Getting Wet

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Flow Visualization: 4151-4200-001

Intro

The image depicted below displays one instance in time of the dissolving food coloring and sugar from skittles. The purpose of the video was to demonstrate the different characteristics of flow phenomenon within fluid dynamics. This report documents the different phenomenon that may have occurred to produce the observed fluid flow. The figure below shows the point at which the flow stopped.

Figure 1: Screen-capture at 14.11s of edited video

Set Up

The set up consisted of one bag of skittles, a measuring cup, a small white plate, water, a funnel, and a GoPro camera with a tripod mount. The experiment took place on a level, black top table with a plain white wall background, inside, lit from the natural sunlight through a window to the right of where the video was shot. Although the GoPro isn't capable of zoom, the video was shot using a medium range angle, an angle between normal and wide lens, making the set-up appear further from where the GoPro was placed.

Figure 2: Screen capture of initial set-up after water was poured at 3.77s of edited video

A GoPro 5 black was mounted next to the plate, and angled down as to not make the tripod legs visible in the shot. Physically the camera was 5 inches from the lens to the center of the plate. Skittles were aligned along the trough of the plate. Twenty-five skittles (five of each color) were strategically placed to ensure each color was separated and not within three skittles of the same colored skittle as seen above in figure 2. The camera was in normal video more, shooting at 2.7k at 60 fps.

Experiment

Cold water was poured through a funnel at the center of the plate. Unfortunately, enough water was not poured to dissolve to the center. As seen in figure 3, the pour was not being dispersed at the center of the plate, although this was the intention. The flow reached an equilibrium and I was not sure if the colors would continue to mix as they appeared still. Extra water was poured at the end to force the colors to mix. Although it is slight, the plate is crowned, with the skittles sitting in the trough of the plate, and the center of the plate slightly higher than this trough. This is perhaps the reason why the colors dissolved to a certain concentric height along the plate.

Figure 3: Screen-capture of water being poured aimed at center of plate at 3.28s of edited video

Flow

Water stratification is how different masses with different properties create barriers that you see among the colors of the candies (Skittles Science). This may be one reason the colors don't mix. This phenomenon depends on each colored skittle having different compositions with how its dyed. However, other sources state that since each skittle has the same amount of food coloring being dissolved. This would suggest that the concentration of the color spreads out similarly and don't mix since there is no change in density gradient.

The color gradients flow dispersion appears to vary from skittle to skittle. Several aspects can be factored in to affect the flow shown. The skittles may react differently dependent on the color of their neighbor skittles. The plate may not be concentrically uniform. Water poured at the center of the plate may not contacted each skittle equally, starting the dissolve of certain skittles before others. The skittles themselves can have imperfections on how the food coloring is concentrated. Dissolving of the bottom of the skittle is not uniform.

This experiment has been performed several times in the past and each experiment has unique results of how the colors dissolve and how the skittles are arranged and on what surface. Experiments differ with set-up and several factors (as stated above) may dictate how the final flow captured appears. From this, we can assume that even the same set-up repeated may yield varying results.

Figure 4: Screen capture of original video at 1:32.16s

Post-Processing

The total length of the video was 1 minute and 46 seconds. The video was cut and sped up (5x) to ensure the viewers would show the important parts of the flow, as the process was slow. An upbeat remix from Soundcloud was uploaded to match the speed of the sped-up video, aligning the beat with when parts of the flow would change states. The video was edited using the GoPro Studio video editing program. A title was added at the beginning to introduce the experiment.

Figure 5: Screen capture of flow after additional water was added at 18.42s of edited video

After reviewing some of the critiques in class, it was suggested that the speed of the video may have been too quick, especially for the end of the video when additional water was added. If I were to

edit the video again, I would only speed up the section of the video after of the water was poured until more water was added. This is the only part of the experiment that would require the speed up. Additionally, I would slow down the end of the video from the original speed to see how the addition of water forces the mixture. Running the experiment twice to ensure the correct amount of water poured initially could also fix the intended experiment as I wanted the flow to dissolve to the center. This could also be fixed and manipulated using a different plate and surface. An eyelash ended up falling onto the plate, and I did not want my hand to extract it out during the experiment as this would have been distracting in the video. Framing could be adjusted so the camera was angled in such a way that the entire background was one uniform color.

Conclusion

All in all, I learned a lot from the experiment, both in the execution and post-processing of the video. Many of the critiques I received both encouraged the set-up, framing, and experiment itself. I received the most critical feedback regarding using better music that fits the video better, as well as comments on lighting. I will lookout for ensuring my next images/videos obtain this standard. The video was necessary as I believed a photo didn't quite capture the observed phenomenon. However, unlike a still image, much more editing finesse is required to produce a video.

Sources:

Skittles Science Activity for Awesome Candy Science Experiments!" Little Bins for Little Hands, 14 Feb. 2018, littlebinsforlittlehands.com/skittles-science-activity-candy-experiments-for-kids/.