

Hwa Chong Institution

Project Work

Category 3 Inventions Log Book

Title of Project: Water reusal project
Group Name: Across Borders
Group Members: 1) Boo Jin Xian 2) Zechariah Wong 3)Paxton Chng

1. Problem Finding

1 A Document a list of problems you have identified. Your documentation should show clearly how your group came up with the problems.

- Heat in Singapore
- Lack of water
- Too much waste
- Shoelaces being too difficult to tie/come out too easily
- The disabled
- Students are addicted to gaming
- School bags are too heavy
- Students often lose their belongings due to their carelessness
- Gases emitted from factories that are polluting the environment
- The blind
- Few people recycle their rubbish
- Nuclear waste

We came up with these through internet surfing, brainstorming and suggestions from our mentor. We also noticed problems in our surroundings, for example, students were gaming even during lesson time. I have also seen my classmates having to tie their shoelaces when it became loose. We were also inspired by our own problems, such as the heat in Singapore and our heavy school bags. We also had problems on a global level, such as global warming, causing huge problems to the earth where we live in.

1 B You should have selected a problem based on some considerations. Identify and justify these considerations.

1. Are we able to solve this problem?
2. How much is this problem affecting society?
3. Has this problem already been solved?

1 C List some problems your group would like to solve. List also the considerations for selection of problem in the evaluation grid below. Score the considerations, against the problems, with points 1 (least significant) to 4 (most significant). Sum up the total points for each problem. Identify that problem you would like to solve.

Problem Evaluation Grid

*add more columns and rows where necessary

Considerations for Selection	Problems		
	Heat in SG	Water shortage	Shoelaces
Consideration 1 Ability to solve problem	1	2	3
Consideration 2 How much this problem affects society	2	3	1
Consideration 3 How little this problem has been solved already	3	2	1
Total Score	6	7	5

2. Define the Problem (This is one...)

Now that the problem has been identified. It is important to gather information on the extent of the problem and/or evaluate the usefulness of existing solutions based on *some criteria*. You may need to conduct surveys and research on existing solutions.

2 A Extent of problem (Research and discuss the problem and write down the problem statement)

The reservoir in Johor meets half of Singapore's water supply needs, but because of the drought, water levels have fallen well below 40 per cent. Singapore is trying to reduce its per capita domestic water consumption from 151 litres per day to 140 litres by 2030, having brought it down from 165 litres per day in 2003.

The water price in Singapore is revised in two phases. The first phase took place on 1 July 2017 and the second revision on 1 July 2018. Heavy investments in water infrastructure, coupled with rising operational costs, have made the increase in water price necessary. The picture below shows the portable water price in Singapore:

Monthly Water Usage	Phase 1: From 1 Jul 2017		Phase 2: From 1 Jul 2018	
	Price (\$/m ³)		Price (\$/m ³)	
	0 - 40m ³	> 40m ³	0 - 40m ³	> 40m ³
Tariff	\$1.19	\$1.46	\$1.21	\$1.52
Water Conservation Tax (% of Tariff)	\$0.42 (35% of \$1.19)	\$0.73 (50% of \$1.46)	\$0.61 (50% of \$1.21)	\$0.99 (65% of \$1.52)
Waterborne Fee	\$0.78	\$1.02	\$0.92	\$1.18
Total Price	\$2.39	\$3.21	\$2.74	\$3.69

Note: Water is charged per cubic metre (m³), which is equivalent to 1,000 litres. All figures are before GST.

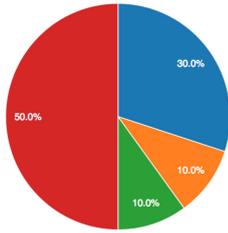
(Source: PUB, 2018)

Singapore currently imports 50 percent of its water from Malaysia. 30 percent of the water supply in Singapore is met by recycled water.

The government has been upgrading our water system to make it more resilient, especially to face the challenges posed by climate change. The revised water price will enable PUB to cater to future demand, strengthen Singapore's water security, and continue to deliver a high quality and reliable supply of water. The water price goes towards meeting the cost of water treatment, reservoir operations, NEWater production, desalination, used water collection and treatment, as well as the maintenance and expansion of the island-wide network of water pipelines. It also includes the Water Conservation Tax, which is imposed on the potable water tariff. The WCT reinforces the message that water is precious. This tax is also to reflect the full incremental cost of producing more potable water (likely by desalination and NEWater) beyond PUB's present output, so that consumers are conscious of the scarcity value of the water they use. Therefore, water is essential and we should try every way to conserve it. Furthermore, in countries that were more constantly hit by droughts, car washes had limited hours or were shut down during times of intense drought. Therefore, water is essential and we should try every way to conserve it.

Since the advent of automated washing, water use inside tunnels and bays has become an issue of concern. As cities have grown and populations have become more concentrated, some states and municipalities have even fought court battles over water use and control. In the past, car washes had limited hours or were shut down during times of intense drought. But these concerns have lessened as more and more washes adopted efficient and economical water reclaim and recycling systems.

Survey on perceptions of water usage



(Pie chart explanation below)

- According to the survey we did to find out how students thought about the water that is used to wash cars, 50% of the students who took the survey believed that water used for showering accounts for the most amount of water wastage.
- 30% of the students believed that water used to wash cars wastes the most amount of water.
- 10% of the students believed that water used for brushing our teeth wastes the most amount of water.
- The other 10% of the students chose “others”, stating things like how “mopping the floor wastes the most amount of water”, or stating that “drinking” water causes a deficiency in the water supply drastically.

2 B Compare and contrast the existing or similar solutions.

Some car washes do not recycle water at all. While, some car washes do, in fact, recycle water. However they only use it in the early rinses and to mix with the detergents. This helps to cut down on water usage, but still a lot is used.

According to <https://auto.howstuffworks.com/car-wash10.htm>, a car-wash facility (without a high-pressure wash) averages less than 45 gallons (171 L) per car. That is still way over 100 litres!

Hence, we realised a lot is still wasted and that something had to be done. We decided to recycle more water including the soapy water in an effort to save the environment and the world that we live in.

3. Your BIG IDEA#

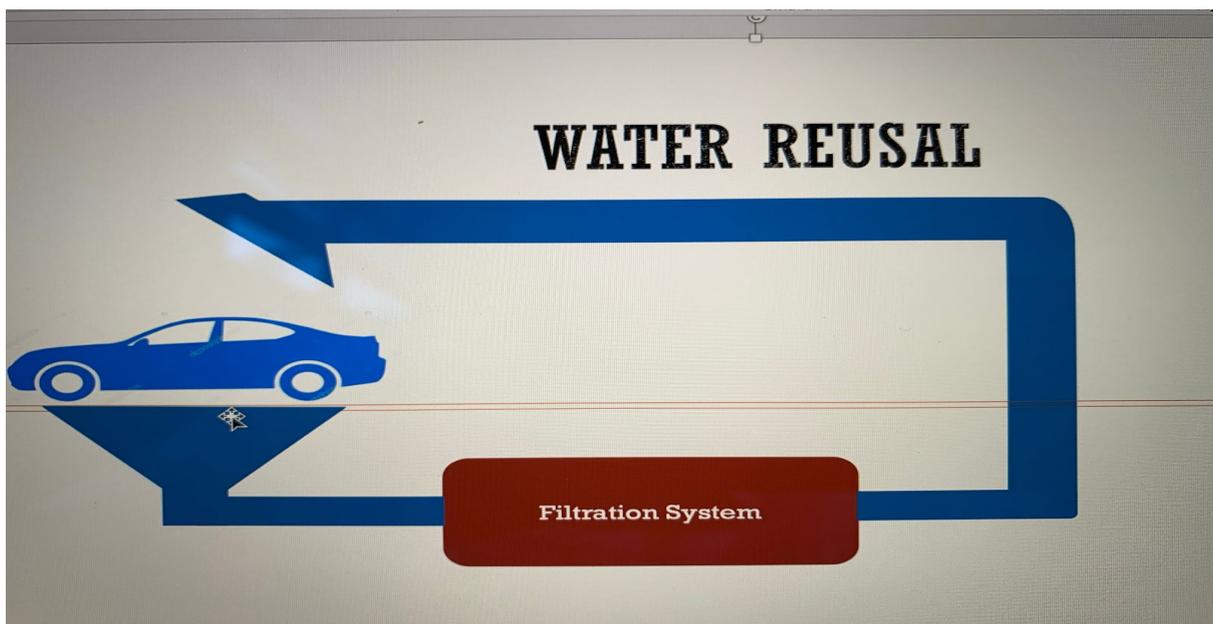
(Developing the idea....)

Write down your proposed invention and why you want to do it. State also how you think your proposed invention is better.

3 A Describe your proposed invention.

As water is a major world wide problem, we decided to recycle water. We considered which areas of water reusal were not We made a simple sketch to show how it would look like.

The sketch is below:



Our proposed solution is a car wash water reusing system able to reuse water and filter out dirt and soap. It would be able to reuse most of the water and keep the water usage to a minimum.

We changed the design a bit to come up with our current design. With research, we learnt how to create the car wash reusal. Though it requires much technology and money, we believed that we could do a small scale prototype.

3 B Explain the purpose of your proposed invention and the potential benefits to users.

Not only will this benefit the car washing companies, the government officials will also benefit. Although some money has to be put into building this project, in the long run, the company will be able to save the money as they do not have the need to spend as much on water supply. Therefore, the company will still make some profit and at the same time conserve the use of water.

The government officials are also benefited from this, because with a great amount of water conserved, the government would save some money.

3 C In what ways would your proposed invention be different and/or better than existing solutions, if any?

It will be able to reuse most of the water in an efficient way.

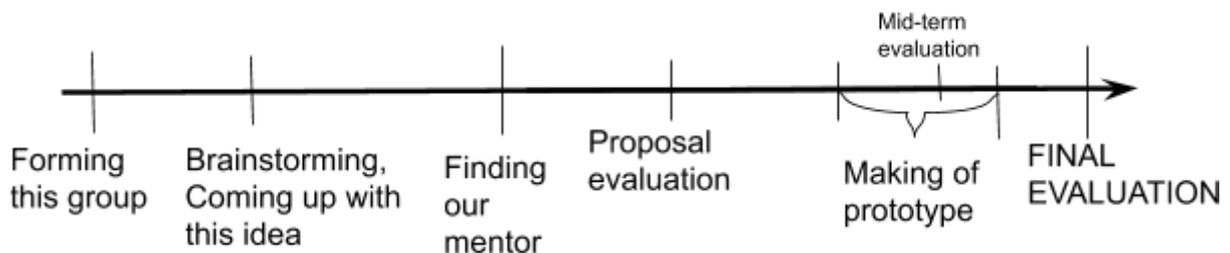
-We did think of how water filters are already existent, but these water filters filter water for drinking water, such as industries like the NEwater.

- There are machines out there that are similar to our product, but they are unable to filter away the suds and only the water used to rinse the cars could be recycled.
- It has been commonly thought that water used to rinse off the suds on the cars is impossible to be recycled, so to change this train of thought and at the same time conserving water usage, we decided to implicate this project idea.

3 D What are some problems you expect in the course of your proposed invention?

It may be expensive and we may not have the technology to create a good filter. As soap is also a liquid, it would be hard to filter it out. The use of chemicals may also be dangerous and may be harmful to our health.

3 E What and when are the major milestone (project timeline) in your invention?



#must be able to be constructed based on current / emerging technologies, must not violate the laws of Science or go against the laws of nature.

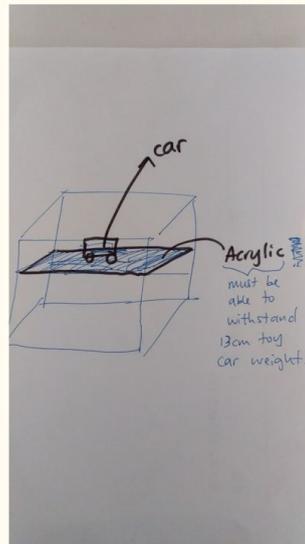
4. Construction or Modelling Process*

(This first... then that...)

You are now onto the fabrication of your prototype/ product. You need to select material and understand how to put them together so that your prototype/ product can perform its function.

4 A Explain how and why the materials were chosen for the prototype/ product of your invention

Initial layout



At this point, we have started on deciding which materials are to be prepared for the prototyping:

- Calcium Chloride= \$10
- Coarse Sand= Collected
- Fine Sand= \$5
- Gravel= \$2
- Pebbles= Collected
- Super-Activated Carbon= \$20
- Filter netting= \$2
- 3 pumps= \$30
- Toy car model= Donated
- Acrylic and PVC planks= \$30.50
- Tubes= \$2.80
- 2 Litres bottles= Donated
- Fish tank+Containers= \$8.80
- Funnels= \$2.90
- Tapes= \$4

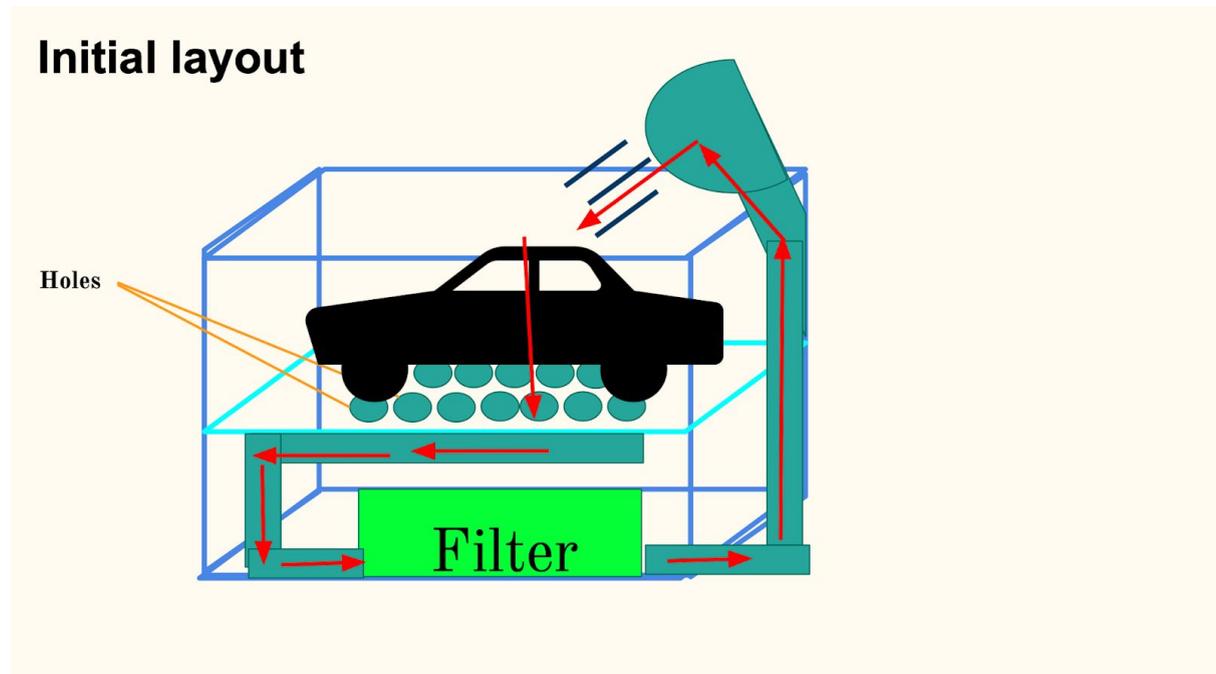
We used pebbles, coarse sand, fine sand, activated carbon, gravel, calcium chloride and containers to form the filters. The pebbles, coarse sand, fine sand, activated carbon and gravel would be able to filter out the solids, while the calcium chloride can filter out the liquid soap. We used tanks, pipes and pumps to make the system of the prototype.

A precipitate is formed when soapy water flows through the calcium chloride, and the precipitate can then be filtered by the filter netting, allowing it to be an effective way of removing soap from water. It is also a cheaper alternative compared to other filters such as reverse osmosis filter and UV filters. Hence, we decided to use calcium chloride.

4 B Explore these considerations that may guide the construction of your prototype/ product.

We must be careful when handling the calcium chloride, and we must not let our filter fall over, and also should try to make as little of a mess as possible when making the prototype and not spill fine sand all over the place.

4 C Document the prototype/ product development stages. You may use drawings, photographs or videos.



The initial layout was not feasible. This was because of the fact that the filter was planned to be underground, and by having to implicate a large system underground is very costly, so to reduce the cost of this product as much as possible, we decided to have the filter above the ground instead, which was implicated in our actual prototype. The most daunting task in this project was to plan the layout of the chemical process of the filter. This was because of the chemical reactions, and we had to plan how to separate the different chemical components before they came into contact with one another.

The first layout of the filter



As seen in the prototyping of the FIRST HALF of the filter, we decided to include Coarse sand, pebbles, Gravel, Fine sand, and Activated carbon. These materials are required to filter out the solid dirt. The FIRST HALF of the filter is a physical process and is not the complete filter.

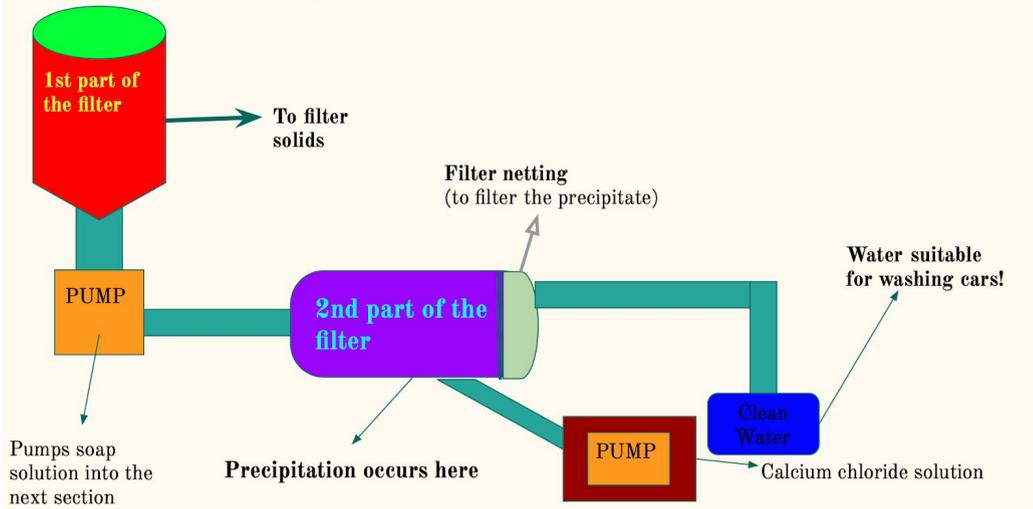
Prototype without filter



Modelling of filter



Our full filter layout



The full filter is as shown above. This diagram depicts the part where there were chemical reactions to remove the suds. Since calcium chloride reacts with the sodium bicarbonate and forms a white precipitate that can be filtered away by the thick filter netting, the water would be free from impurities after going through the whole filtration process.

OR

If construction of the prototype is not possible, then you have to create an animation / as a proof of concept that it can be applied in a bigger scale.

4A Explain why construction of a prototype is not possible and the proof of concept is needed in your case.

A car wash would be way too big to construct a prototype of, hence we had to make our prototype in a smaller scale. It would be too expensive for us to create an actual one, and we would also not be able to bring it into the classroom to show the judges. Hence, we had to construct a small scale prototype. **However, construction of a small scale prototype is still possible.**

4B Briefly explain how the video / animation can effectively show how your invention will work and the different considerations.

We can use our small scale prototype to prove its ability to function, hence this is not necessary.

Warning:

- Video / animated simulation only if prototyping is absolutely no possible.
- Video / animated simulation must be logical and convincing that the invention works.
- Constraints must be clearly included in the logbook or the project will be heavily penalized.

5. Modification and Evaluation

Upon the completion of your prototype/ product, you would need to see if it is working the way you want it to work. Check if your product has met the identified purpose and the user's need; and implement necessary modifications and improvements. This process may take several rounds.

5 A Write down your prototype/ product test criteria and check against it if it works. Identify areas of weakness for modification. Indicate the test iteration and date of test.

Test Iteration:	Tick			Remarks
	Pass	Fail	Potential Failure	
Test Date: 4 July 6 August				
Test Criteria 1 Does the water flow through the tank successfully?				
Test Criteria 2 Is water that comes out from the filter clean?				
Test Criteria 3 Is water able to go through the filter efficiently and quickly?				

*Add more rows for more criteria

** Repeat table for next test iteration

OR if you are creating an animation / video to show how your invention will work, write down the different possibilities / outcomes [success or failure) if a full-scale prototype is to be constructed.

6. References

Read <http://www.bibme.org/citation-guide/apa/> on how to cite references.

6 A Cite the references you have used for your project work. Your source of reference should come from different types (eg books, magazine, websites, journal articles, interview, photographs, product brochure, reviews etc.)

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