FRUGAL SCIENCE

OPEN-DEFECATION TEAM

"Redefining flushing: Vacuum-powered efficiency for sustainability."

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Source: Youth Ki Awaz

Problem

- Open defecation persists as a global challenge, predominantly in low-income and rural areas lacking sanitation infrastructure.
- This practice poses severe health risks, contaminating water sources and propagating diseases like diarrhea and cholera.
- Addressing open defecation requires a multifaceted approach that includes improving access to sanitation facilities, promoting hygiene education, and fostering behavioral change within communities.
- The Swachh Bharat Mission, launched in India, aims to eradicate open defecation by constructing toilets nationwide through extensive infrastructure development and awareness campaigns but it isn't successful.

Problem Analysis

The Government of India launched a Swachh Bharat Abhiyan Initiative in 2014, creating over 100 million toilets throughout the country by 2022, but the problem still persists, why?

Poor Maintenance	Lack of maintenance of toilets make them unusable. It can be due to a lack of connection to a sewage system, an ill-managed centralization, theft, vandalism, etc.
Poor Behaviors/Habits	Old habits die hard. It is difficult to start using toilets when someone has been defecating openly since childhood.
Water Scarcity	Lack of a proper source of water makes it difficult to maintain hygiene in a confined space of a toilet. There's no enough water to flush.
Lack of Education	Leads to lack of awareness and ignorance, causing the people to not be aware of the consequences of defecating openly.
Communal Indifference	Collective action problem and a lack of a sense of unity prevents people from coming together and taking appropriate actions for the benefit of all.
Conservative Beliefs	Some individuals may refuse to build toilets in their houses due to religious beliefs associating bodily waste with impurity or spiritual contamination.

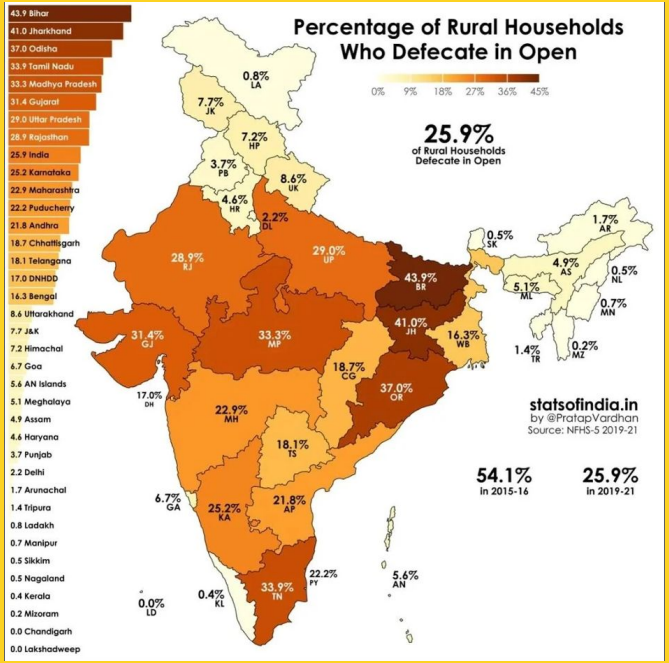
By the Numbers

01 80 toilets for 10 million women in Haryana.

02 Out of the 3.3 million children in Haryana, 10% died due to diarrheal diseases in 2011

03 India has 1.4 billion people and 800 million people lack access to safely managed sanitation services.

04 In 2020, over 200 million people defecate openly, risking the spread of diarrheal diseases, which kills over 600 thousand people each year in the country. The number was over 500 million in 2014.



By the Numbers

04 140 govt schools didn't have female toilets, affecting (increased dropout rate) 5000 girl children and 100s of female faculty. "Sources in the data collection team attributed the lack of maintenance of toilets behind the increase in number of schools without the facility. " (2017)

05 Cost of maintenance of a proper toilet: 1057 USD or ₹86,423.5 (Not an Indian Study though). So, the maintenance cost is more than building cost. (2021). And, so the toilets get abandoned after being built.

06 6.67 billion kg of feces is produced each year by 57% of the global population that has a safely managed sanitation service (SMSS). 507.5 million kg of feces go untreated in a day. (Almost 1/12th).

By the Numbers

07 9.9% of deaths in India were due to diarrheal diseases in 2017.

08 **Assumption:** a toilet requires at least 20 X 20 inches of area. Not having one leads to a huge land getting contaminated

09 **Assumption:** If it takes a person 15 mins to use toilet, then in a day where it is used for 8 hours, 32 people could use it. In such a case, the toilet requires frequent maintenance.

10 In Haryana, each of the 17 wards of a village, 10-15 houses don't have toilets. So, 170-255 houses don't have toilets. That could be 510-765 people, **assuming** that each house has 3 people.

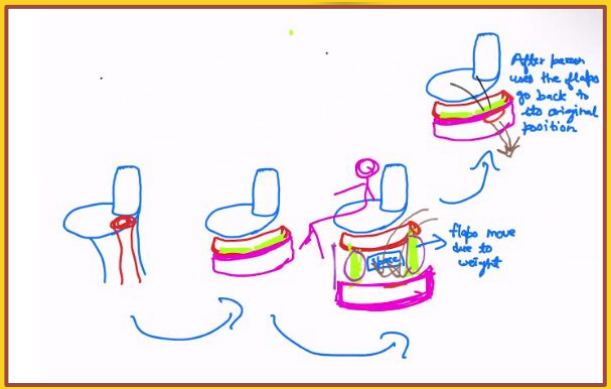
FRDPARRC

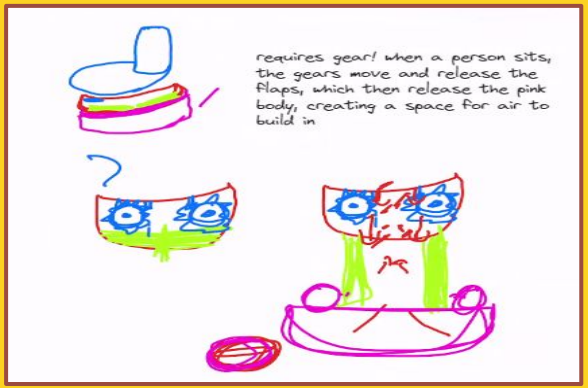
Functional Requirements	Design Parameters	Analysis	Refernces	Risks	Countermeasure
DESIRABLE & CONVENIENT	Clean and Maintained (Better flush) Rewards Awareness		Link 1	Privacy	Education
COST	Cheaper Build from recycled material				
EFFECTIVE	Should remove odour Should clean properly Vacuum assisted flush	Design a weight assisted negative pressure system	Link1		Material can be odor absorbing
SUSTAINABLE	Usage of less water (Vacuum assisted flush) Decomposing the waste using bacteria	Create a biodigester chamber that decomposes waste	Link 1 Link 2		

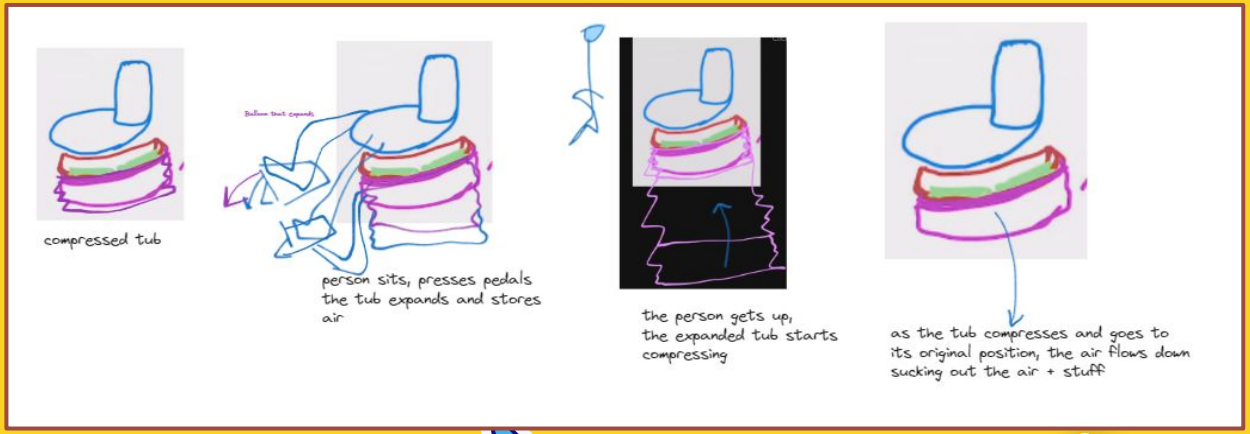
Our Focus Area

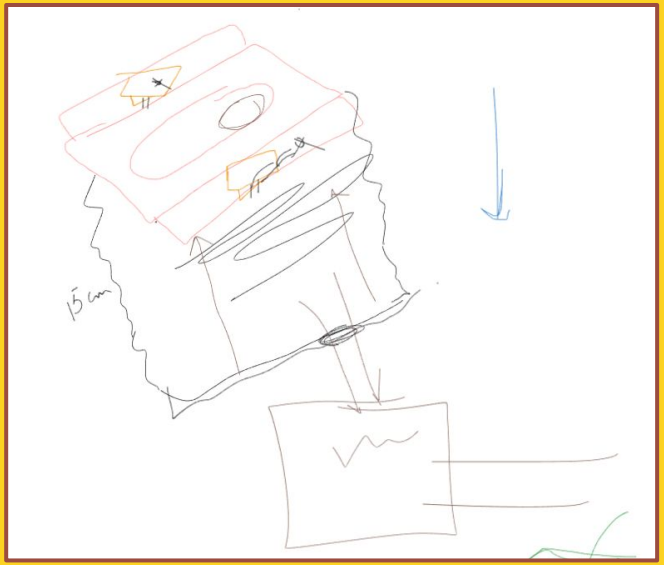
Design a weight-assisted vacuum system that produces negative pressure and can be used as a water-less flushing system for an “automatic” maintenance of toilet.

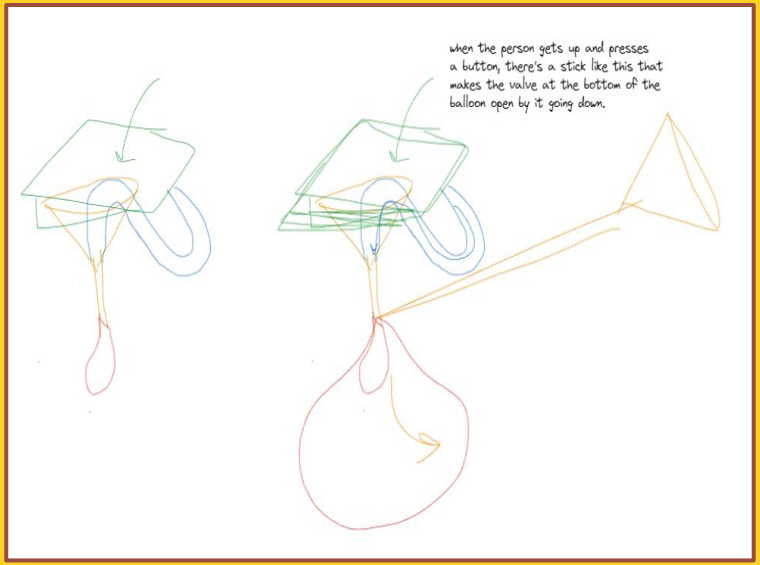
Experiment Design



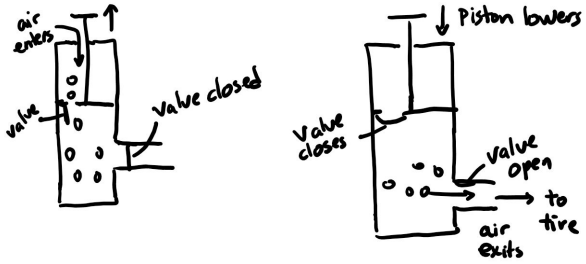




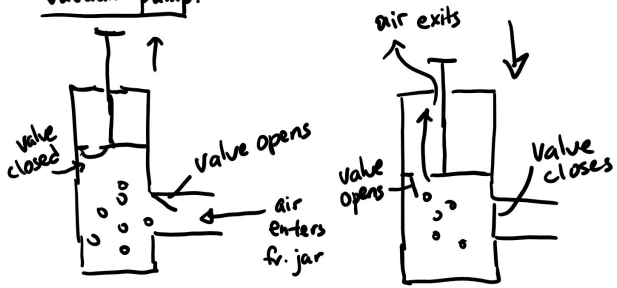


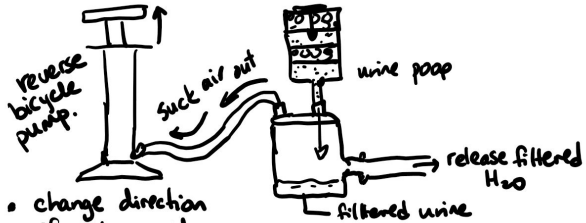

when the person gets up and presses
a button, there's a stick like this that
makes the valve at the bottom of the
balloon open by it going down.

Normal bike pump

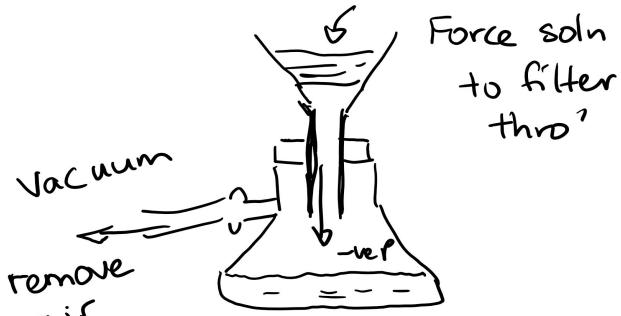


Vacuum pump.

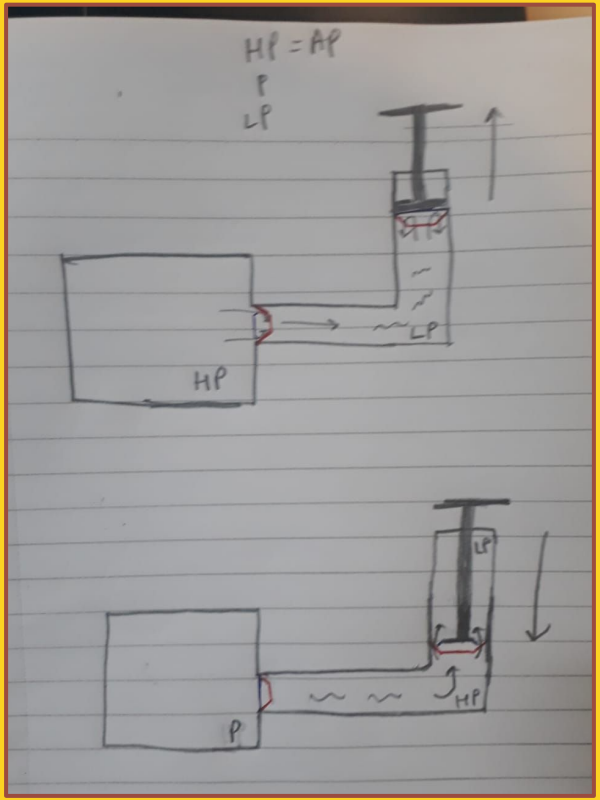




- change direction of valve inside
- can use hand/foot pumps



Prototype Diagram



MATERIALS USED

N95 MASK

SYRINGE

CONTAINER

INFUSION SET

Prototype

OBSERVATIONS

01 The chamber of the syringe became hot after 15-20 pumps.

02 With time it became slightly difficult to pull and push the piston.

03 The tube through which air passed turned white due to water vapours.

04 The body of the container became more rigid.

05 The balloon shrunk from 3.1 cm to 2.9 cm but then expanded back eventually after taking it out of the container.

LIMITATIONS / FUTURE SCOPE

01 The membrane used can be designed to stick to the valve better so that it is perfectly uni-directional

02 The tube can be thicker so that more air can be extracted out with less pumps.

03 A pressure gauge can be used in future to quantify the change in the pressure in the system

04 The negative pressure system will be connected to a filtration system + biodigester that separates solid and liquid waste and treat them.

Thanks!