Gregory Kornguth
MCEN 4151
9/23/2023

Get Wet Report

Fluid interactions and dynamics are extremely complex areas of science that have many applications in a wide variety of fields and technologies. Many people find conceptualizing these interactions within fluids difficult because they are often invisible without special observation techniques. When brainstorming ideas of interactions that are not often made visible, my mind steered in the direction of convection. I wanted to capture the way in which portions of fluid at different temperatures move around each other, and I figured that a simple yet visually striking way to do that was to melt a colored ice cube into warm water and see how the cold ice water flowed through its surroundings.

To create the conditions I had envisioned for my image, I needed to make dyed ice cubes, then fill a clear tank with warm water and figure out the best angle and lighting to capture the flow resulting from my setup. I filled a clear plastic tank with warm water and then tried to figure out the best technique for lighting any flow within the fluid. I ended up using a desk lamp and a flashlight to light the flow from two different angles and had to put some towels over the desk lamp to minimize reflections of my camera in the plastic. The desk lamp was lighting the flow from above, and the flashlight was lighting the flow from the side which resulted in some interesting reflections on the surface of the water. When the ice cube was dropped into the water it started melting which released a stream of blue water. Because the water coming from the ice cube was much colder and therefore denser than the surrounding warm water, it started sinking into the warmer, less dense water. Even though this type of flow happens all the time within fluids, it is very hard to see due to it usually occurring within fluids of the same composition but at different temperatures. Something interesting that I observed in the flow was how straight the streams of cold water were once the initial disruptions from placing the ice cube in the tank died down. It was very difficult to place the ice cube into the water without causing it to bob up and down for a little, causing ripples and currents within the large tank of water. These ripples caused the dyed water to fan out and disperse a little bit more as the cold streams progressed downward, but once the ripples went away and the water was almost completely still, the streams of cold water were very straight and almost perfectly vertical. The reason that the streams were so straight was the lack of internal forces within the water. When the water is perfectly still, there are no forces acting horizontally on the cold water at all, and the only net force in the vertical direction is gravity. Because of this, the water goes almost straight down. Although this phenomenon is interesting from a physics perspective, I found that the photos of the flow when there were disturbances in the water were much more visually striking and interesting. These disturbances caused the flow to look almost like a jellyfish, with multiple streams coming from it and rippling out like tentacles.

To capture the flow, I needed to make sure there was plenty of contrast between the flow and the surrounding water. I used a food dye that I got from Target to make sure that the streams of cold water coming off the ice cube were clearly visible to the naked eye. The tank I used to hold the warm water was just a large Brita tank that I already had at home and repurposed for this setup. When putting the ice cube into the water tank, I first made sure that the water was calm so that the streams of cold, colored coming from the ice wouldn't get too distorted or dissipate into the water too fast. For lighting, I used a simple handheld flashlight as well as a

desk lamp covered with dark towels to ensure that the light was not bouncing off my camera causing a reflection in the clear plastic tank. To ensure that reflections were not visible in the photograph, I had to shoot at nighttime with all non-focused light sources turned off. This made sure that the only thing illuminated was the water within my setup so that there were no reflections.

In my final image, the camera is about a foot away from the ice cube. This is about the closest I could get to the object while still being able to hold focus, and I did this in order to get as much detail in the image as I could. The focal length of the photo was 41 mm, and I used an 18-55 mm lens. The image was shot on a Canon EOS Rebel T2i, and the original image's dimensions were 3456x5184. The exposure time I used was 1/125 and my ISO was 200. I didn't really mess with these settings too much because I figured that my shot looked pretty good without altering these values. I did not do any editing to the photo besides cropping it to fit within the required dimensions which resulted in a final size of 1300x873.

This image very clearly shows how the temperature difference of water causes it to flow. From the image, it is obvious that the colder, denser water is sinking to the bottom of the tank due to the difference in density. This type of flow happens a lot in fluids of non-constant temperature and is part of a convection current. Convection is a method of heat transfer within fluids in which cold parts of a fluid sink, and warmer parts rise, eventually causing the fluid to mix and reach equilibrium. I really appreciate how simple and easy to understand my photo is in relation to this effect. One part of my photo that I could work on is the focus of the flow. I feel that the focus was pushed too far onto the ice cube instead of the colored streams of water coming from it. If the streams were sharper, I think that would improve the overall quality of the image. To develop this idea further, I could possibly have an ice cube tied to a fishing line and submerged within the tank. This way, it would be even more clear that the cold liquid does not rise, and purely sinks within the warmer water.

I am very satisfied with how my image turned out, and I believe I chose an interesting yet simple type of flow to photograph. It was a simple setup, but it still took many attempts to get the outcome that I wanted, and I learned a lot about the process of visualizing flow. I hope that next time, I will have an easier time setting things up, especially figuring out the focus and lighting of the image.