Tak Sun Secondary School
S.T.E.M.
Survival Kit for Disaster Preparedness
Water Filter Column

Science: Applying concept of different types of water impurities and purification methods

Technology: Using micro:bit for testing the turbidity of water

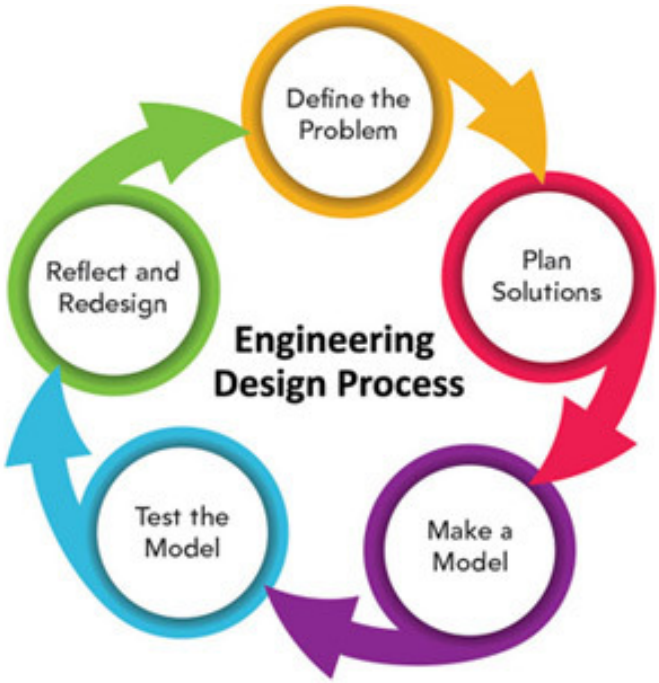
Water Filtering Survival Kit

Engineering: Design and implement a solution under constraints

Maths: Data processing in the measurment of turbidity

Engineering Design Process(EDP)

Engineering Design Process is used by most engineer to solve real-life problem. You will experience this process throughout this project.



Problem Definition

In this part, you should **ASK**: what is the problem to be solved.
You will know this from the CL lesson.

You may **ASK**: "what is the problem to be solved?". In the CL lesson, you have got the necessary information.

What is the problem?

Teacher Guideline:
Students can recall the answer from the CL ppt

(1 mark)

What are the expected outcomes?

Teacher Guideline:
Students can recall the answer from the CL ppt

(4 marks)

What are the constraints?

Teacher Guideline:
High order thinking
Knowledge constraint : HK Citizens, Easy to use, limited resources (e.g. microbit), limited knowledge (e.g. filtration bar, micro:bit, etc.)

(3 marks)

Mark for this page: _____ / 8 marks

Plan a solution (1)

Reflection of knowledge that might useful in the project

The following are what I know that might be useful to the project

IS Knowledge

☐ Water filtering concept learnt in Term 1

☐ Testing of water cleanliness by the turbidity

☐ _____

CL Knowledge

☐ Micro:bit programming

☐ light sensor

☐ _____

(2 marks)

Break down a big problem to smaller **sub-problems**.

I will break down the problem into the following parts:

1. Design and Making a water filter column
2. Design and Making a micro:bit tool kit for measuring the turbidity
3. Testing the filtering bar by using the micro:bit tool
4. Refine my water filter column based on my testing (repeat 2, 3 several times)
5. Create a video to teach the HK citizens to create the survival kit
6. Document my project in this logbook.

What is the advantage of the above planning process?

_____ _____

_____ _____

Teacher Guideline:
Students should appreciate the break down of sub-problem can help them to solve the problem easier / easier to manage a large problem

(2 marks)

Mark for this page: _____ / 4 marks

Plan your first solution (Water Filter Column)

My Design of the water filter column.
Choose 3 materials can be found in home for constructing the water Filter column. Explain why in drawing.
(Draw and Annotate with explanation)

Aim: _____

(To compare the untreated water and filtrate cleanliness by turbidity meter)

Independent variable: _____**(Different water samples)**

Dependent variable: _____**(Degree of filtrate cleanliness)**

Submission Date: _____

(You must submit this before starting to build your solution)

Teacher Guideline:
Effort in drawing in detail (10 marks) (7 is average)
Mentioning of materials (2 marks)
Quality of explanation (10 marks) (0 mark: no explain; 5 marks: average, 10 mark outstanding)
Design thinking with empathy (5 marks)
Extra bonus mark for creativity (0 to 5 marks)

Checklist for your solution:
☐ Drawing ☐ Mentioning the materials used ☐ Explanation of your design

Mark for this page: _____ / 35 marks

Plan your first solution (Micro:bit turbidity testing tool)

My Design of the micro:bit turbidity testing tool
(Draw and Annotate with explanation)

Submission Date: _____
(You must submit this before starting to build your solution)

Teacher Guideline:
Effort in drawing in detail (10 marks) (7 is average)
Mentioning of materials (2 marks)
Quality of explanation (10 marks) (0 mark: no explain; 5 marks: average, 10 mark outstanding)
Design thinking with empathy (5 marks)
Extra bonus mark for creativity (0 to 5 marks)

Checklist for your solution:
☐ Drawing ☐ Mentioning the materials used ☐ Explanation of your design

Mark for this page: _____ / 35 marks

Make your model and testing (1)

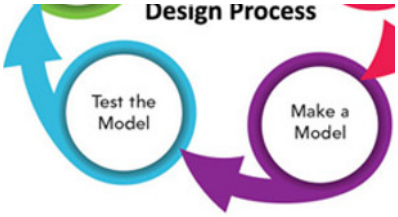


Photo of our first product (10 marks)

Teacher Guideline:
5 marks: photo of Water filter
5 marks: photo Turbidity Tester

Mark for this page: _____ / 10 marks

Make your model and testing (2)

Result:

Measurement of:

Independent variable: _____**(Distilled water vs untreated water)**

Dependent variable: _____**(turbidity reading of filtrate)**

	Untreated water (experiment setup)			**Distilled water (control setup)**			**Percentage Improved**
Turbidity Reading							
Average							

Conclusion:

Water filter column can improve untreated water by XX%, comparing to distilled water.

Do you think your water filter column can provide clean water suitable for drinking? Why?

If your answer is no, don't worry. You can still continue your work by making the final video and just treat your water filter column as a prototype. (xxxx)

Scenario

Reflection and Re-design

Problem1 :

Improvement Done 1:

Problem 2:

Improvement Done 2:

My Video

How do you show your commitment in your video?

How do you show the national security in your video? *(refer to the attachment (1) for more information)*

How do you show the law abiding concept in your video?

Final Comment from teachers

Total marks for Value: _____ / 50

Total marks for Video _____ /30

30 marks: explanation of the value in the video (commitment, national identity, law-abidding) (10 each)
10 marks: On time submission (Responsibility)
10 marks: Commitment (overall attitude)

Video Quality
10 marks – Easy to understand by general public (Empathy)
10 marks – Positive messages
10 marks – General impression

Attachment (1)

(A) Fresh water supply in early Hong Kong

Hong Kong does not have large lakes, rivers or groundwater (地下水) storages. Before the 1860s, Hong Kong relied only on streams and water wells to supply fresh water. To cope with the increasing demand for fresh water, the Hong Kong government started to build reservoirs (水塘) to collect and store rainwater in 1860 (Fig a). By 1978, 17 reservoirs had been built.

Fig a Pok Fu Lam Reservoir (薄扶林水塘), the first reservoir in Hong Kong

(B) Water shortages in Hong Kong

The water supplies from streams, water wells and reservoirs greatly depend on rainwater, but rainfall in Hong Kong can show huge variation from year to year. When rainfall is low, water shortages may occur and water rationing (制水) may be needed. In Hong Kong, there were several rounds of water rationing from 1895 to 1982. In the most severe phase of the droughts (乾旱) in 1963 and 1964, water was only supplied to the public for 4 hours every 4 days (Fig b).

Learn more about the supply of water on the Water Supplies

Fig b People queuing for fresh water during water rationing

(Photo credit: https://www.wsd.gov.hk/filemanager/en/share/pdf/DJW_Leaflet-e.pdf)

Water shortages can have serious impacts on the environment, society and economy. For example:

- hygienic conditions become worse due to insufficient water for showering and cleaning
- some diseases (e.g. cholera 霍亂) spread more easily as people may drink untreated water from streams
- conflicts may occur when people use or collect water during water rationing
- farm production drops as crops cannot grow without water
- industrial production (e.g. textiles) drops and, hence, income of workers falls

(C) Importing fresh water from Mainland China

To ease the problem of water shortages, the Hong Kong government had imported water from the Zhujiang (珠江) since the early 20th century. In 1960, an agreement was reached between the governments of Hong Kong and Guangdong Province (廣東省) to supply water to Hong Kong from Shenzhen Reservoir (深圳水庫). To further secure fresh water supply, the Hong Kong government signed another agreement with the Guangdong government in 1963 to purchase water from the Dongjiang (東江). Today, about 70% of fresh water consumed in Hong Kong is imported from the Dongjiang, with the rest supplied by local reservoirs.

The Dongjiang originates in Jiangxi Province (江西省). It provides fresh water for more than 40 million people in Guangdong Province and Hong Kong. Dongjiang water is first carried through water pipes to Shenzhen Reservoir. It is then delivered to Muk Wu Raw Water Pumping Station (木湖原水抽水站) in Hong Kong (Fig c). Finally, the water is delivered to water treatment works (濾水廠) for purification, or to local reservoirs for storage.

Fig c The supply route of Dongjiang water

To ensure the quality of Dongjiang water meets the national standard, the Guangdong authorities have taken a number of measures. For example:

- remove polluting factories and farms along the Dongjiang
- raise water charges to discourage water usage
- build dedicated (專用) water pipes (Fig d) from the Dongjiang to Shenzhen Reservoir (Fig e)
- install facilities to prevent polluted water from flowing near pumping stations
- build a biological treatment plant at Shenzhen Reservoir to improve water quality
- closely monitor the quantity and quality of water in the Dongjiang river basin (流域)

Protecting the water quality of Dongjiang also helps secure water resources of China.

Fig d Dedicated water pipes for transporting Dongjiang water

Fig e Shenzhen Reservoir for storing water from the Dongjiang