香港教育大學
The Education University of Hong Kong

FACULTY OF LIBERAL ARTS AND SOCIAL SCIENCES
博文及社會科學學院

科學與環境學系
Department of Science and Environmental Studies

2024-2025 Quality Education Fund Thematic Network - Tertiary Institutes

Progressive Development of STEAM Literacy through STEAM Education and Self-directed Learning

透過STEAM教育自主學習有序發展STEAM素養

Titanium Dioxide Solar Cell

中華基督教會蒙民偉書院

Aims of the testing

1. To investigate whether there is degradation of the organic solar cell over time (observe for at least 15-30mins)

2. Especially in two conditions (1 with light; 2 without light)

Table lamp light (20 cm) Vs No light (covered up with paper box)

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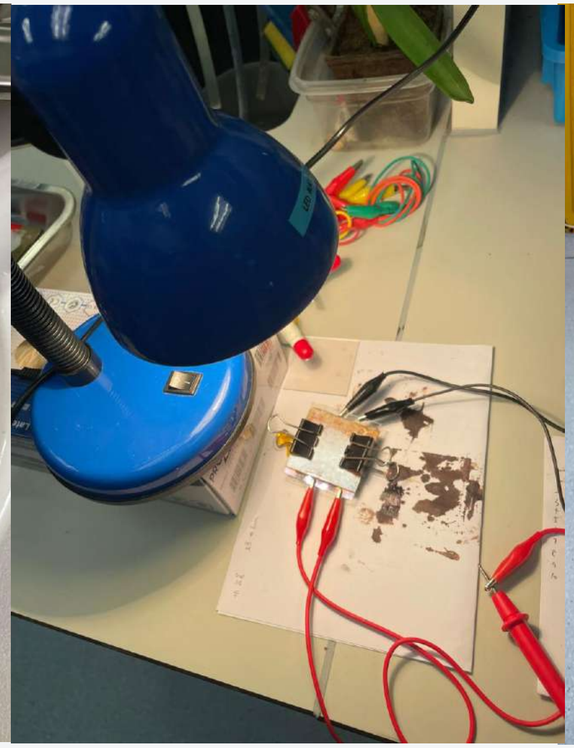
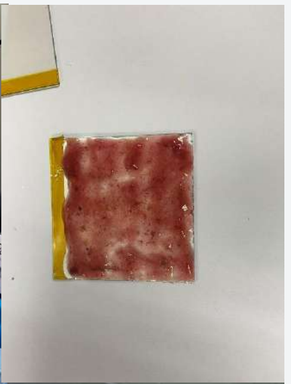
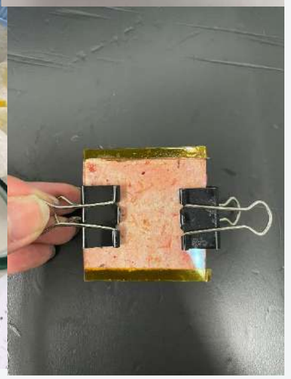
Set up





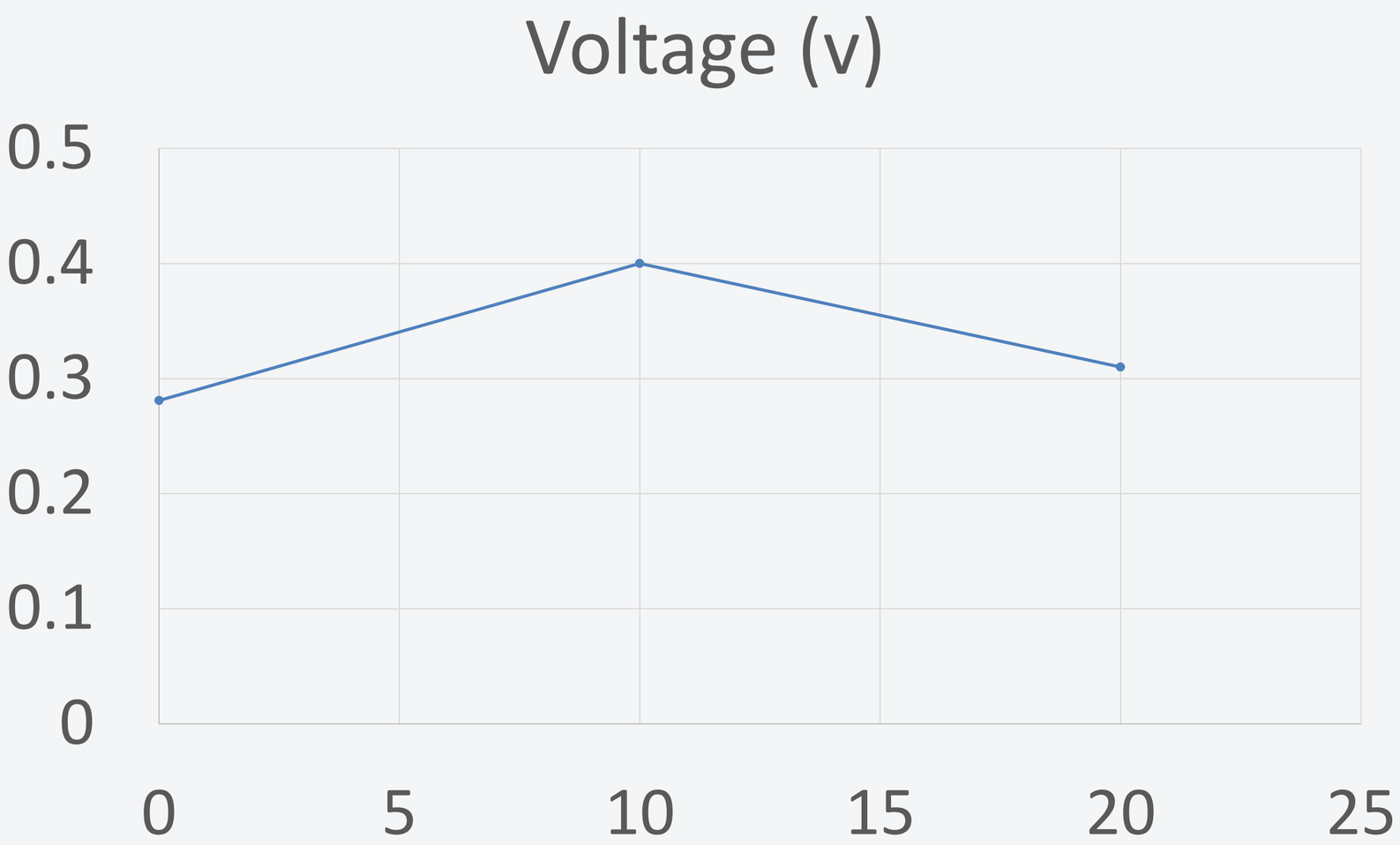


Adjustments made to the experiment

Coating:

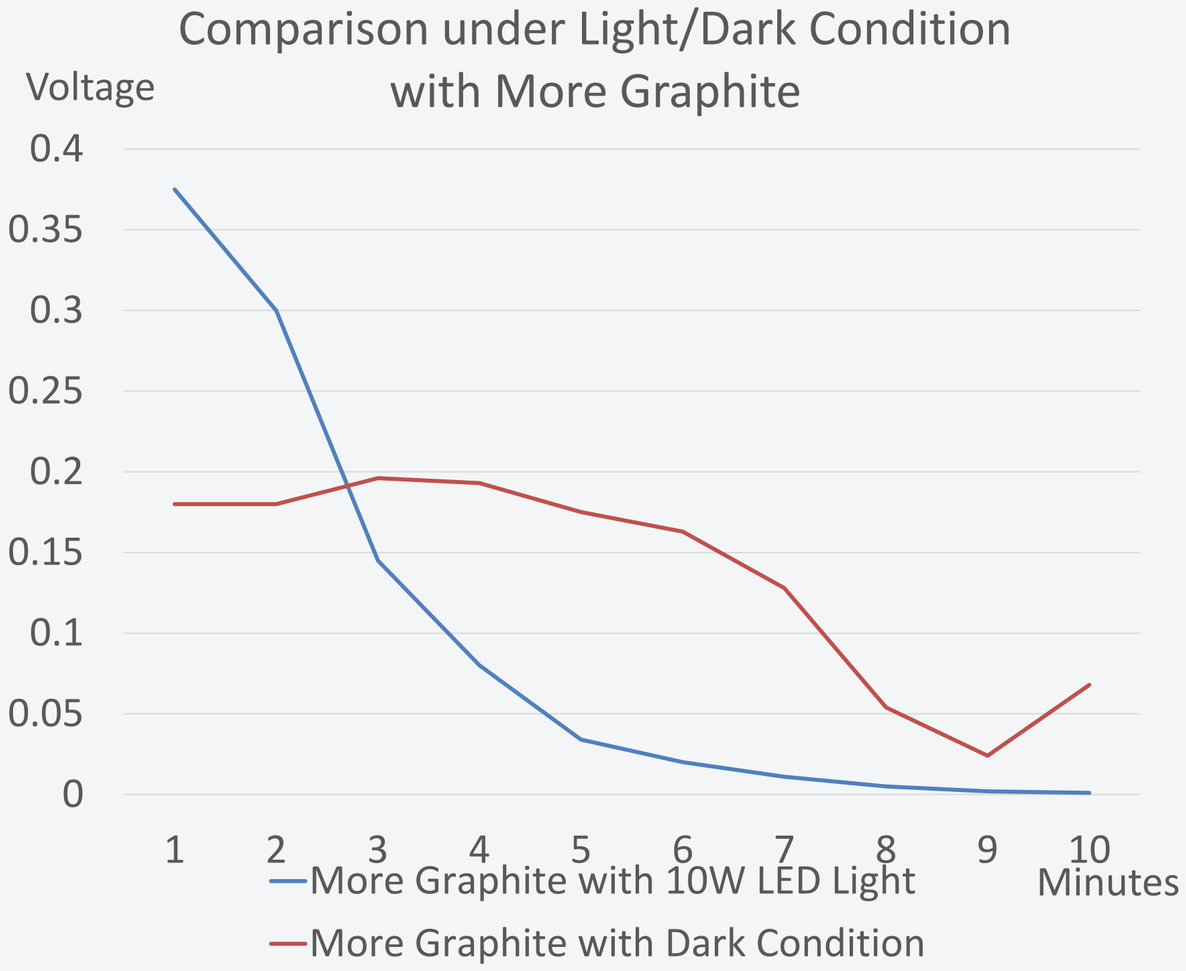
1. Tried using oven to heat up (around 80C -150C for 15mins), instead of hot plate (around 125C)
2. Used few (2-3) drops of (2M) dilute ethanoic acid + soap water, instead of water
3. Making sure the glasses slides were tested (using the conductive side)

Testing_20241018

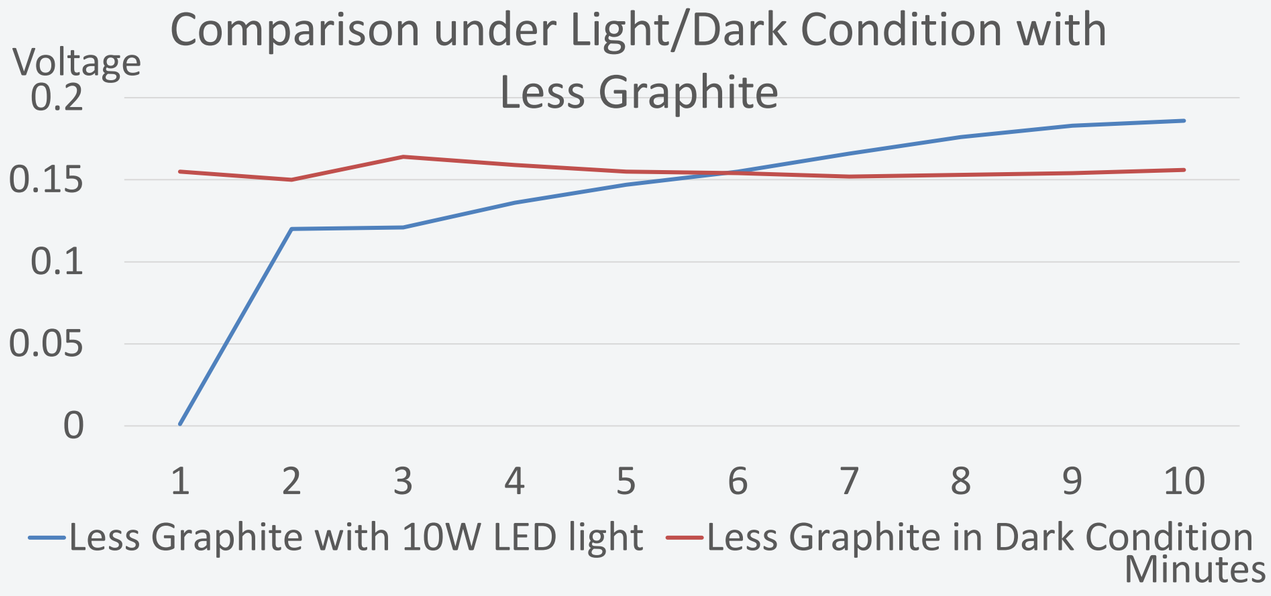


Time	0 min	10 min	20 min
Voltage	0.281	0.4v	0.31v

Testing_20241024



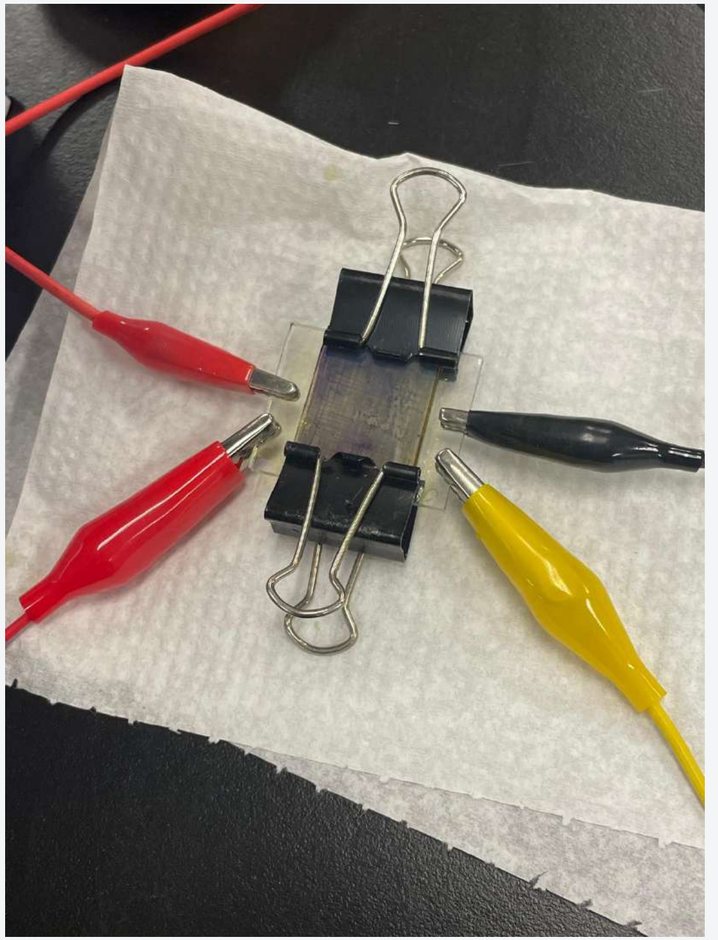
*Taking data every minute



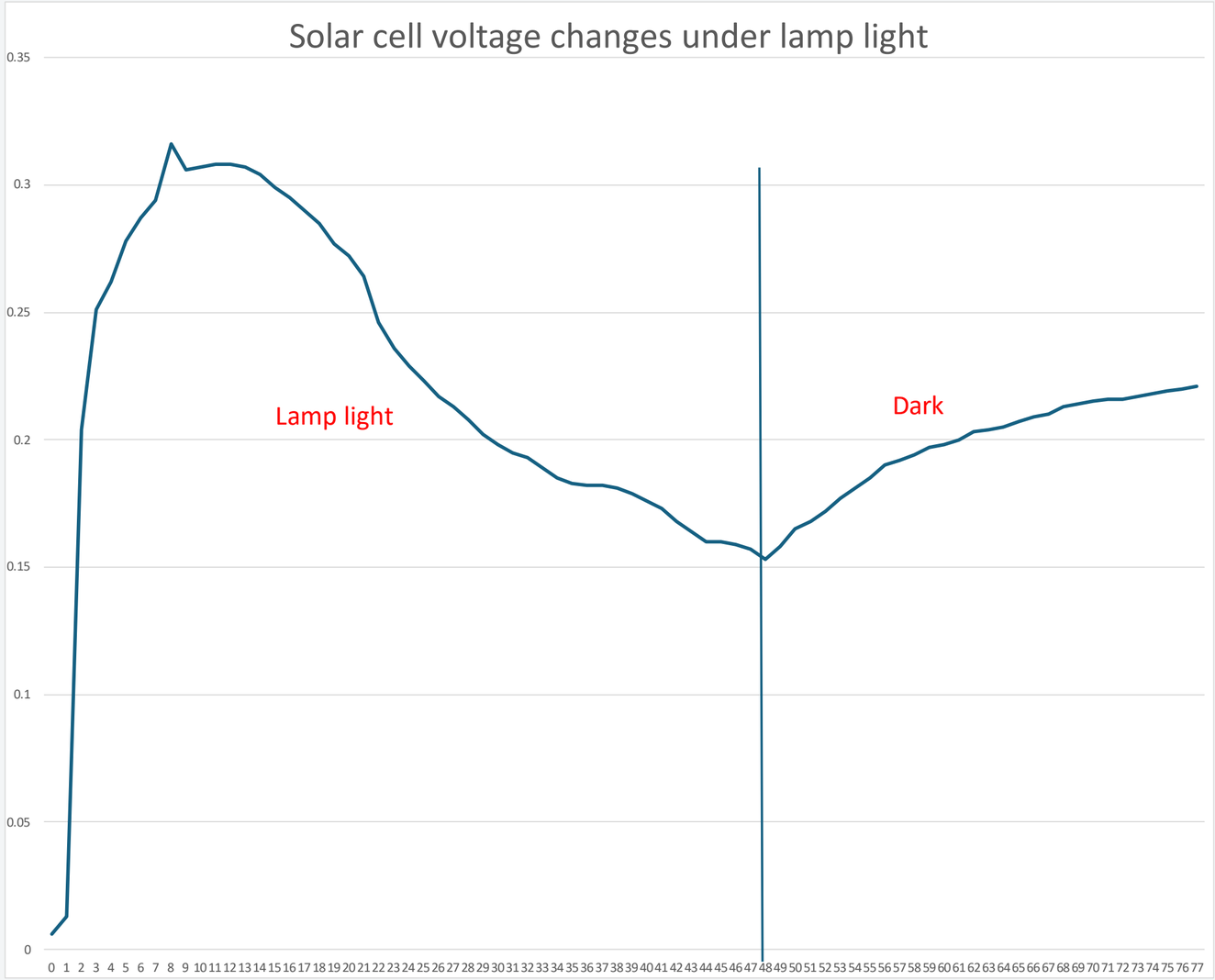
Adjustments made to the experiment

<u>The part to be done by students</u>

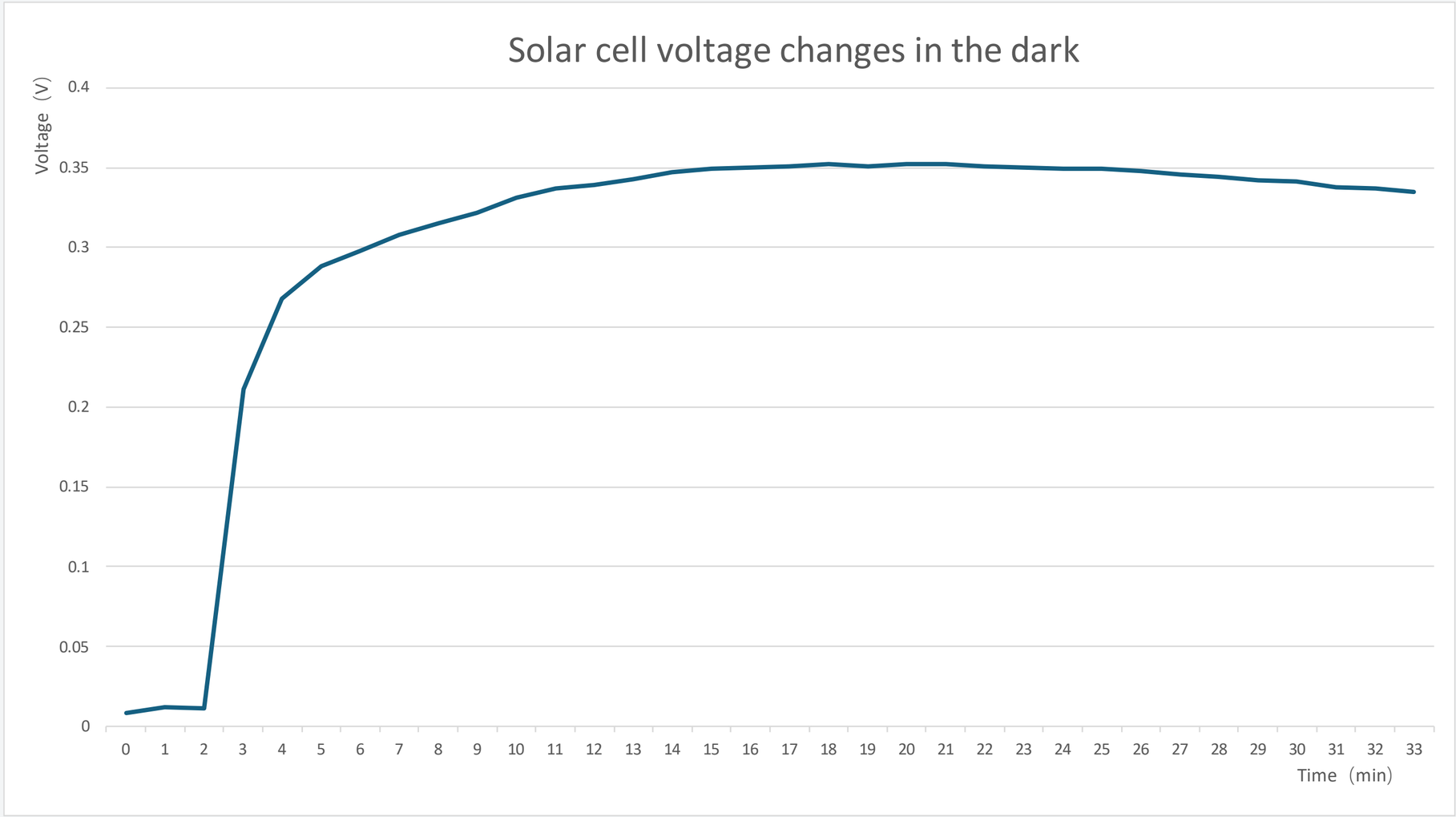
1. Used 4B pencil, instead of the golf pencil (alternative- yellow frame to burn instead of pencil)
2. Used 4mm heat-resistant adhesive tape (耐熱膠紙) at both ends of the glasses
3. Making sure the pin of Voltage meter not touching the creamy paste



Testing_20241028 (1)

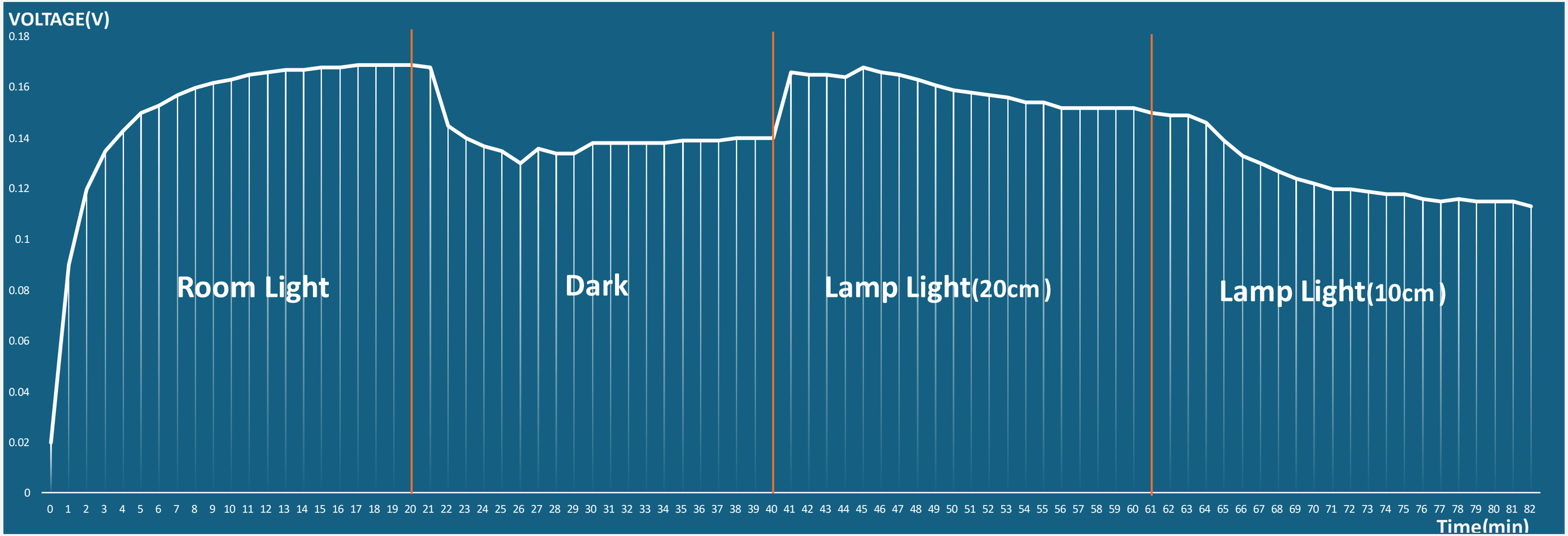


Testing_20241028 (2)

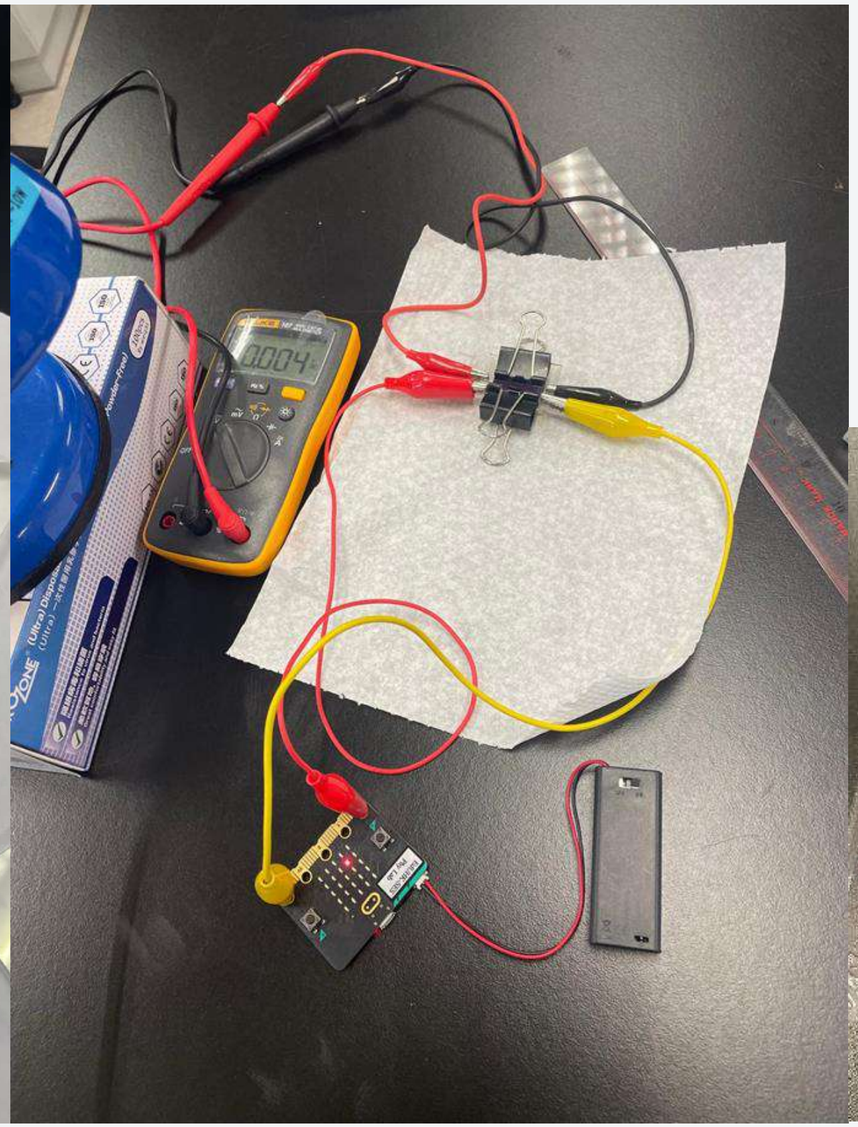


Testing_20241031

Under four conditions

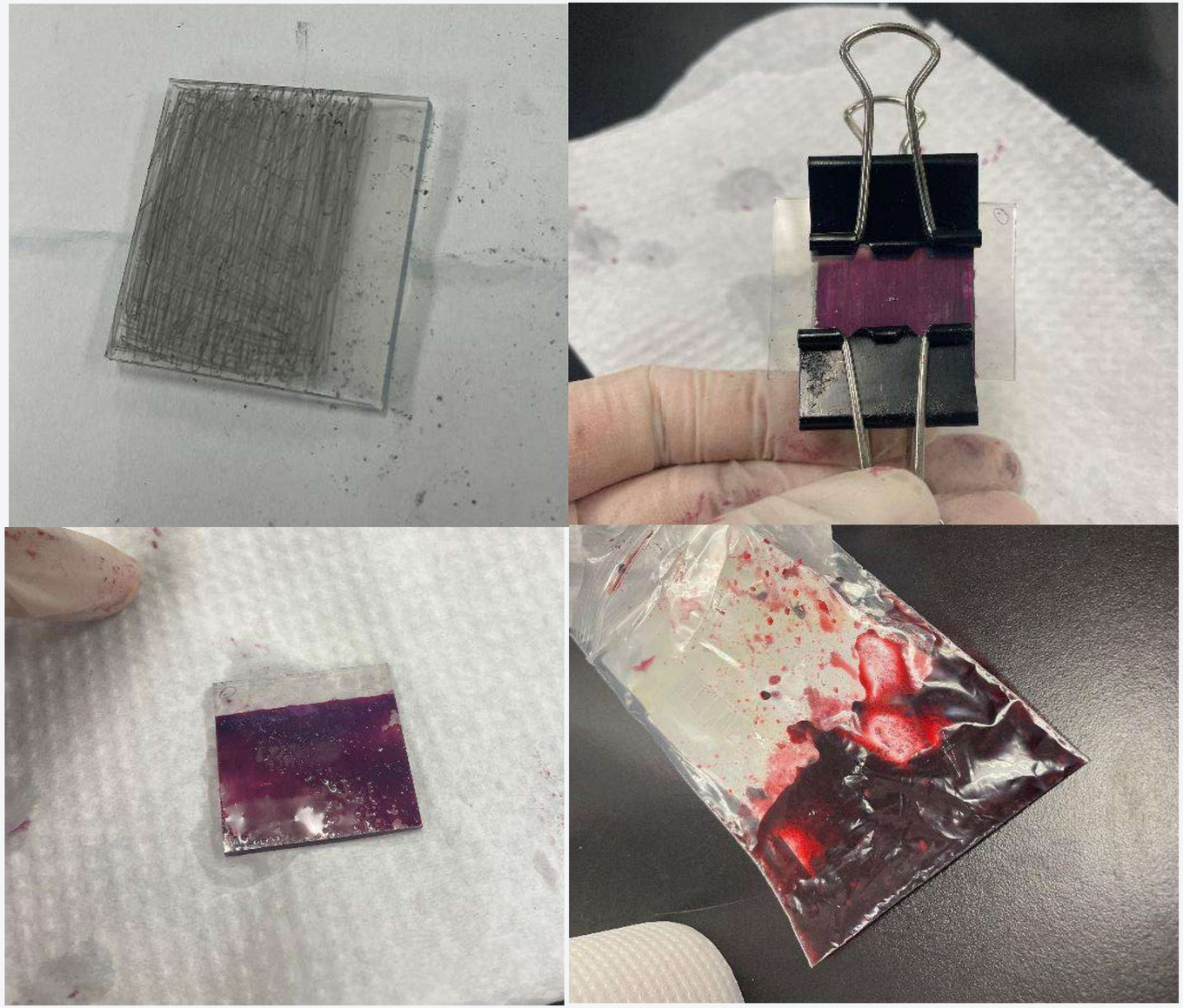


Testing_20241112



- Using glasses slides provided by the school
- Using Blackberries Vs Blueberries
- With micro:bit datalog

Blackberries



- Used 6B Pencil

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Blueberries

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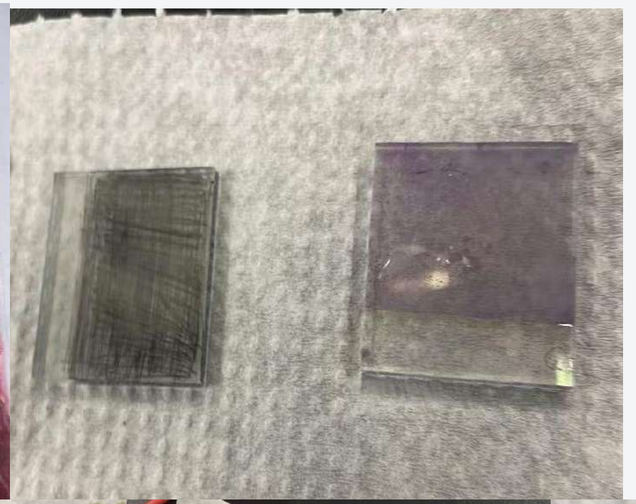
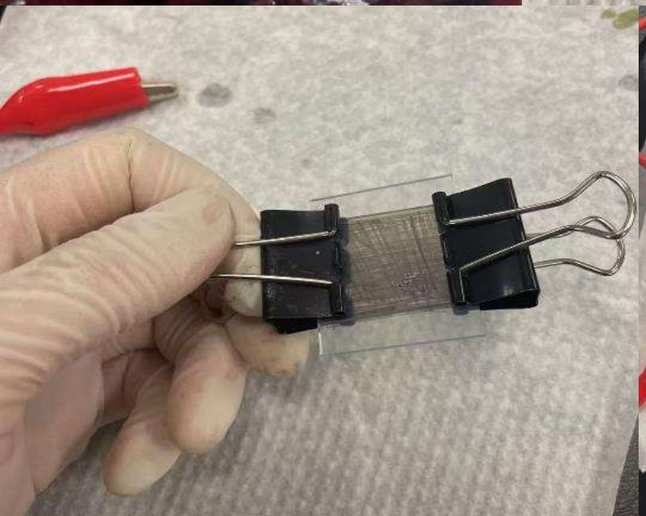
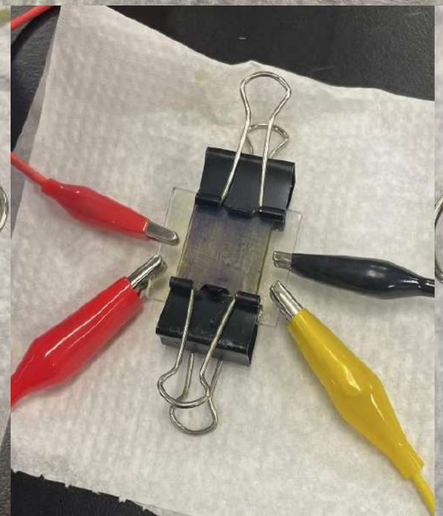
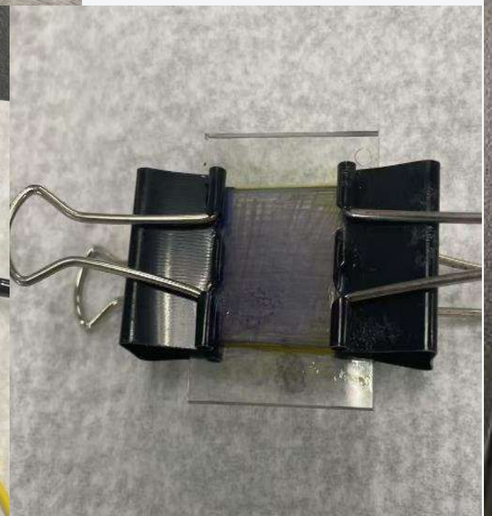
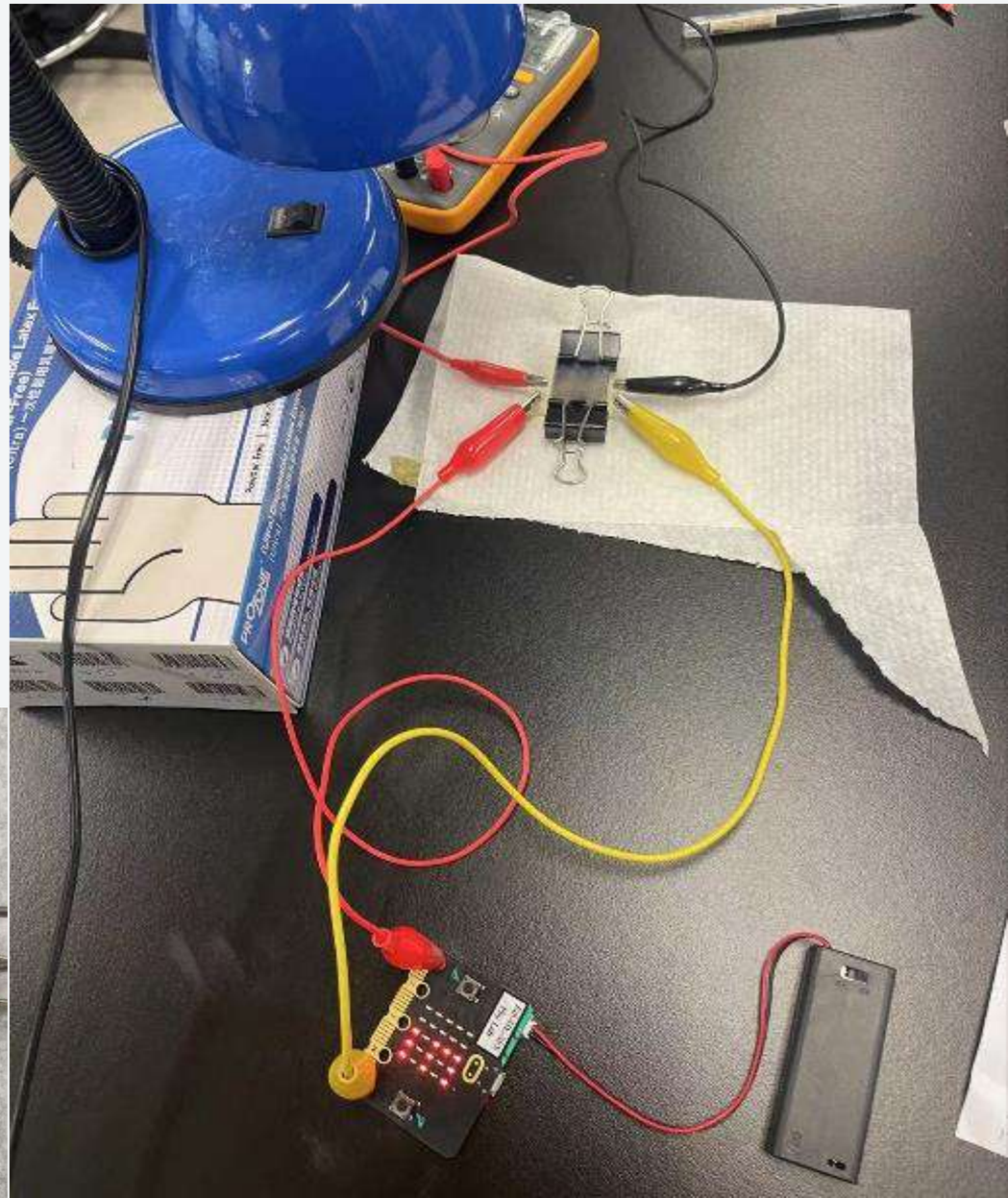


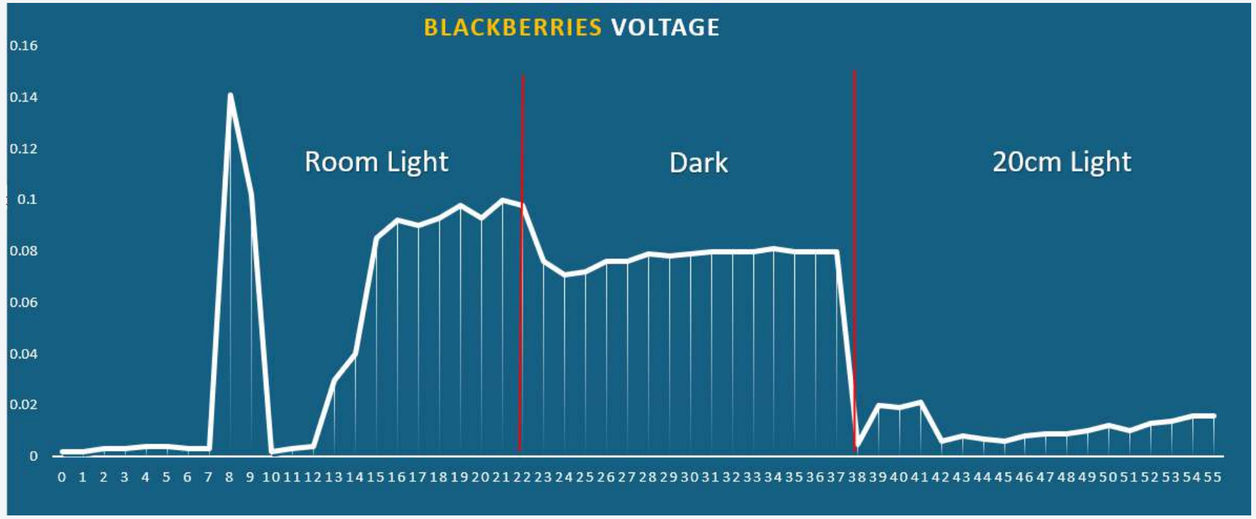








Testing_20241112_Using glasses slides provided by the school

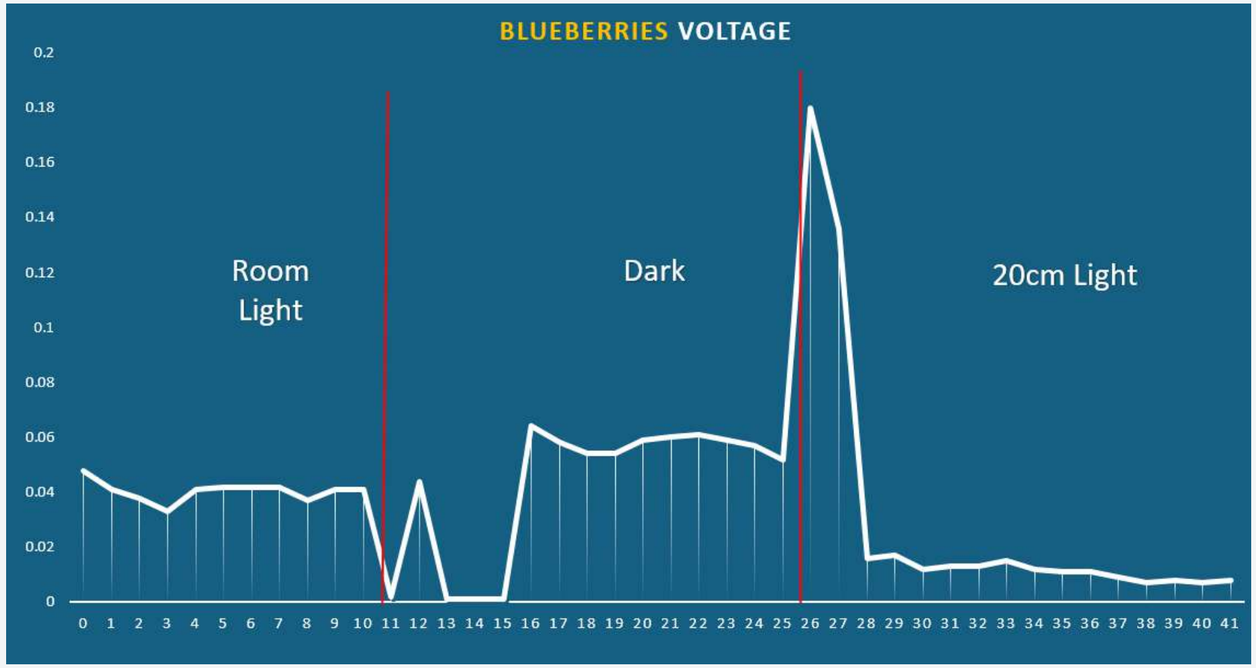


實驗安排： 0-23分鐘 室內光線，23分鐘-38分鐘 黑暗環境 ，38分鐘-55分鐘 20cm光照

實驗觀察：室內光線環境下0-7分鐘電壓極低，只有0.003V左右，在第8-10分鐘突然有波動（可能有一些外界幹擾因素例如光線等），在第15-22分鐘電壓穩定在0.09V左右

在第22分鐘用紙盒蓋住solar cell變成黑暗環境，電壓有瞬間降低到0.076V，之後的15分鐘電壓穩定在0.08V左右

在第38分鐘用20cm檯燈光照，發現電壓突然降低到0.005V，在之後有一個微微的上升空間。

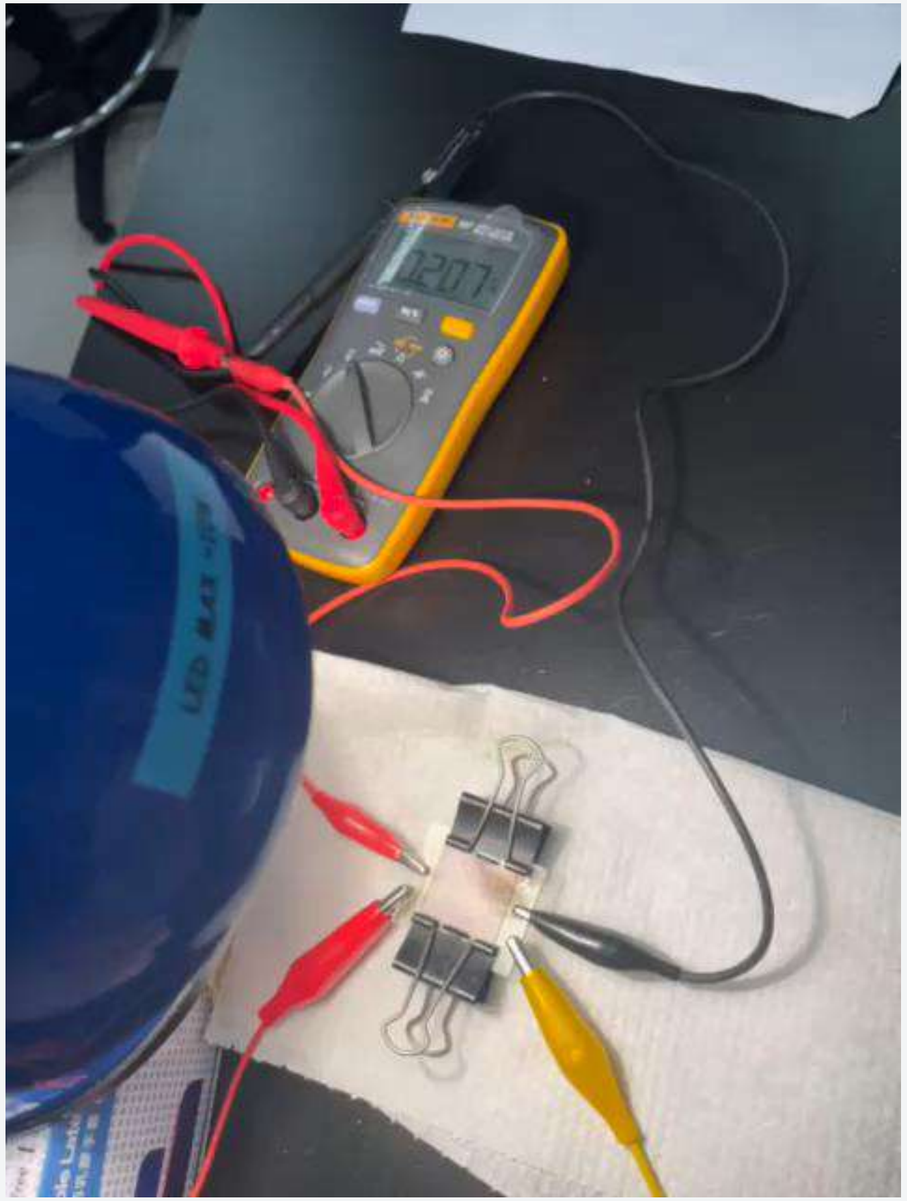


實驗觀察：室內光線環境下0-10分鐘電壓穩定在0.04V左右

在第11分鐘用紙盒蓋住solar cell，發現電壓突然降低到0.002V，隨後一分鐘恢復到0.044V，之後的時間內電壓穩定在0.05-0.06V之間（猜測第十一分鐘的電壓暫時降低可能是由於蓋上紙盒瞬間碰到Solar cell引起）
在第26分鐘開始用20cm的檯燈光照Solar Cell，可以發現開檯燈後電壓由之前的0.052V突然增加到0.180V，隨後電壓又不斷下降，下降到0.01V左右

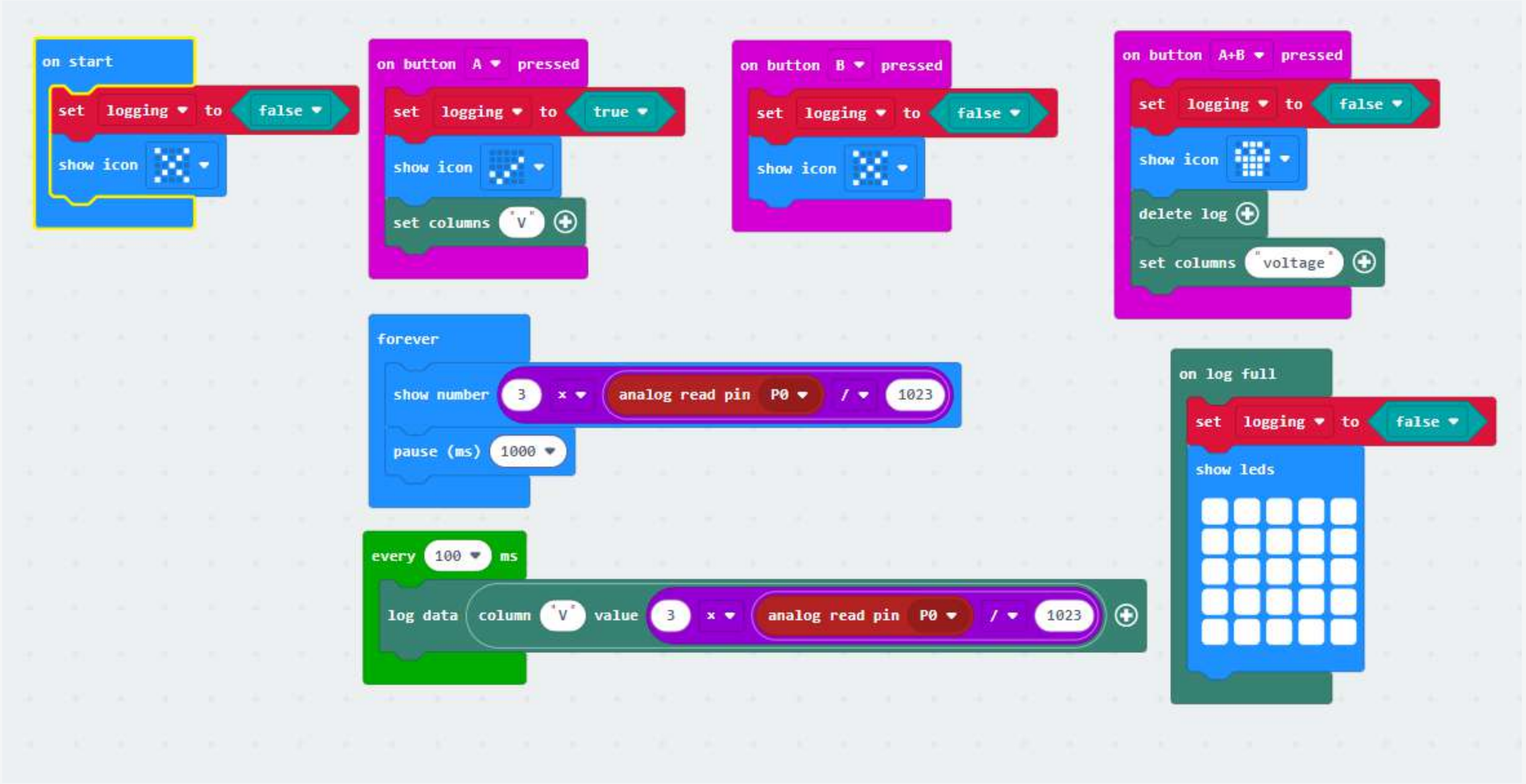
Testing_20241112

Blackberries



Blueberries

With micro:bit datalog



https://makecode.microbit.org/67748-84732-97847-44690

Summary & Suggestions

1. After connecting the solar cell, it is suggested to allow time for the voltage to be stable before doing more tests (results showed voltage become more stable after 10 mins)

2. From the results, it is found that some solar cells perform better (up to 0.35v), but most of the time unstable and may have degradation as time passes. For testing, suggest to allow students to explore differences between light and dark (e.g. taking video to record the voltage changes), rather than the distance from light.

Possibilities

1. Compare between light and dark
2. Compare between more Graphite and less / using pencil or burn
3. Compare between uses of different fruits

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Thank you for your attention