Reinventing the Toilet

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Abstract:
The most significant issue with modern toilets is their consumption of water. The average household toilet uses nearly 25,000 gallons of water per year. Vacuum toilets were explored as an option and it was found that they use 12 times less water per flush. Vacuum toilets also spread significantly less disease than conventional toilets. The main barrier to the implementation of vacuum toilets is cost. Through calculation it was found that the savings in water cost would offset this investment within the toilet lifespan. To unveil other potential barriers to their widespread adoption, a survey was conducted among college students. It was found that the knowledge level surrounding vacuum toilets was low. A website and brochure were then constructed to share the benefits and drawbacks of vacuum toilets. These mediums will hopefully convince more individuals to invest in vacuum toilets due to their environmental and long-term cost benefits.

Introduction:
The average conventional gravity toilet uses up to 6 liters of water per flush (Stauffer 2019), and a household averages 69 gallons of water a day, or roughly 25,000 a year just in toilet water (Deoreo and Mayer 1999). Almost all of the water used for a single flush is wasted. Another drawback of a flush toilet is the aerosols that are produced during the flush. These contain bacteria and viruses that spread disease. Vacuum toilets are much more sanitary than a flush toilet since far fewer aerosols are released during a flush (Li 2020). Vacuum toilets are commonly used in transportation settings such as airplanes, ships, and trains, but some can be found in households. These toilets, while having a high initial cost, use only 0.5 liters per flush and the cost of the water saved recoups the initial investment (Jenssen 2002). The initial cost and high noise level during a flush are big factors for why vacuum toilets are not currently in widespread residential use.

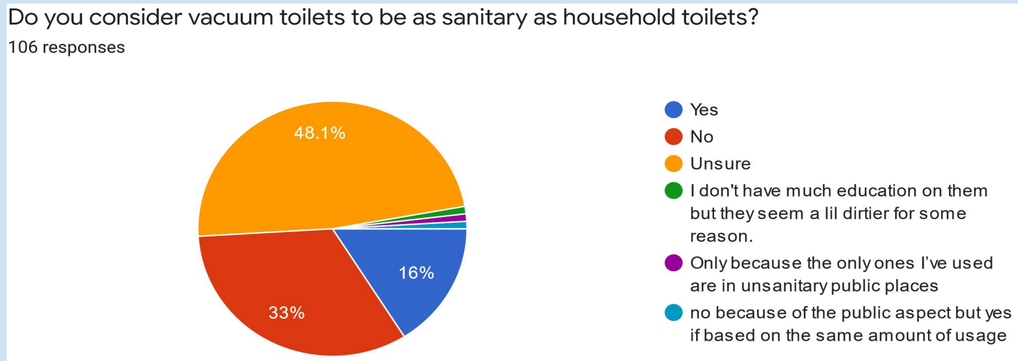
Methods and Solution:
The goal of this project is to create an educational campaign to spread the knowledge of the benefits of vacuum toilets.

SCI 150
- Wanted to tackle toilets' water usage, as well as the problem of aerosols released by toilets
- Eventually concluded on vacuum toilets because they had low water usage and reduced aerosols
- As COVID-19 started to affect our project, we decided to do a survey in SCI 200

SCI 200
- The research we had done was used to conduct a survey about students' general understanding of vacuum toilets. The survey results would indicate our next steps
- The survey results showed that we should do an education campaign to increase the knowledge level of vacuum toilets

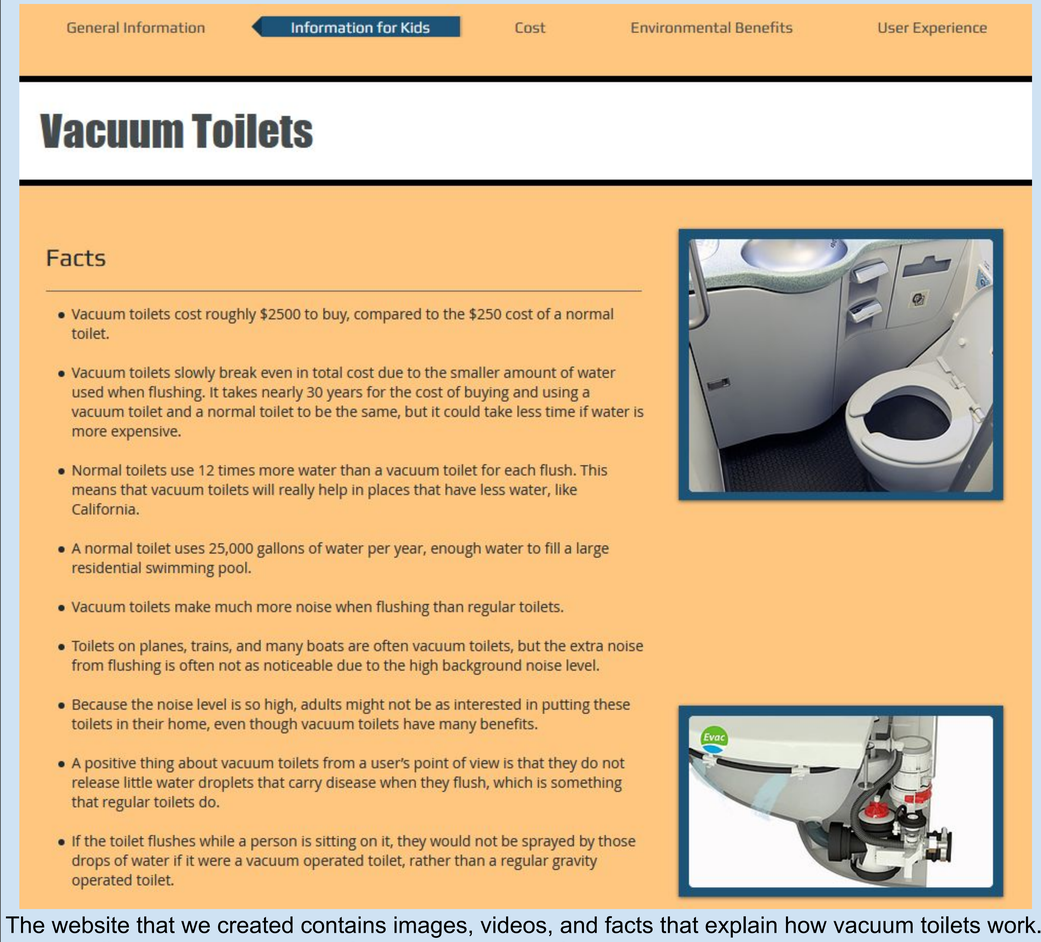
SCI 250
- Made a website with all of our compiled research on vacuum toilets such as cost, environmental benefits, and user experience
- Made a brochure to distribute around Chapman University as a physical medium with the link to the website for more information

Results:



A survey of Chapman students was conducted in November 2020 to determine the knowledge level surrounding vacuum toilets. The above question was indicative that the knowledge level surrounding them was low and that a website with information about vacuum toilets would be beneficial.

https://vacuumtoilet.wixsite.com/vacuumtoilet



The website that we created contains images, videos, and facts that explain how vacuum toilets work. Additionally, it descibres the benefits and drawbacks of vacuum toilets.

Conclusion:
Through the use of our survey in SCI 200, we found that Chapman students did not fully understand the benefits of vacuum toilets. Because of this, we made a website outlining all of the main benefits as well as the drawbacks of vacuum toilets. Due to the website being an accumulation of all of our research for the past three semesters, it allows our project to be a stepping off point for anyone that wishes to push this grand challenge even further.

Acknowledgements:
Throughout our GCI project, we learned a lot about our grand challenge from different websites such as sswm.info and evac.com. These websites look in depth at vacuum toilets and specifically at their benefits. We also believe a great source was our meeting with Andrew Whitesell, an expert on vacuum toilets, in SCI 200. He gave us multiple paths we could take with our project moving forward. Additionally, we would like to thank our GCI professors, Dr. Welles, Dr. Ng, Dr. Gormally, and Dr. Zhang for their help and support on our project.

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