Image/Video #1 Report

Ryan Flynn | MCEN 4151

For the first image assignment I decided to try to capture the natural draft of smoke from an unlit candle. I have always been fascinated by the physics of smoke and the serenity of laminar flow so my goal for this assignment was to try and capture that. The reason I chose this method of capturing laminar flow was because of how easy it is to replicate and perform over and over with similar results. This allowed me to focus more on the composition of the photo over the experiment itself.

This experimental setup was relatively simple to allow me to focus on taking a good picture. To achieve laminar flow from the wick I isolated the candle from any external breeze or drafts. This was crucial for capturing a smooth flow. Since I had to blow the candle out to produce visible smoke I had to allow the area around the candle to return to a steady state before taking a picture. After blowing the candle out, I waited until the smoke flowed from the wick naturally to capture the laminar flow. This natural draft is caused by the differences in temperatures. The air surrounding the candle is significantly cooler than the smoke being produced. These differences in temperatures cause the density of the smoke to be significantly less than that of the surrounding air which is the driving force for the upward draft. The only forces acting on the gas are the force of gravity and the buoyant force given as:

$$F_b = \rho g V$$

Where ρ is the density of the air, g is acceleration due to gravity and V is the volume of the displaced air. While the smoke exhibits laminar flow for the most part, the smoke eventually becomes turbulent as it rises due to the smoke cooling and other external forces.

This image was captured just by using the smoke from an extinguished wax candle without any dye. The wax used in the candle is uncolored and only mildly scented. The background used was black construction paper supported by cardboard.

The camera used to take the picture was an iPhone 11 Pro without flash enabled. The only light used was direct natural sunlight, oriented parallel to the lens of the camera. Since I had limited control over the camera, this picture was taken within six inches of the wick of the candle to optimise the camera's ability to focus. Processing the photo included cropping, centring the candle in frame and slight adjustments to the contrast using Apple's built in features. Exposure specifications below:

Shutter speed	1/30 sec
Aperture	f/1.8
ISO	800
Focal length	4.25mm

Although this image does a good job illustrating laminar flow from an extinguished candle I wish I would have been able to capture this image with a better camera. I struggled a lot trying to get the iPhone to focus properly and ultimately compromised with a lesser quality photo. The other major thing I would change would be the background and lighting. In my setup, I had trouble with light reflection off of the background which I believe could be minimized by the material of the background and the angle that the light hits it.