

Igniting curiosity through science: A journey for gifted students

Yuen Long Merchants Association Secondary
School



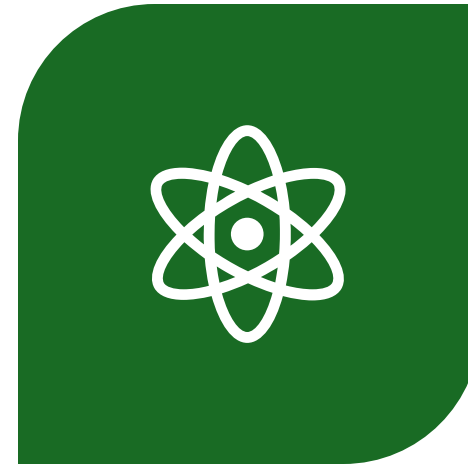
Background of the school

- EMI school
- STEAM – curriculum mapping
 - D&T
 - HE
 - CL
 - BAFS
- Science has less connection with other subjects


Outline of the sharing





TRY-OUT 1: STEAM IN JUNIOR SCIENCE –
LEVERAGING THE POWER OF
TECHNOLOGY TO TEACH ADVANCED
SCIENCE



TRY-OUT 2: HKDSE PHYSICS –
ELECTRICITY BLACK BOX



Try-out 1:
STEAM in Junior Science – Leveraging the
power of technology to teach advanced
science



Current practice

- Filter column: the result is hard to measure and it is subjective
- A traditional set-up



Focus of the tryout



Modifying the current practice to promote gifted education



Element to incorporate: Teaching the idea of transmittance in S.1.



Promote STEAM education in Science:

Converting Microbit: into a colorimeter
Calculation of transmittance: application of percentage

Situation

Now you are an engineer working for an NGO that promotes clean water in rural areas. Your mission is to create a filtering device that can effectively purify polluted water using at most **THREE** filtering materials. This device will help communities access safe and clean drinking water and improve their health and quality of life.



Materials and Apparatus

1. Choose THREE filtering materials for your filter column from the list below:

(Hints: Consider their properties and how they will work together to purify water.)

- Small stones
- Large rocks
- Sand
- A4 paper's fragments
- Cotton
- Rubber stopper
- Matchsticks' fragments



Task: To create a best filtering device for rural areas

- Limited resources for problem solving
- Students can only choose three materials

Technology- Building a colorimeter

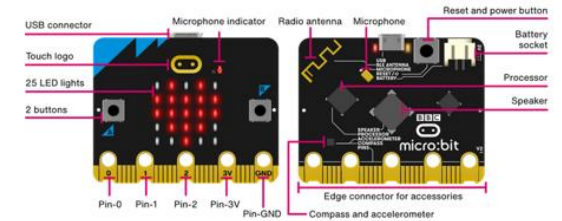
A self- study material is given to students to support them in building their colorimeter

Introduction:

To measure the filtering power of the filter, we will measure the transmittance of the light. The higher the transmittance of the light, the higher the filtering power of the filter. In this pre-practical task, you have to make a device to measure the transmittance of light.

Hint:

In micro:bit, there is a light sensor that can detect the light intensity. Based on the skills learned in the computer literacy lesson. Design a device to measure the transmittance of light.



Below are some designs of a practical device to measure the transmittance of light of a material:



From the data given, propose how this device works.

Building a colorimeter

- With the self-made colorimeter, we can turn the “clarity” into actual numbers.
- Hence, data analysis could be done.



2. How does this % transmittance relate to the clarity of the water?

The higher the light transmittance of water, the clearer the water, the opposite, the more turbid it is.

Tiered assignment to cater for learning diversity

- 3 levels for students to choose. Gifted student can choose level 3 while other students can choose level 1/2.

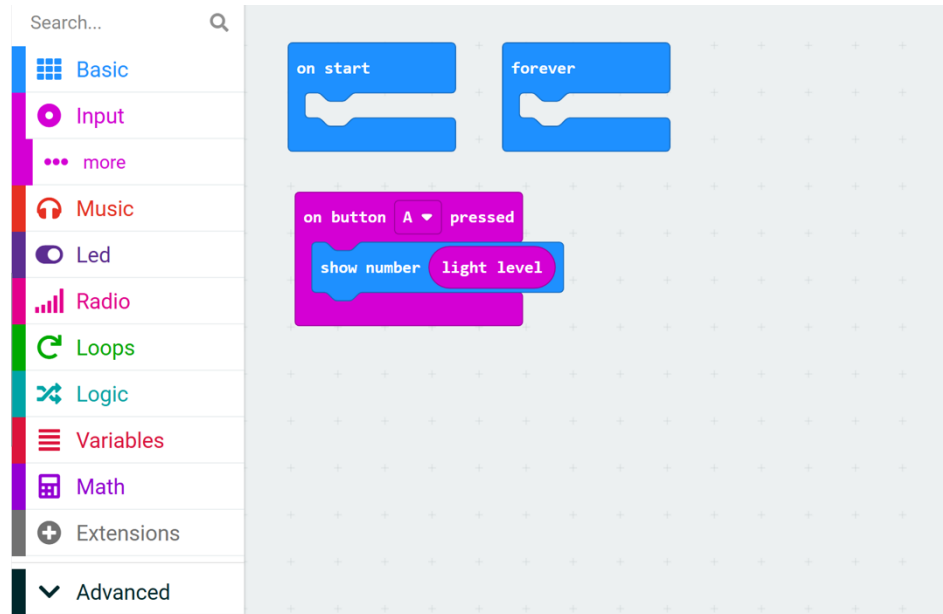
Based on the design, how do you set up the program of the micro: bit?

1. Go to <https://makecode.microbit.org/> (Scan the QR code)
2. Paste your code below.
3. To complete the task, there are 3 different levels of difficulty for you to choose from:
 - Level 1: measuring the light intensity only (range from 0 – 255)
 - Level 2: measuring the light intensity ranged from 0 – 100.
 - Level 3: using one micro: bit to measure while the second micro: bit to read the data.



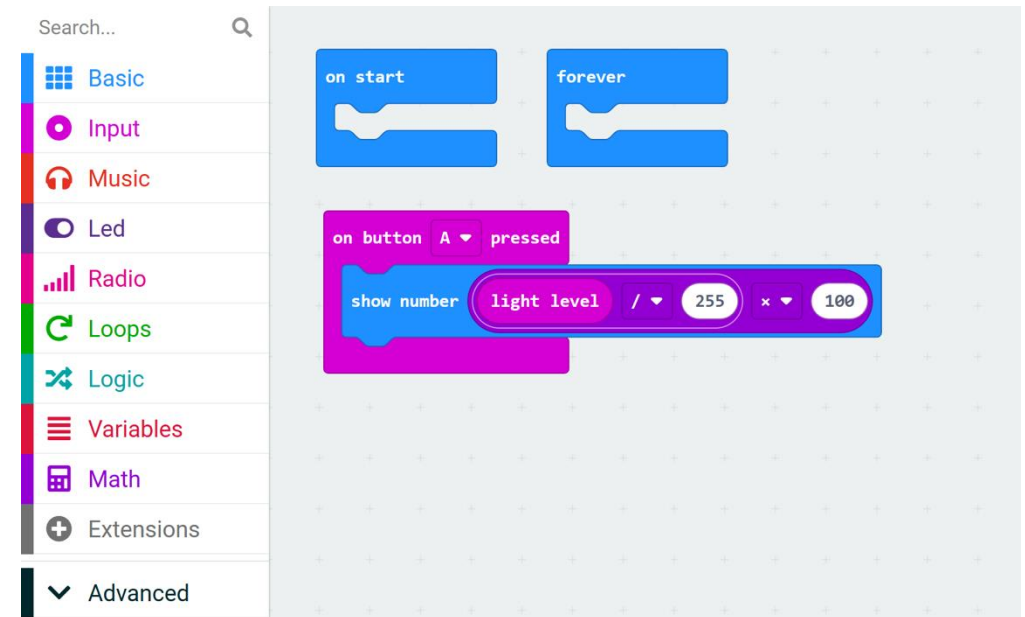
Tiered assignment to cater for learning diversity

- Students with different ability can achieve the same goal.



The image shows the Scratch code editor interface. On the left is a sidebar with a search bar and a list of categories: Basic, Input, more, Music, Led, Radio, Loops, Logic, Variables, Math, Extensions, and Advanced. The main workspace contains a script starting with an 'on start' block followed by a 'forever' loop. Inside the loop is an 'on button A pressed' block with a 'show number light level' block attached to it.

Lower Tier

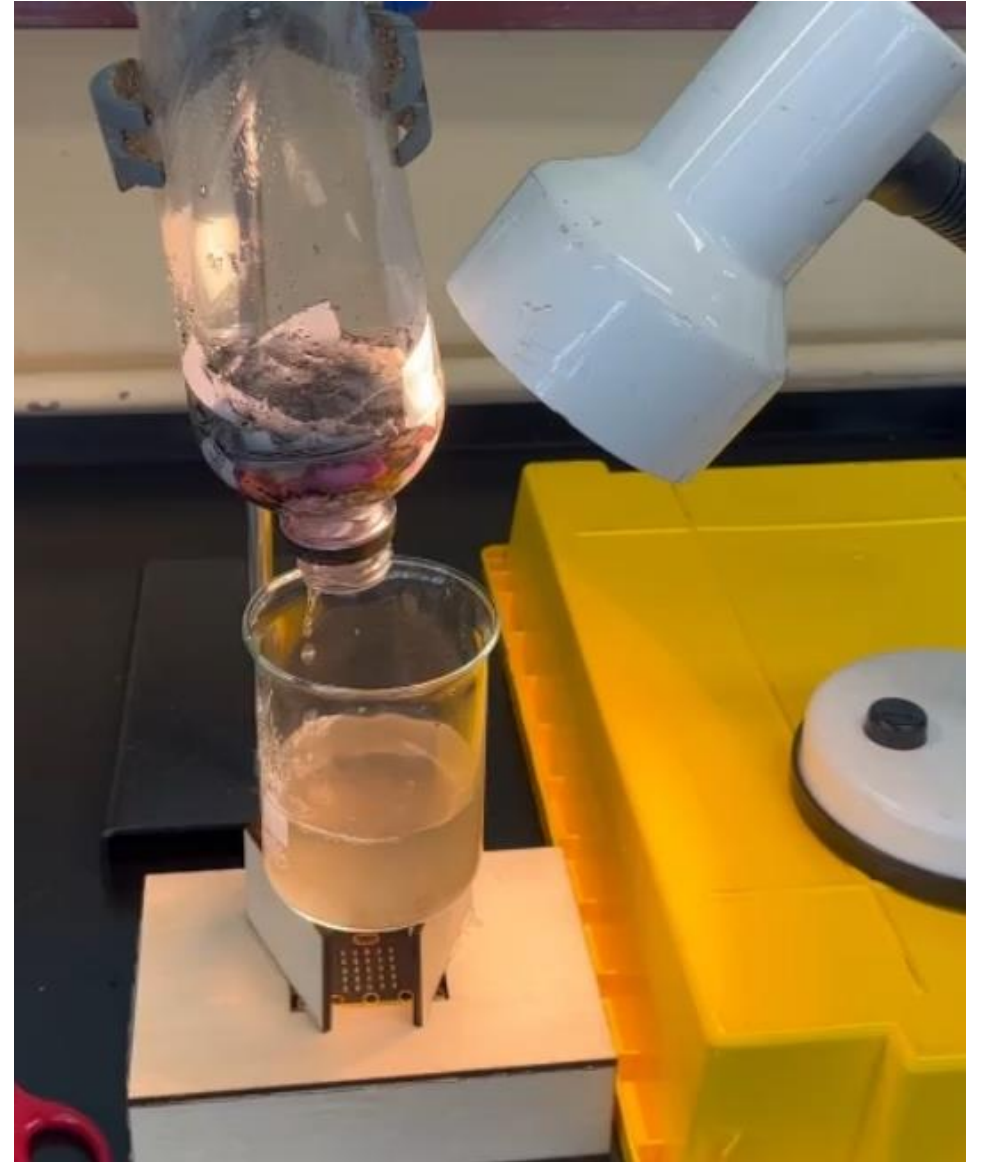
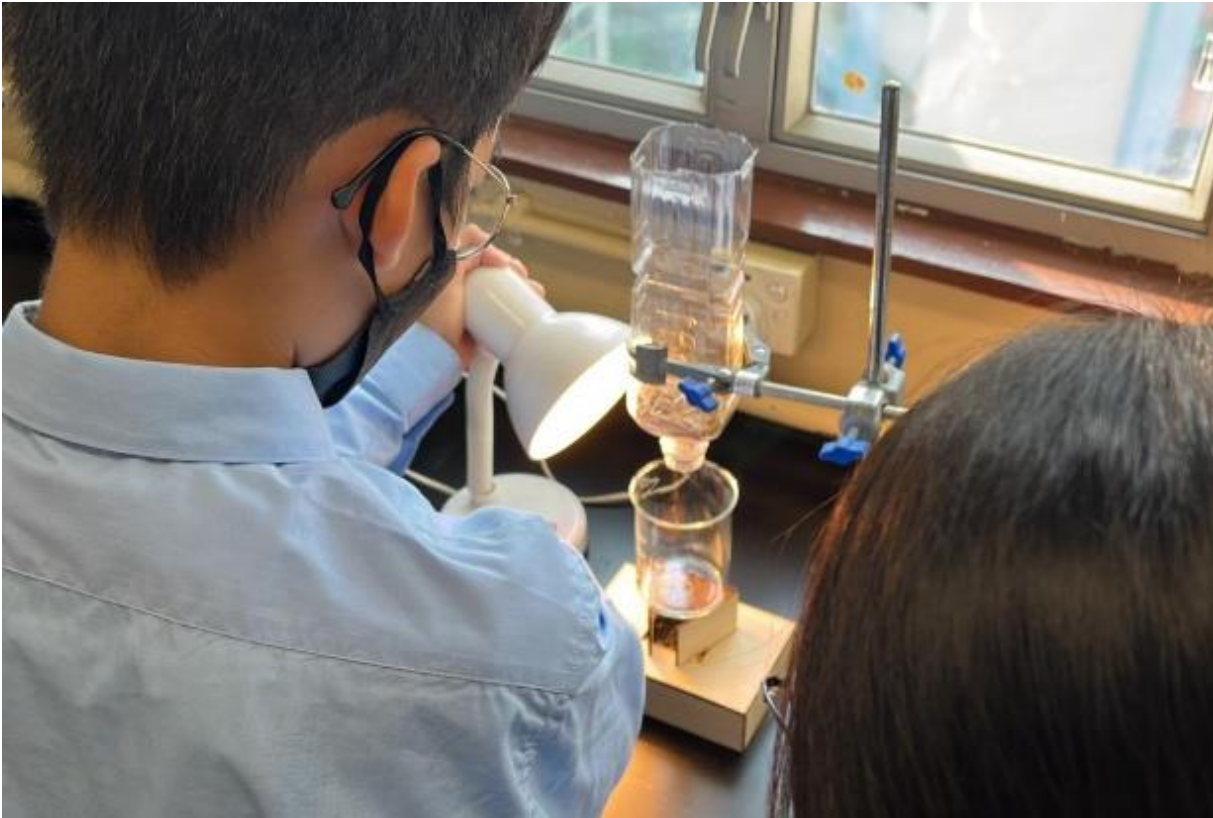


The image shows the Scratch code editor interface, similar to the first one. The sidebar is the same. The main workspace contains a script starting with an 'on start' block followed by a 'forever' loop. Inside the loop is an 'on button A pressed' block with a 'show number' block attached to it. The 'show number' block has a 'light level' input field, a division symbol, a '255' input field, a multiplication symbol, and a '100' input field.

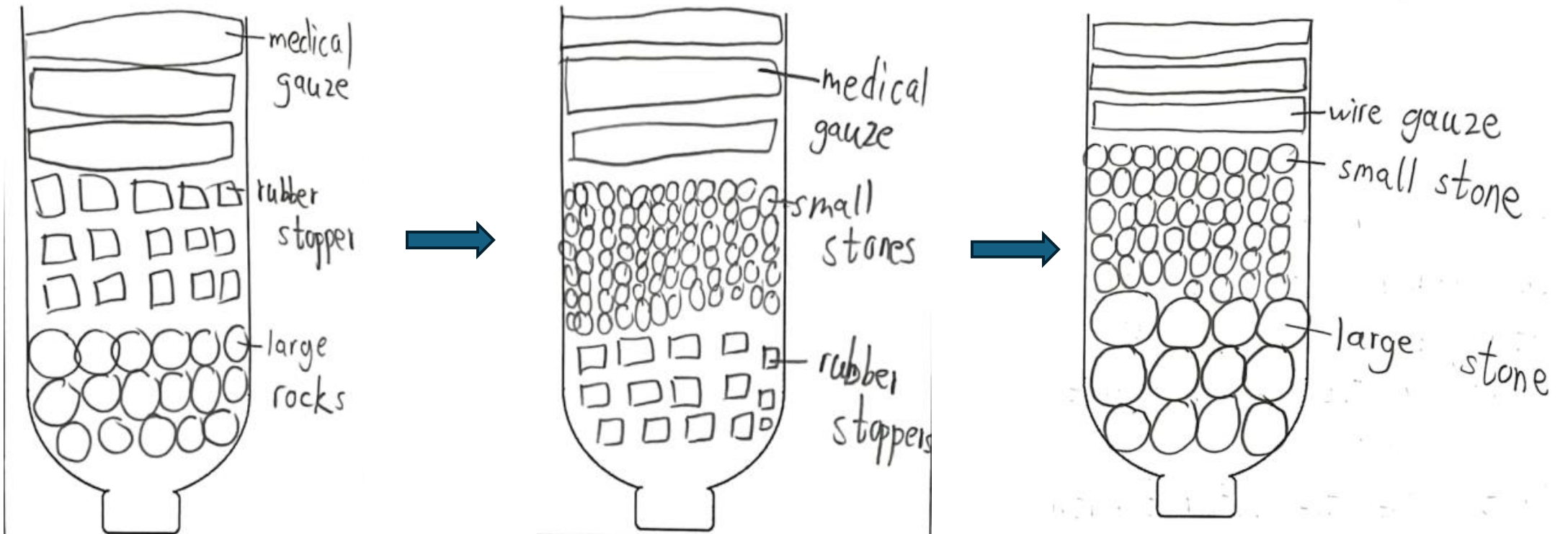
Middle Tier

Engineering cycle

- Students will test and modify during the project.



Engineering cycle – student work



Mathematics- application of percentage to calculate transmittance

- Students are required to calculate the transmittance of the filtrate.
- This requires them to apply the concept of % learnt in mathematics.
- An organic connection with mathematics: while students are learning advanced content, they also apply the mathematics learnt.

Student learning from the project

2. Explain filtration in your own words.

Filtration is a technique for separating mixtures by using a porous medium to separate solids and liquids. When the mixture passes through the medium, the solid particles are retained in the medium, while the liquid flows out through the medium.

3. How does your filter column design relate to real-world water treatment methods?

Just like the water treatment plants in Hong Kong, they also use filtration method.

2. Explain filtration in your own words.

Filtration is a way to separate things.

3. How does your filter column design relate to real-world water treatment methods?

They have sedimentation, filtration and adsorption steps to purify water.

Reflection




Students can generally understand the idea of transmittance.



Tiered assignment allows gifted students to perform while also catering the majority of students.



An open-end project allows students to cultivate their creativity.



Try-out 2: HKDSE physics -electricity
black box

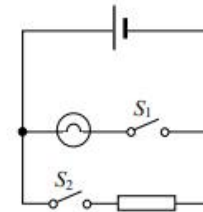
Pain point

- Students can analyze the circuit.
- Yet, they are weak in manipulating the circuit based on the specification.

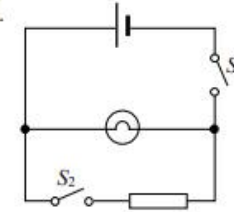
46. [HKDSE_2015_1A_25]

For safety purposes, the driver seat of a car is equipped with a seat belt warning light. When the driver seat is occupied, the switch S_1 under his seat will close. If the seat belt is not yet fastened, switch S_2 will remain open and the warning light will light up. If the seat belt is fastened, the switch S_2 will close and the warning light will shut off. Which circuit design below is the best design ?

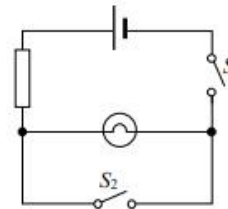
A.



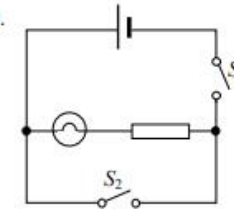
B.



C.



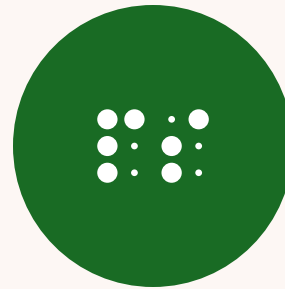
D.



Aim of the tryout



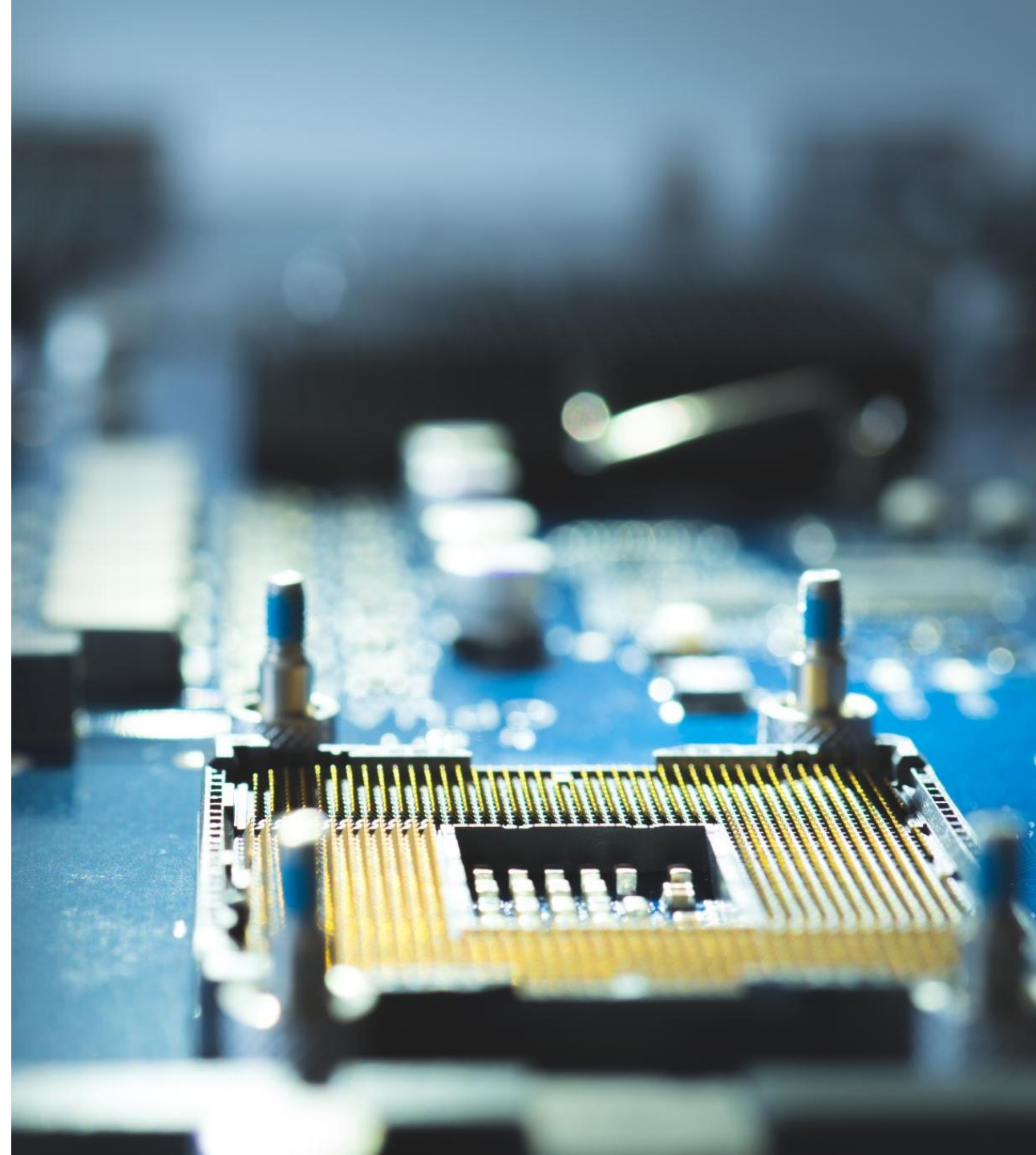
To explore if there are any way to support students in building a circuit based on specification.



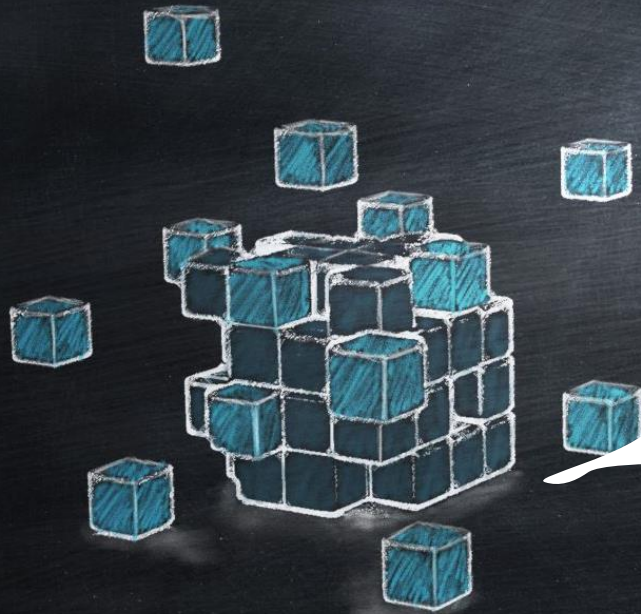
To support gifted students in abstract manipulation of circuit.

Some input from GE network

- Input activity: Black box of A-F electronic component
- Students are required to match A-F with different possible components.

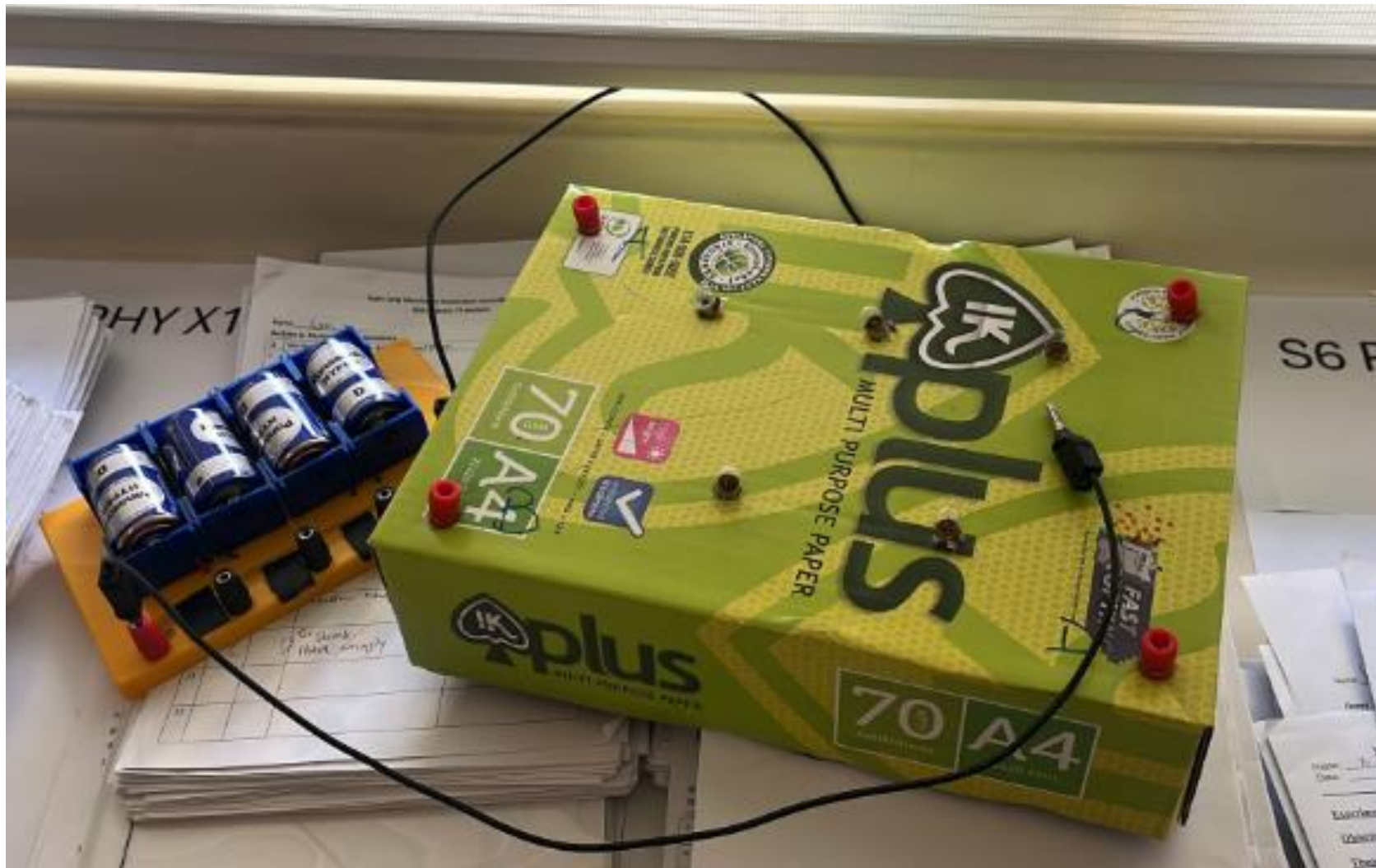


A new design



- To create a black box activity for students to guess the circuit inside.
- Students have to observe and propose the circuit inside. Furthermore, they have to refine their idea based on the further information.

The model





Teaching sequency

Stage	Learning activity	Rationale behind
Create the initial circuit	Propose the circuit based on the observation	Observe and make sense of the circuit
Prediction	Predict which light bulb will be turned on if: AB is shorted and the battery is connected to CD	Allow students to predict based on their initial circuit
Gathering information	Tryout and gather information	Collect real life data to support/rebut their prediction
Refine the circuit	Discuss and refine the circuit	Refine the circuit based on further information
	Make consensus among the classmates	

Stage 1- creation

- Students were proactive in the practical work.
- Students proposed their initial idea and give reasons

Stage 2: prediction and gathering information

- Connecting a wire between AC and ask students to propose the result of different bulbs based on their initial model.
- After that, students redo the practical work and see if it echoes with their prediction.
- Students Refined the model after stage 2 and give reasons.



Overall Reflection

- A challenging open-ended activity can allow the gifted students to engage more.
- Furthermore, it also serves as a tool to identify gifted students.
- With a careful design of learning activity, students are able to learn advanced concept.

Thank
you!