

Using UVC Light as an Effective Form of Sanitation

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ABSTRACT

Our goal is to manage disease outbreak by using UVC light as a new, efficient yet effective form of sanitation. It is important to find a way to successfully clean commonly touched/used surfaces multiple times a day to reduce the spread while helping to maintain good public health.

- What we've achieved:
 - Research about the spread of COVID-19
 - How to inform the public about UVC light as a form of sanitation
 - Created a prototype of a handheld UVC sanitation device

INTRODUCTION

WHY USE UVC LIGHT:

- Shortest wavelength (<280 nm) compared to UVA and UVB allowing it to be highly effective in killing superficial bacteria¹
- An environmentally friendly and affordable alternative to disinfection and disease prevention^{1,2}
- Human DNA has a maximum wavelength near the max UVC light absorption, allowing for UVC to have greater germicidal efficacy than UVB or UVA⁵

OUR MISSION:

- Create infographics to spread the word to local communities on this new idea of sanitation
- To develop an easy-to-use sanitation wand
- Expand ways to safely implement this to common areas such as:
 - Hospitals
 - Schools
 - Airports and Airplanes
 - Hotels
 - Grocery Markets and Restaurants
 - Entertainment Sites

CITATIONS

¹CDC. 2020 Feb 11. Community, Work, and School. Centers for Disease Control and Prevention. [accessed 2021 Apr 30]. <https://www.cdc.gov/coronavirus/2019-ncov/community/disinfecting-building-facility.html>.

²Couto E de A do, Calijuri ML, Assemany PP, Santiago A da F, Lopes LS. 2015. Greywater treatment in airports using anaerobic filter followed by UV disinfection: an efficient and low-cost alternative. *Journal of Cleaner Production*.106:372–379. doi:10.1016/j.jclepro.2014.07.065.

³Schaffzin JK, Wilhite AW, Li Z, Finney D, Ankrum AL, Moore R. 2020. Maximizing efficiency in a high occupancy setting to utilize ultraviolet disinfection for isolation rooms. *American Journal of Infection Control*. 48(8):903–909. doi:10.1016/j.ajic.2020.05.004.

⁴Visible-to-UVC driven upconversion photocatalyst sterilization efficiency and mechanisms of β -NaYF₄: Pr³⁺, Li⁺@BiOCl with a core-shell structure. 2021. *Journal of Environmental Management*. 288:112394. doi:10.1016/j.jenvman.2021.112394.

⁵Welch D, Buonanno M, Grilj V, Shuryak I, Crickmore C, Bigelow AW, Randers-Pehrson G, Johnson GW, Brenner DJ. 2018. Far-UVC light: A new tool to control the spread of airborne-mediated microbial diseases. *Scientific Reports*. 8(1):2752. doi:10.1038/s41598-018-21058-w.

METHODS/TIMELINE

SCI 150:

- Preliminary research on the spread of COVID-19
- Brainstormed solutions

SCI 200:

- Created an infographic
- Created a scientific poster
- Met with a professional

SCI 250:

- Created 5 more detailed infographics
- Made a prototype

RESULTS

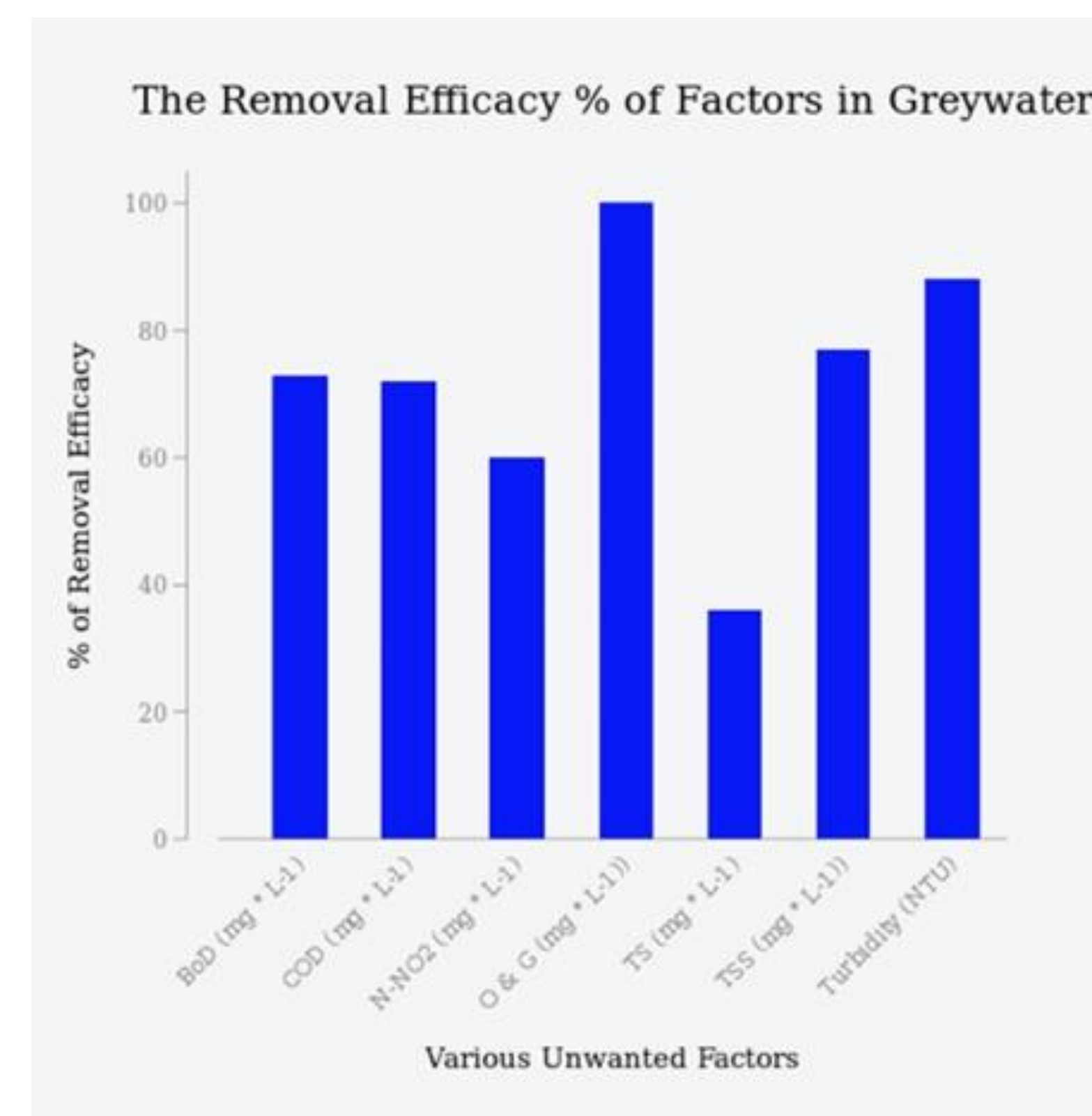


Figure 1 (Above): Image from our poster (The Effects of UVC Light as a Form of Sterilization in Multiple Settings), explaining the removal efficiency of various unwanted factors within greywater in airports in mg/L⁻¹.²

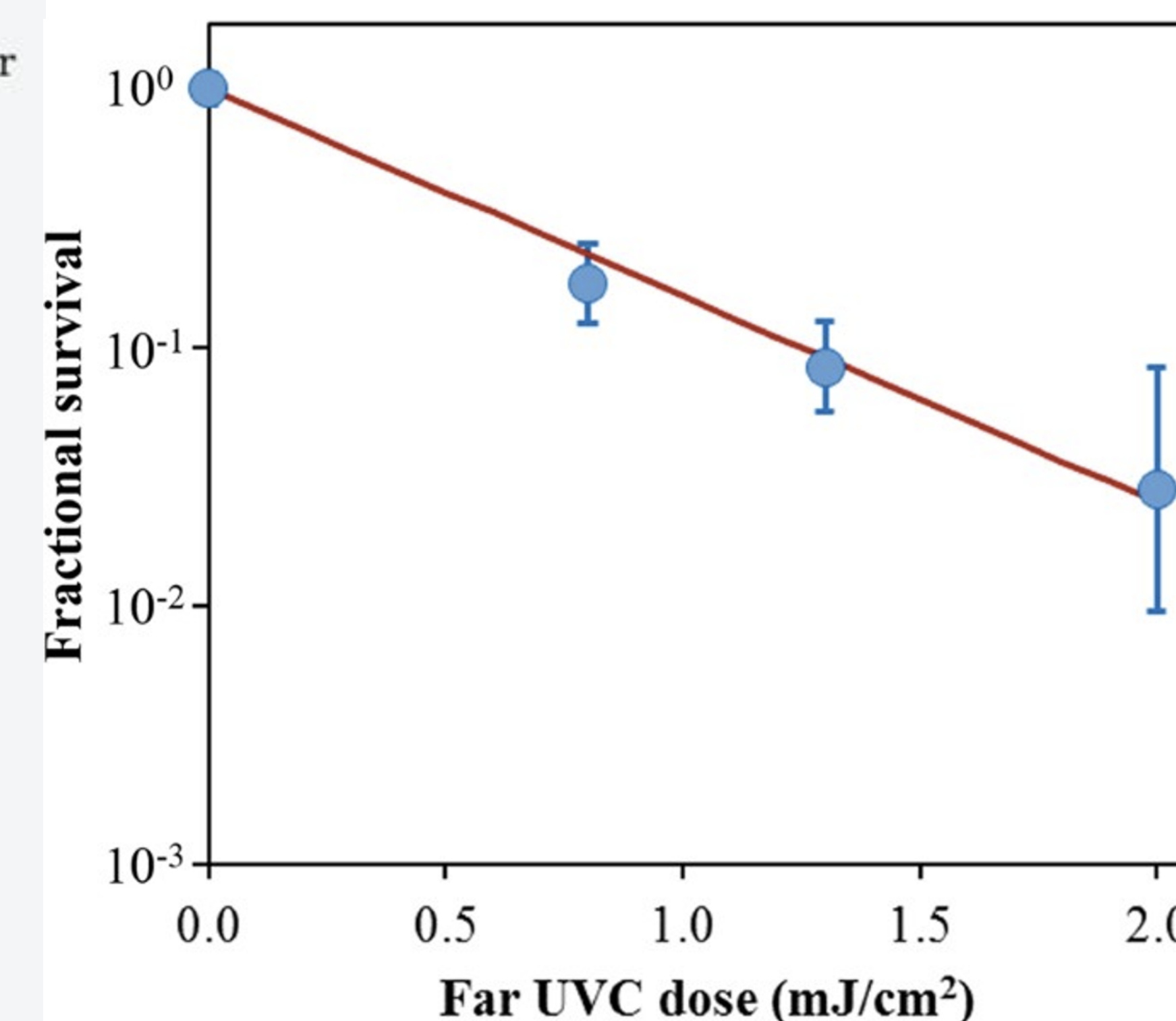


Figure 2 (Above): Image from our poster (The Effects of UVC Light as a Form of Sterilization in Multiple Settings), showing the fractional survival of bacteria based on the quantity of UVC dosage.⁵

CONTROLLING SPREAD OF DISEASE WITH UVC LIGHT

WHY UVC LIGHT?

- FAST
- EFFICIENT
- MOST GERMICIDAL

MORE ABOUT UVC LIGHT:

- EFFECTIVE IN MICROBIAL CONTROL
- CAN BE USED IN MULTIPLE SETTINGS (LIKE BIO LABS AND MEDICAL FACILITIES)
- MUST BE HANDLED WITH CARE

Figure 3 (Above): Created infographics to be shared with local communities about our topic.

WHAT WE'VE LEARNED

- How to build a prototype
 - Using Thingiverse and learning more about 3D printing
- The components of a UVC light strip
- The approval process it takes for infographics to be posted in local cities
- Effective ways to inform the public of the benefits of UVC light as a disinfectant and sterilization method
- How to create a scientifically based poster regarding the efficiency of UVC light
- Foundational layouts to implement UVC sanitation into target areas
- What measures it would take to implement UVC light in specific locations
 - Safety precautions of using this new form of sanitation in common areas

CONCLUSION

Our finished prototype would help many businesses efficiently disinfect and clean commonly touched surfaces. Using UVC light is a convenient way to reduce bacteria and viruses in overpopulated areas. Through our grand challenges initiative, we learned a lot about the knowledge of UVC light and its use¹. We also learned about the spread of common bacteria and viruses, specifically how fast COVID-19 spread and how UVC light as a form of sanitation will help reduce spread². In the future, we hope to run multiple experiments on a variety of surfaces such as door knobs, countertops, and chairs, testing our wand's effectiveness and how long it would take to disinfect our targeted surface. We will then compare our findings to other people's research³. We would also like to have our infographics posted and spread around our local communities such as Orange, Anaheim, and Santa Ana.

ACKNOWLEDGEMENTS

We would like to give a huge thanks to Dr. Harrison for helping us fund our materials, to Dr. Gray to help gear us toward the right direction despite COVID, and Mr. Ing for helping us learn about how our infographics can get approved so we can implement and share our infographics in cities.



Figure 4 (Above): Thingiverse UVC light prototype created with a 3D printer in the GCI Maker's Space.