LUNA: Accessible Water For All

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Global Water Issue:

One of the biggest crises of the world is the lack of access to clean water for everybody. It has been estimated by the Center for Disease Control that about 35% of the world's population has no access to clean sanitary water (1). Unfortunately, this is a huge issue worldwide that a college project team could not fully tackle. We decided to narrow our focus instead to a specific water contamination problem and region. While researching for inspiration, the Flint Water Crisis caught out hearts and attention.Our group decided to focus on this public health issue as our challenge. We were inspired to create a water filter product to help combat the contaminated water issues at Flint. Our vision is to produce an affordable, accessible, and reliable water filtration system that can adapt to any water bottle, sink, or any other household nozzle.

Our Story:

Coming together during the second semester of our freshman year we were all compelled by the challenges people face across the globe with a lack of access to clean water. Water is one of the most basic human rights that people need to survive, our team decided to attempt to tackle this challenge and create our own design for a low cost water filtration system. We were especially inspired by the situation in Flint Michigan where the entire city was affected by heavy metal contamination into the city's main water system. As a group, we came together and decided to focus on three main sections to solving this problem: designing, testing, and education through the use of social media.

Design:

Beginning the design process, our main goal was to be able to provide users with an affordable, efficient, fast, and safe alternative to drinking heavy metal contaminated water. This is why we chose to complete our design using a 3D printer as they can be produced anywhere in the world that has access to one, or they can be mass produced and then distributed worldwide. Taking a deeper look into the design process, we used our background knowledge in 3D modeling to create a 3 piece design for our water bottle. This includes an insulated water container, a bottle cap, and a filter holder. The filter holder is able to be screwed into the bottle cap which is then put together with the container to create a fully functional water bottle. The last step is then to add the filter mixture within the filter capsule. The filter is inspired from fish tank filtration methods with the main filter being granular carbon, and pellet beads to increase filter surface area

Materials:

PLA Filament (for 3D printing)
Granulated Activated Charcoal
Plastic Beads
3D printer
Spectrophotometer
Control and Variable samples for testing water
Coffee Cup Filter
$FeCl_3$ - imitation of heavy metal contaminant

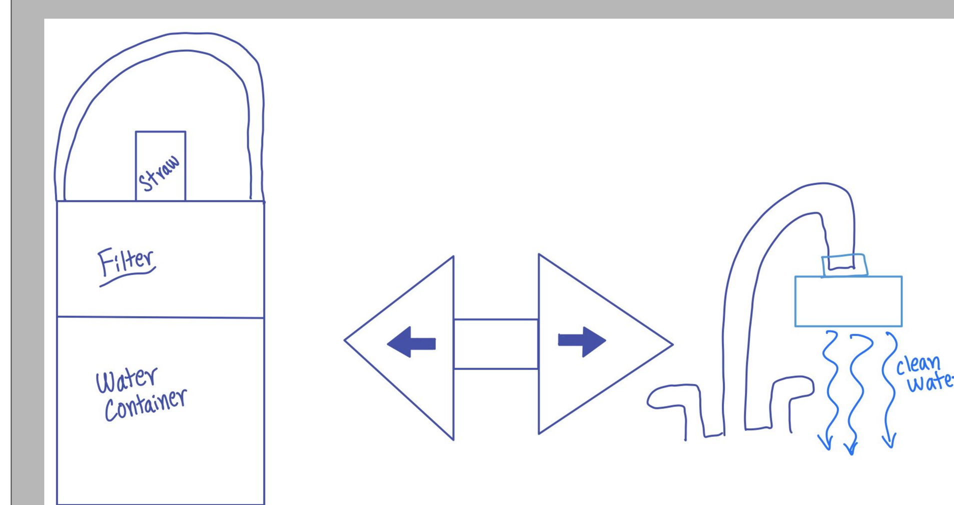
Methods:

For our testing process:

1. assembled our filter in layers. From top to bottom: the 3D printed filter container, coffee filter paper, granular carbon, pellet beads.
2. Created a stock solution of 0.1 M $FeCl_3$ as an imitation of a possible metal contaminant.
3. We took the absorbance of the stock solution and the absorbance of the filtered solution to compare and analyze how well the filter worked.

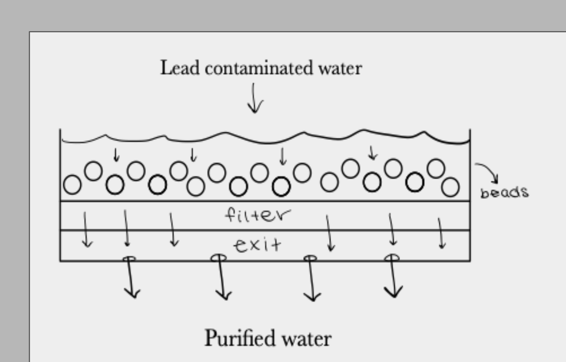
Timeline in Pictures:

Original Sketch

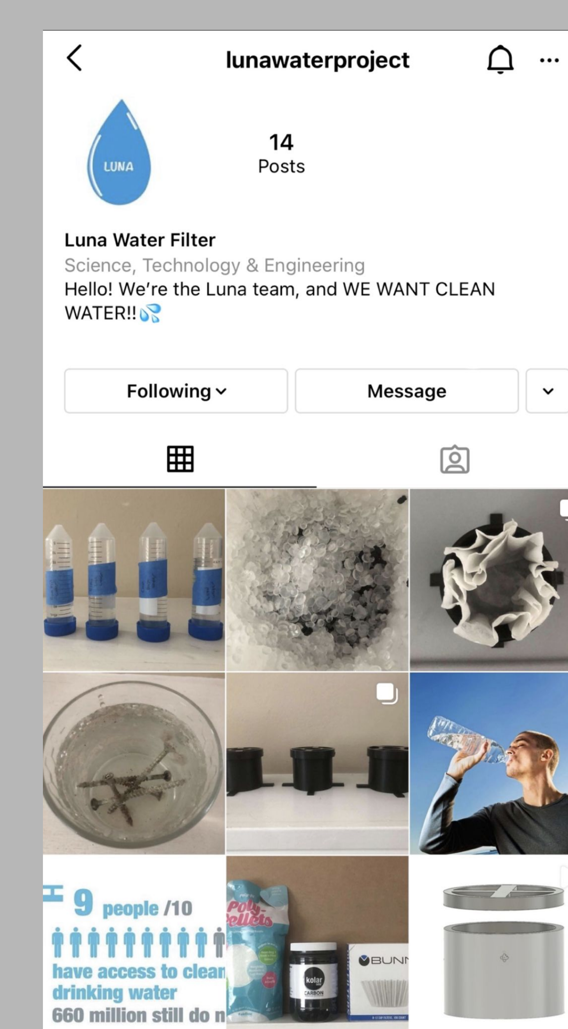


3D Designs

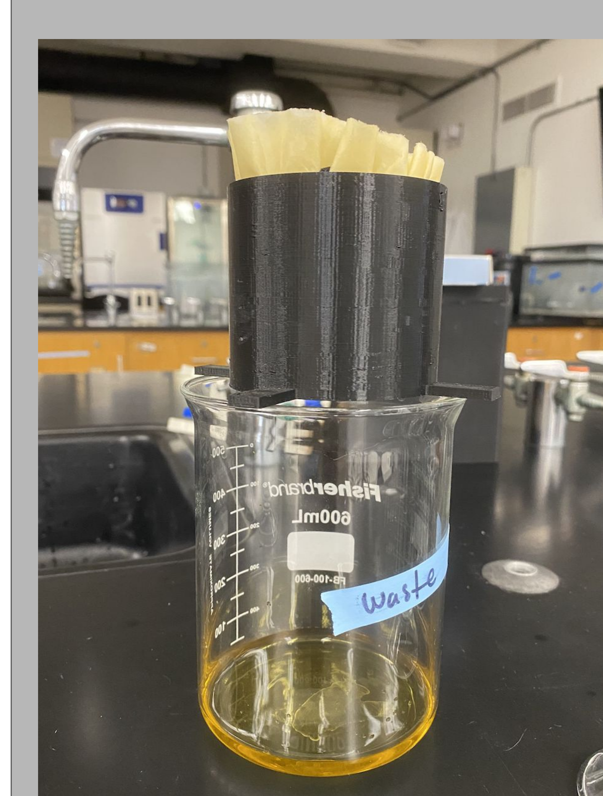
Our Filter



Social Media Page



Testing



Results:

Absorbance of Unfiltered Solution #1: 1.598
Absorbance of Unfiltered Solution #2: 1.532
Absorbance of Filtered Solution: 1.574
Color of stock: light yellow

As seen above, our testing process yielded interesting results. We utilized about 10 mL of ~0.1 M $FeCl_3$ as our contaminated solution.

Initial problems:

- Running the 10 mL through the filter - all of the solution was absorbed, nothing came through the other end.

Fix the Problems:

- Made more stock solution - 50 mL at ~0.1 M with an absorbance = 1.532.
- After running about 50 mL, took the absorbance of our filtrate = 1.574.

This was higher than our second stock solution absorbance, and it can be concluded that the solution passed through the filter was more concentrated as well.

Errors:

- Higher concentration of filtrate:
  - carbon absorbing water from the solution and leaving a higher concentration of $FeCl_3$ to come out the other side.
  - systematic errors of not cleaning the filter properly between testing. If there was excess $FeCl_3$ leftover in the filter it could have added to the concentration of each solution run through the filter causing an increase in absorbance and contamination.
- Filter paper size:
  - paper filter was too big for the actual size of the printed filter.
  - This impacted the experiment because it absorbed extra solution at a disproportionate amount making controlling the filtration not possible.

Conclusions and possible plans for the future:

Unfortunately, the filter was not as effective as projected. The absorption levels between the unfiltered contaminated water, and the filtered water did not differ substantially. One possible cause of this could be that the activated carbon was not effectively filtering the water. This is likely because the paper filter was too big for the actual size of the printed filter; as a result, the water being filtered might not have been able to reach the activated carbon. Due to COVID-19 circumstances, we weren't able to complete multiple trials of testing for our filter. In the future, it would be beneficial to complete extensive testing on our filter.Also, for future experiments we would like to confirm our theory regarding the activated carbon's ability to absorb water from the $FeCl_3$ solution.

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