screen)

Assembly:

To make your drip chamber, pour glycerin into the culture flask. You will need only a few tablespoons (15 to 30 milliliters). Pour in enough so that when tilted flat, the fluid forms a film a millimeter or two thick.



To do and notice:

Place a piece of white paper on a table. Hold your drip chamber parallel and above the paper, 6 to 12 inches (15 to 30cm). With your flashlight on, hold it a few inches (10 or more cm) above the drip chamber. Let the light shine l through the chamber. Watch what happens as the drips drip!

What's going on?:

Cool! Right?

The patterns you see on the paper are caused by light passing through the clear viscous fluid. Each drip changes how light passes through the chamber. As drips form, they make convex and concave shapes. Because the fluid is transparent, these curved shapes act as lenses. These fluid lenses cause the light rays to bend (actually, refract), concentrating or spreading out the light. Compared to the ambient light from the flashlight, the projections through the fluid causes brighter and darker regions (shadows) to appear on the paper. Since the fluid is, well, fluid, it flows, causing the patterns to constantly change. This type of patterning is called a caustic.

Going further:

- Light patterns like these can be seen on the bottom of swimming pools, reflections off lakes surfaces and even on a table, next to a glass of water. Look around, where else can you find them?
- Try to match the pattern/region on the paper the convex or concave shape inside the drip chamber.
- Do you notice 120-degree angles and hexagonal shapes forming? Hexagons and their characteristic 120-degree angles, make the most effecient planar geometry. These shapes tend to pack well on the interior surface of the culture bottle.
- Sweet! You can use this type of phenomena to determine sugar content of a beverage, such as wine. For example, swirling a glass of wine and then allowing the fluid to run down the sides of the glass in the light. This will produce caustic patterns. The speed of the changing patterns will be an indicator of your drink's sugar content. These drips of wine are known as "tears" and this type of patterning is known as "legs."

Teacher tips:

- This is a great lesson for introducing optics and ray diagrams.
- Try other liquids. What patterns will they make?
- See how distance changes your projection:
  a. Try changing the distance from the paper to the drip chamber?
  b. Try changing the distance of the flashlight to the drip chamber?

References:

https://www.exploratorium.edu/exhibits/drip-chamber
http://charlessowers.com/drip-chamber (Charles Sowers is the creator of the Exploratorium exhibit "Drip Chamber")

Last image:
http://exploratorium.tumblr.com/post/53795457097/at-our-drip-chamber-exhibit-liquid-glycerin-drips