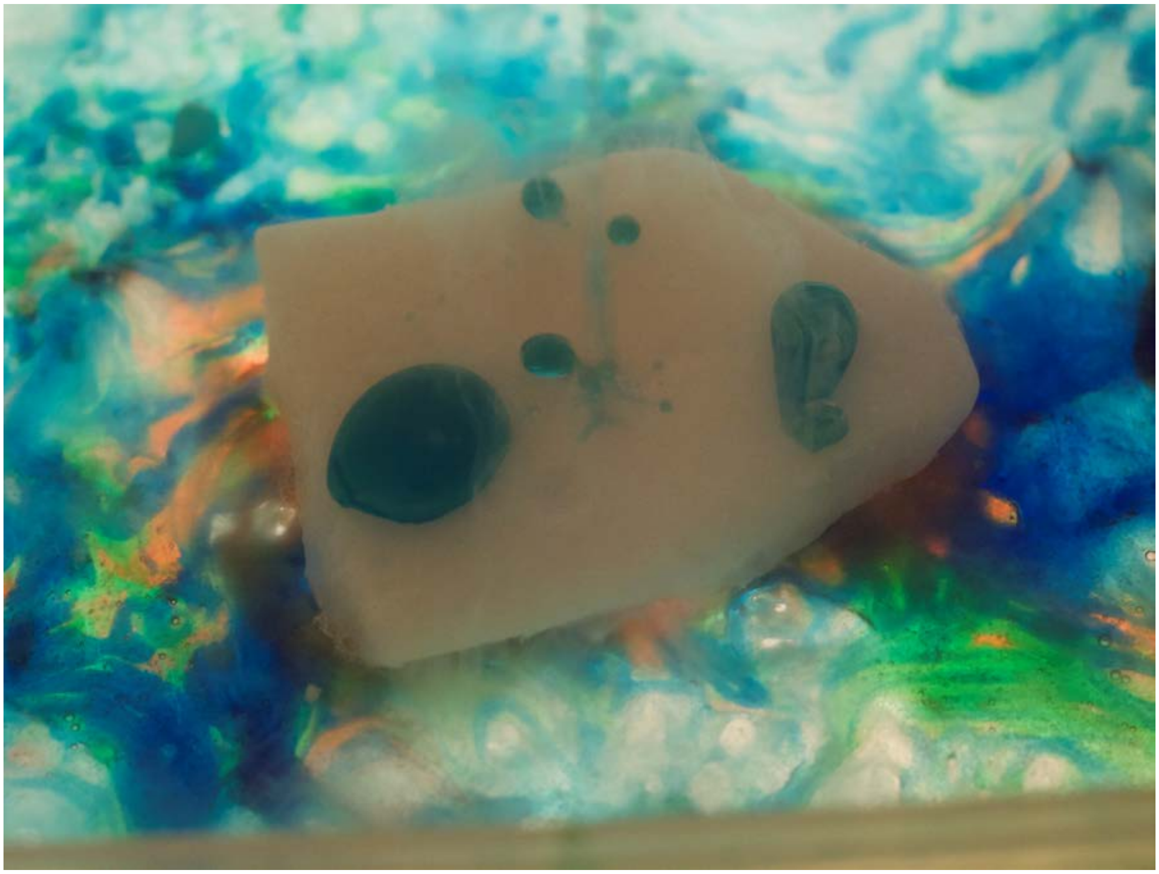
Get Wet Assignment:
Image Report



http://vimeo.com/85795878

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Flow Visualization
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I. Project Goal and Description

The aim of this project is to demonstrate the effects of dry ice (solid CO_2) when combined with a relatively warmer liquid (glycerine). The intended result is an adequate visualization of fluid flow.

I determined a still image was insufficient to capture the movement in this experiment, so the final project is showcased in a high definition video format. The video itself may be found at the link on the cover page. Furthermore, the cover page image, although not taken from the actual video, accurately portrays the artistic style of the project.

II. Project Setup

1. Black backdrop; used for correctly exposing video and images.

2. Glass pane; allows for under-lighting.
3. Simple desk lamp with socket splitter. Two 60w incandescent bulbs are installed. There is ambient light from two ceiling mounted bulbs, also incandescent.
4. Aluminum tripod w/ adjustable head; used to stabilize camera during shooting. The camera lenses is ~4” from the focus area.
5. Plastic container ~11” x 5” x 3.5” (WxDxH).

III. Camera Setup

The camera is a Micro 4/3 model, specifically a Panasonic G5. All controls are set to manual and I used a Pentax 1:4 Macro lens, adapted from a film SLR. In addition to the lens, I used a 30mm extension tube, which increases sensor-lens distance by about 40 mm. This 10mm difference is accounted for by the lens and senor mount adapters, which are required by the tubes. The result of the extension tube is a minimum focusing distance that is less than half of the stock lens. Furthermore, compared to stock, there is also a narrower field of view (~2.5”) that allows more detail to be captured.

The aperture range on the lens is f/4-f/32. I shot at f/8 to maximize sharpness and depth-of-field and to limit the incoming light. The original video was captured in AVCHD quality at 60 fps. However due to editing the Vimeo version was downgraded to MP4.

IV. Project Methods

To start the project, the plastic container was filled halfway with water and frozen for several hours. Placing the container on a block of dry ice will greatly accelerate the freezing process. Once frozen, the ice creates an interesting and level medium on to which the glycerine can drain. It also diffuses the relatively bright lights from below.

The ice in the video is colored from previous experiments with different colors. Food coloring was added to glycerine (normally clear) to create more contrast with the dry ice. 3 drops of food coloring was sufficient for 100 ml of glycerine. After about 5 trials I proceeded to add dry ice to the center of the container. Using a turkey baster, I dripped glycerine from ~4.5”-6” above the container onto the dry ice. I wished to portray a more natural fluid dynamic, so there was no intentional pattern to the glycerine drops.

V. Conclusion

There are at least two examples of molecular forces in this experiment. The first is the Leidenfrost effect and the second is the hydrophobic property of dry ice.

1) The Leidenfrost effect occurs when there is a significant temperature difference between the liquid and contact surface. This causes a layer of gas to form, insulating the liquid from freezing or evaporating and allowing it to bead up. This is most commonly observed on a hot cooking pan when temperature nears 300ºC, if water is added to the pan, it will bead up and roll around. The same phenomenon is observed with the dry ice and glycerine. When the glycerine contacts the dry ice, it sublimates some CO_2, which then forms the insulating layer described above. [1]

2) Hydrophobic essentially means “water-hating” and it describes chemical interactions in which one substance is water-adverse. A common example of this is oil and water. Hydrophobic molecules are nonpolar and typically have a long chain of carbons. [2]

VI. Sources

1. Johnson, Daniel. "Sublime Leidenfrost." RSC RSS. 4 July 2013. Royal Society of Chemistry. 10 Feb. 2014 <http://www.rsc.org/chemistryworld/2013/07/sublime-leidenfrost-water-bounce-dry-ice>.

2. Than, Justin. "Hydrophobic interactions." - Chemwiki. UCDavis. 13 Feb. 2014 <http://chemwiki.ucdavis.edu/Physical_Chemistry/Physical_Properties_of_Matter/Atomic_and_Molecular_Properties/Intermolecular_Forces/Hydrophobic_interactions>.