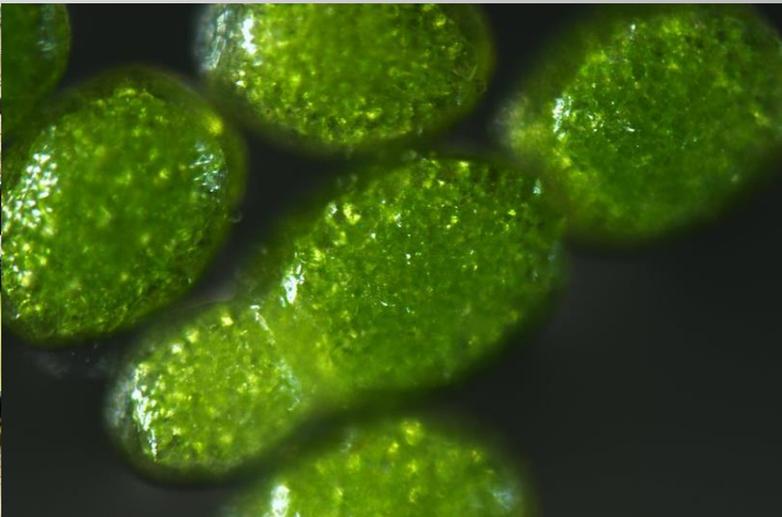


1st Access to Space for All Initiative Expert Meeting

“Watermeal, the Future Food Source for Space Exploration”



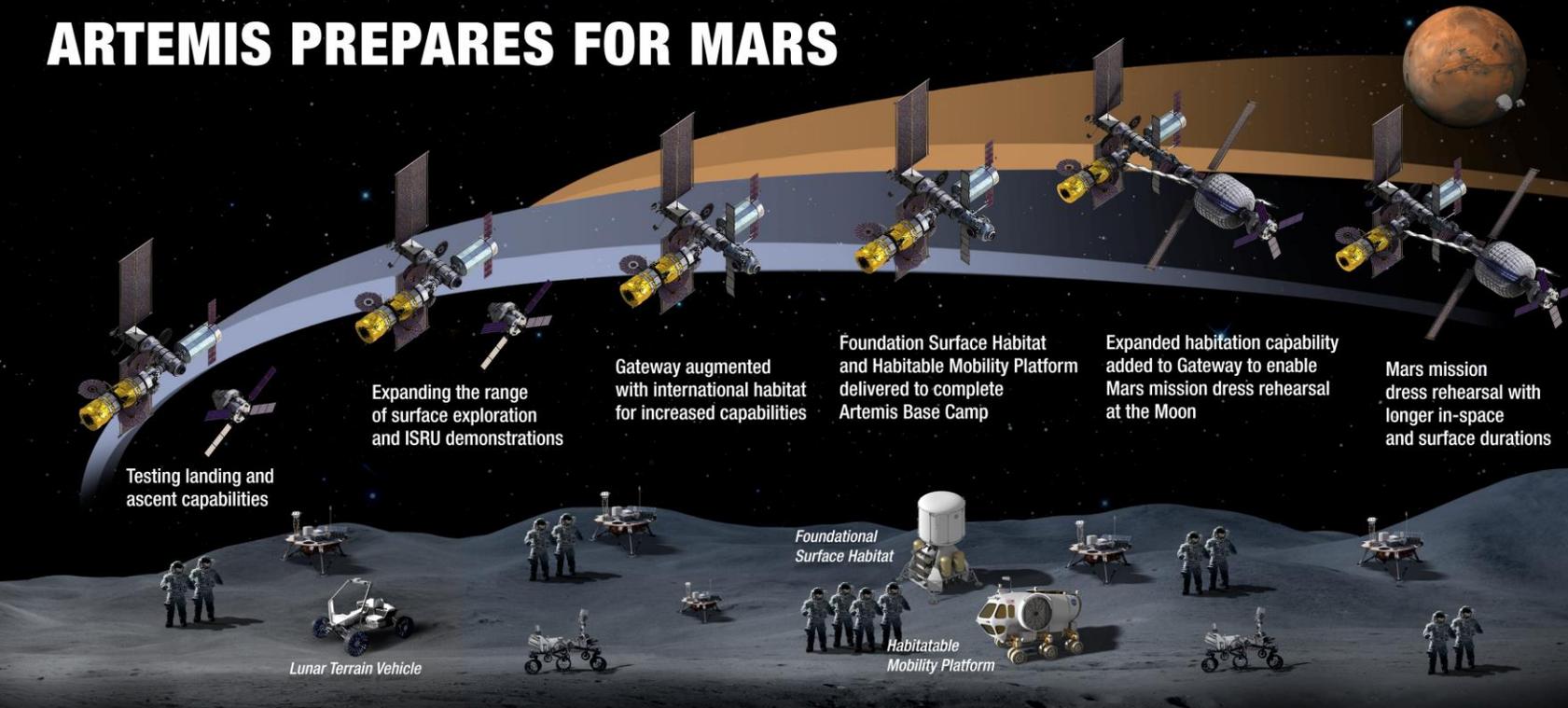
Tatpong Tulyananda, Ph.D.
Faculty of Science, Mahidol University



Thailand was invited to join Artemis program through Artemis Accords in 2018



ARTEMIS PREPARES FOR MARS



SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

MULTIPLE SCIENCE AND CARGO PAYLOADS | INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS



Mahidol University
Wisdom of the Land

Our group

- Space-related plants research
- Find suitable plants for space usage from an extensive biodiversity in Thailand
- Long-term plant storage for space travelling

Who We Are?
Plant Biology & Astrobotany Laboratory



HyperGES “Watermeal, the Future Food Source for Space Exploration”

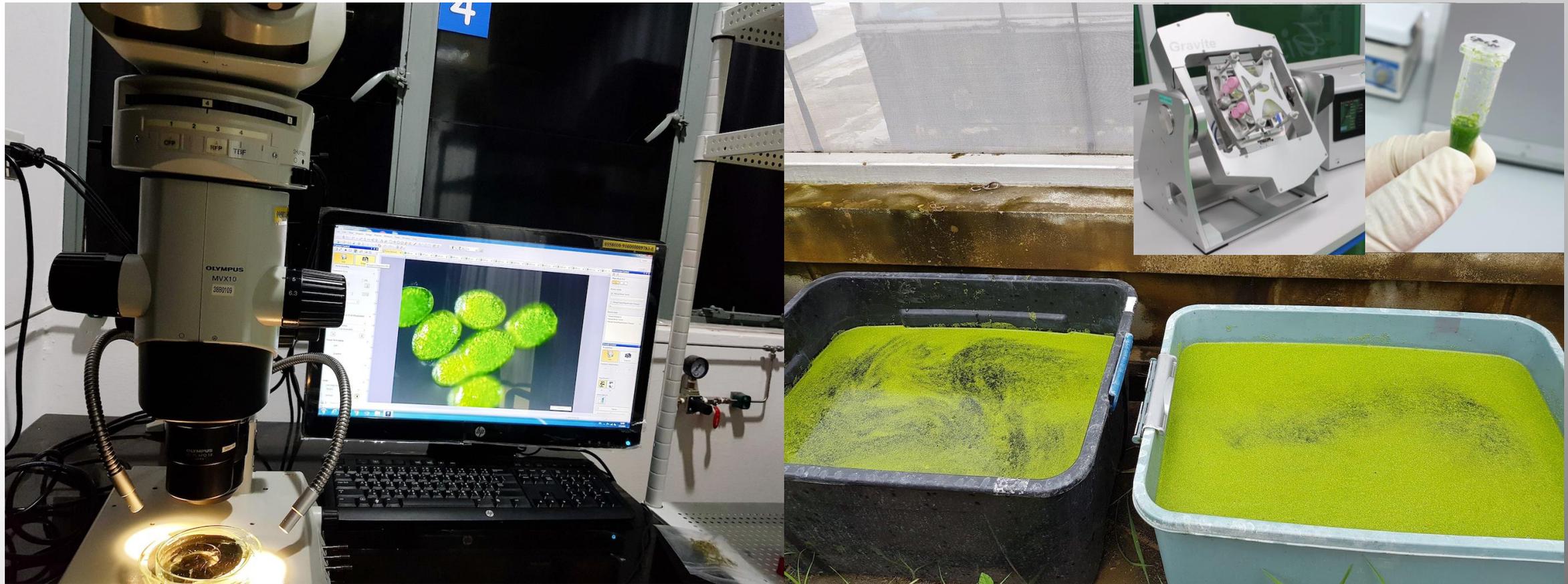


HyperGES summary

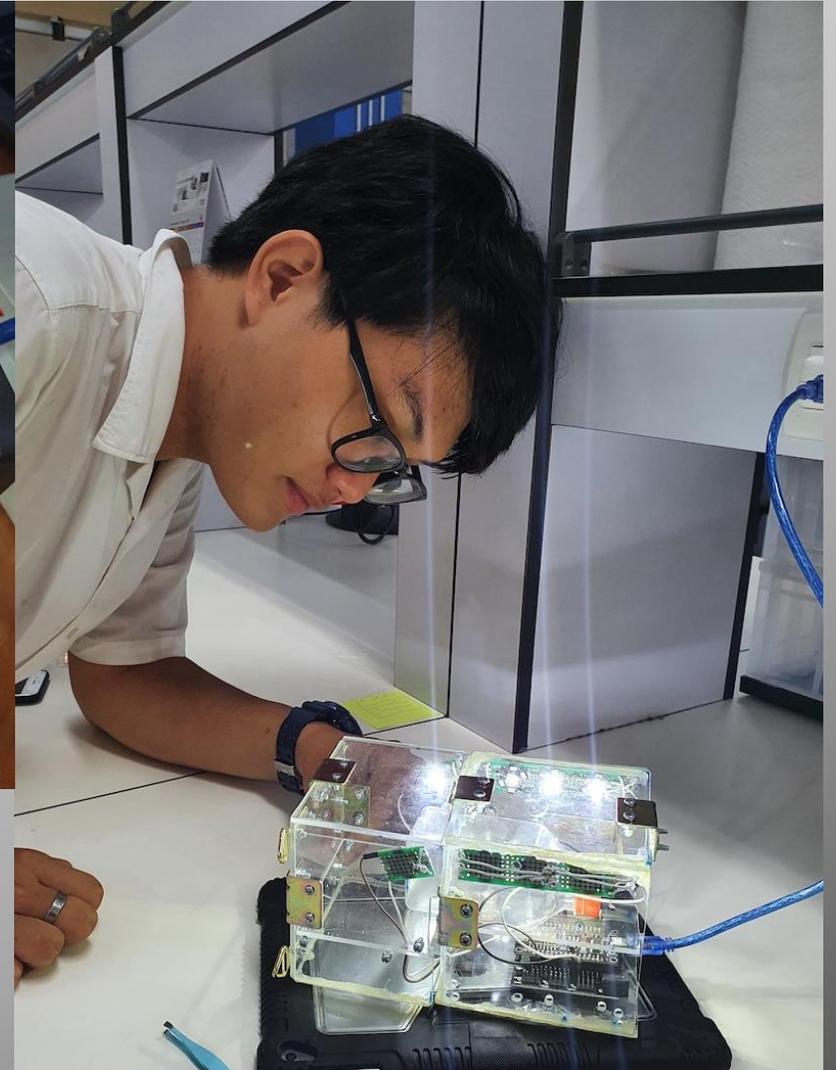
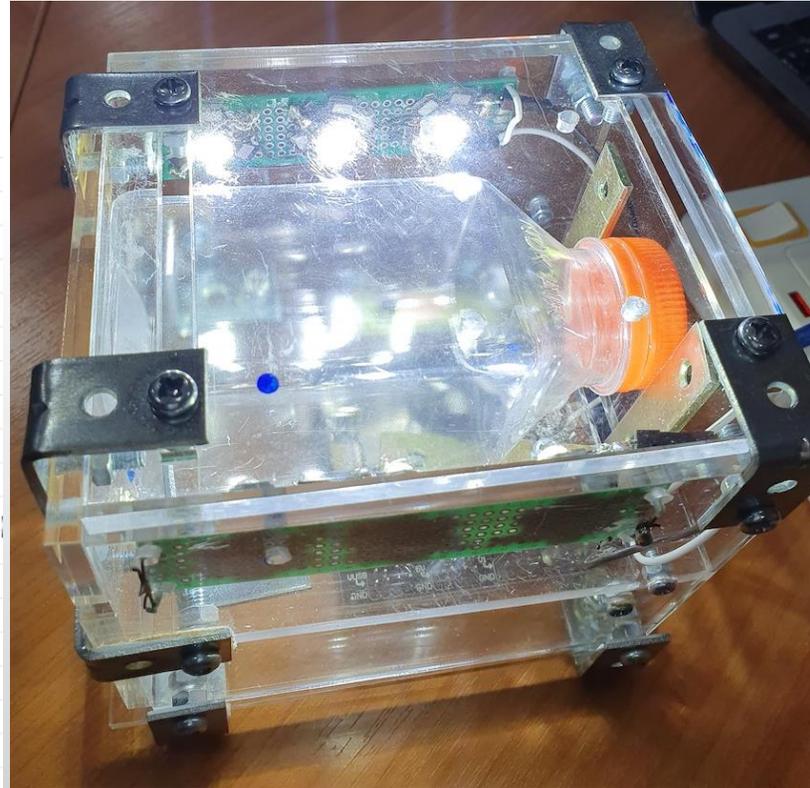
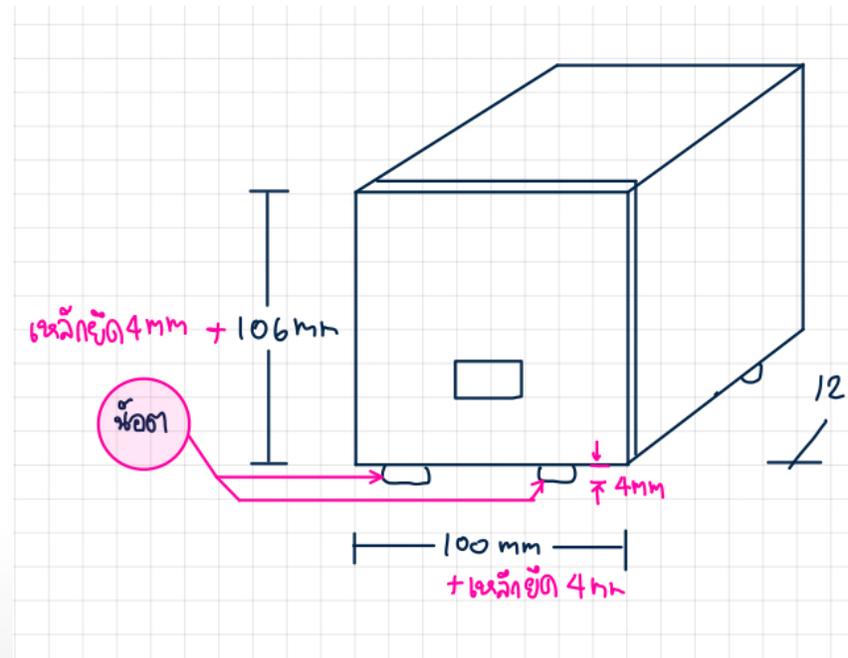
- Study adaptation and yield of Asian watermeal under hypergravity environment
- ESA’s LDC (Large Diameter Centrifuge) enable a long-term gravitational-controlled study
- Funded by UNOOSA, ESA and partially by Mahidol University
- Scheduled by Fall of 2023



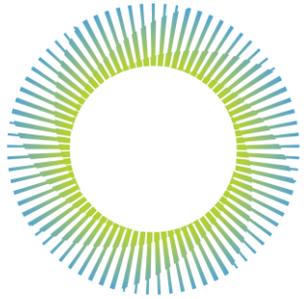
HyperGES “Watermeal, the Future Food Source for Space Exploration”



Watermeal Chamber Development Design Concept

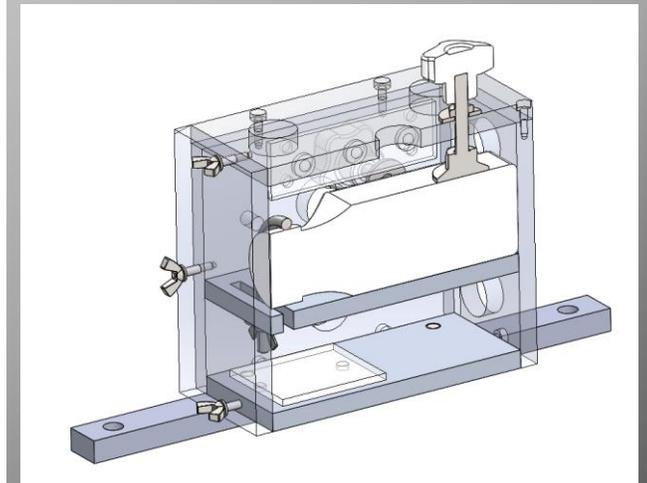
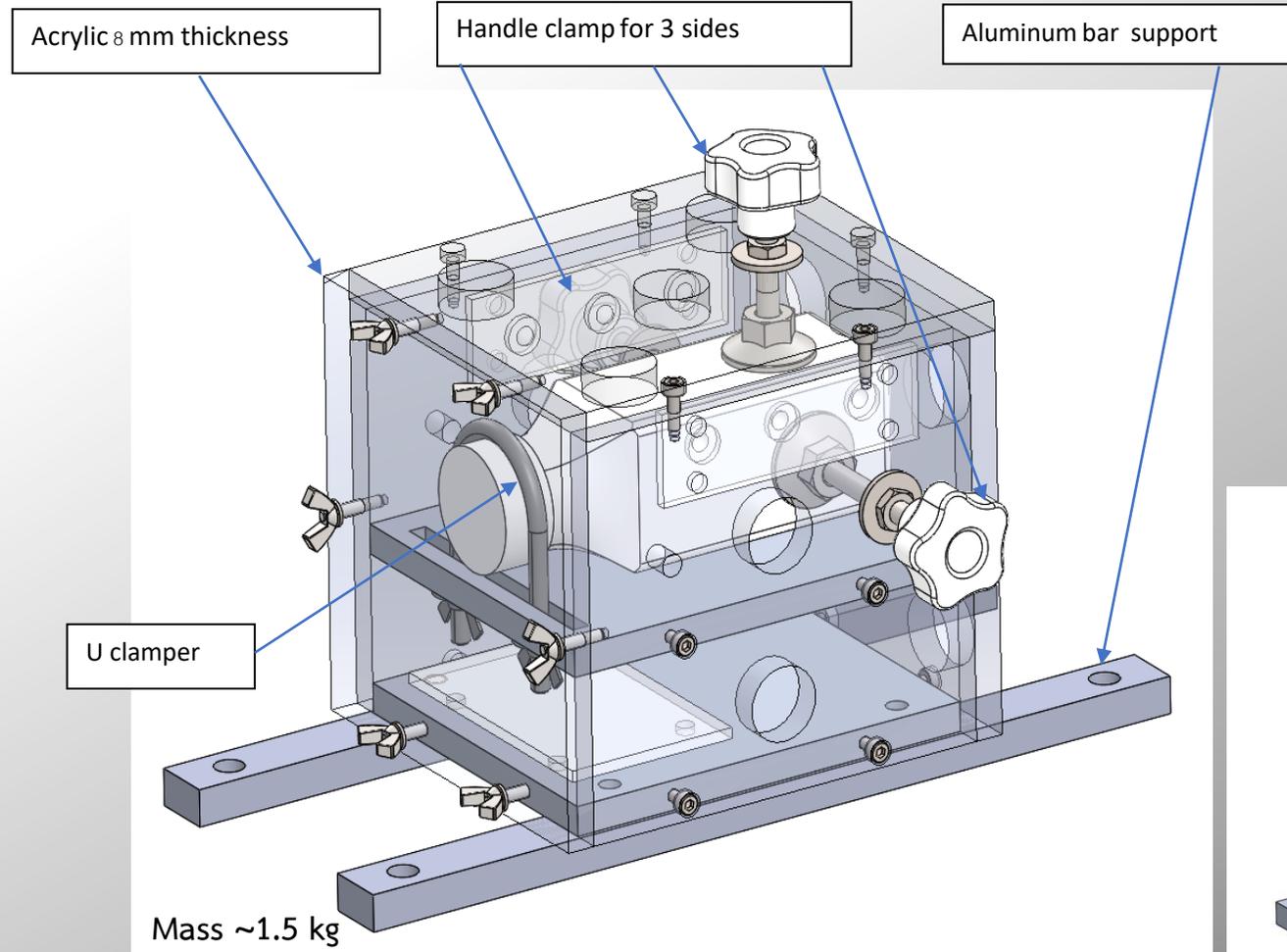


Watermeal Chamber Development Design #1



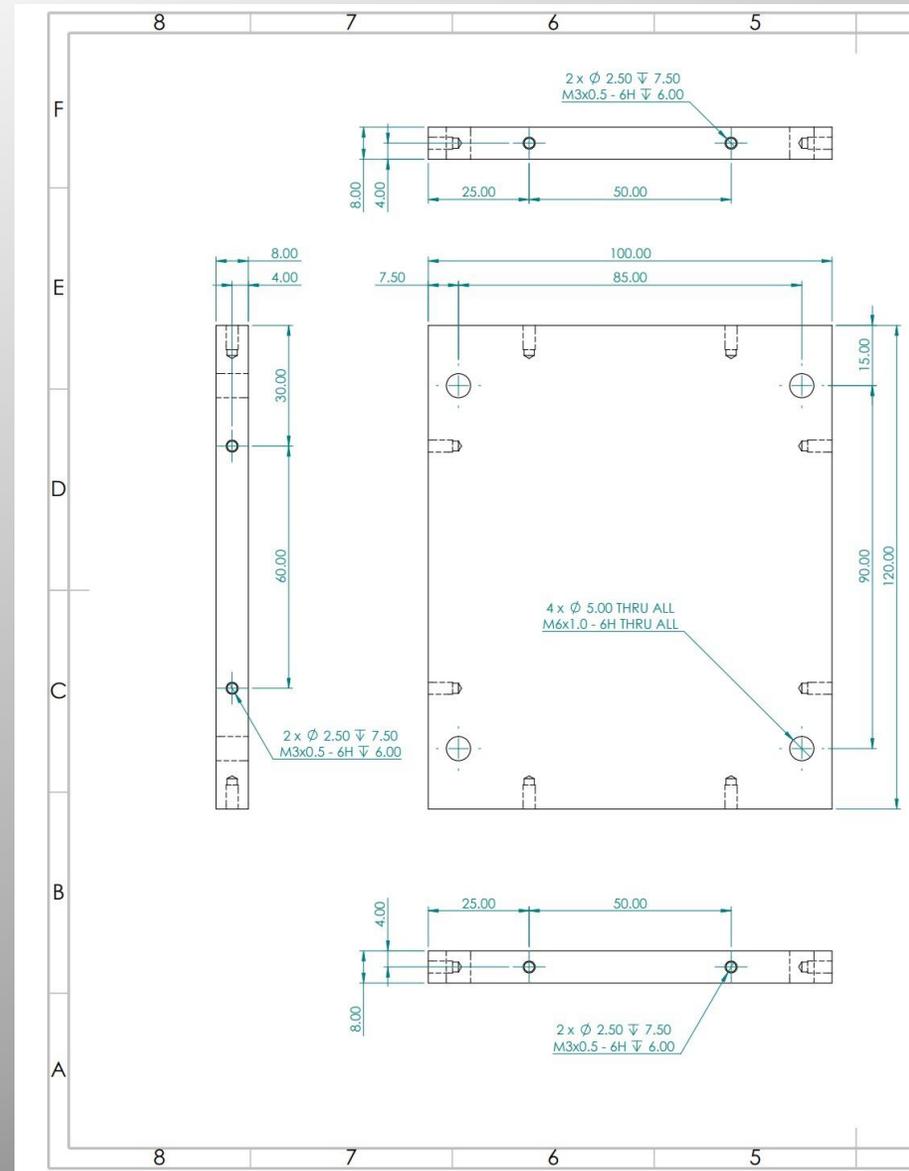
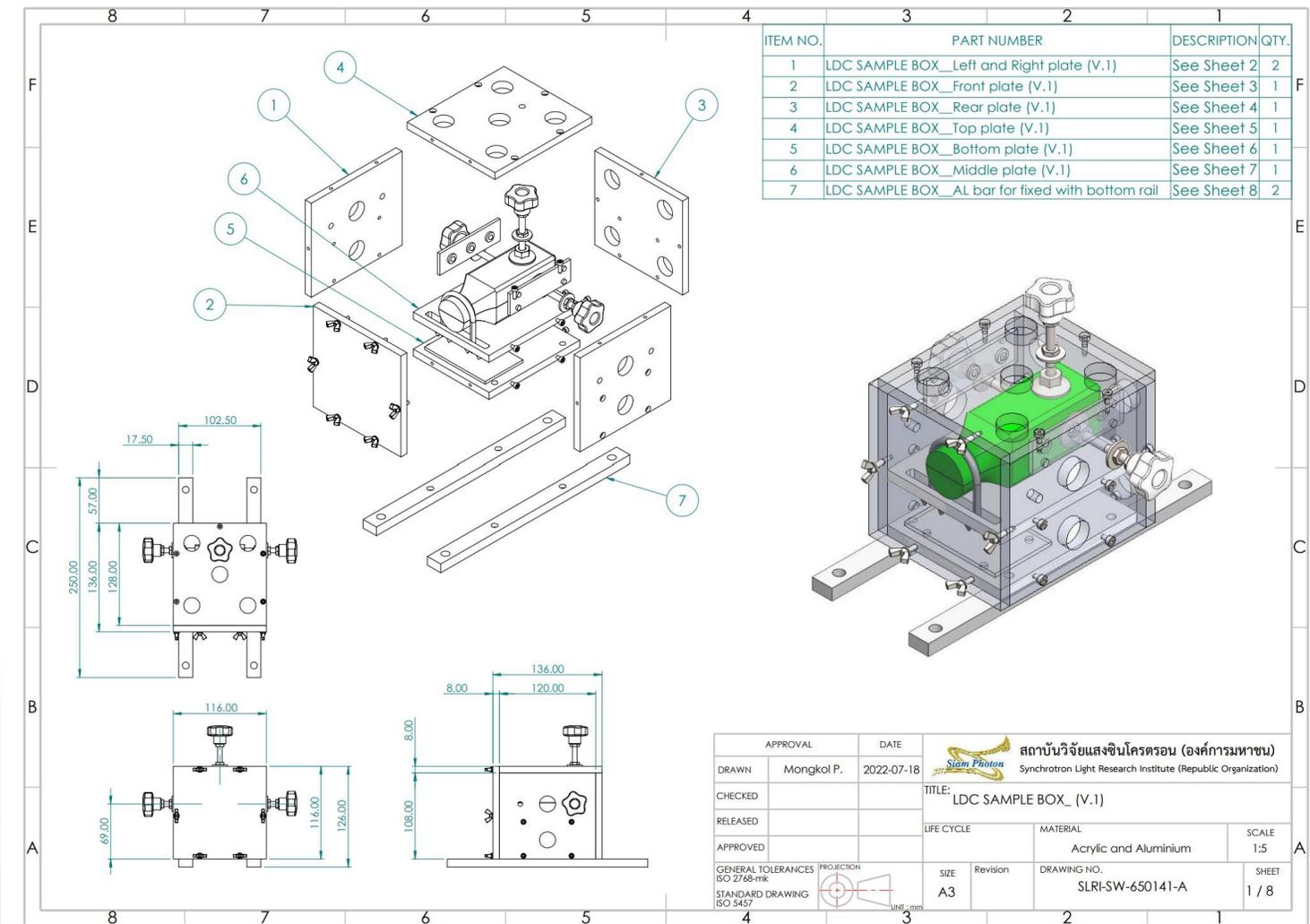
SYNCHROTRON
THAILAND
CENTRAL LAB

Watermeal chamber design

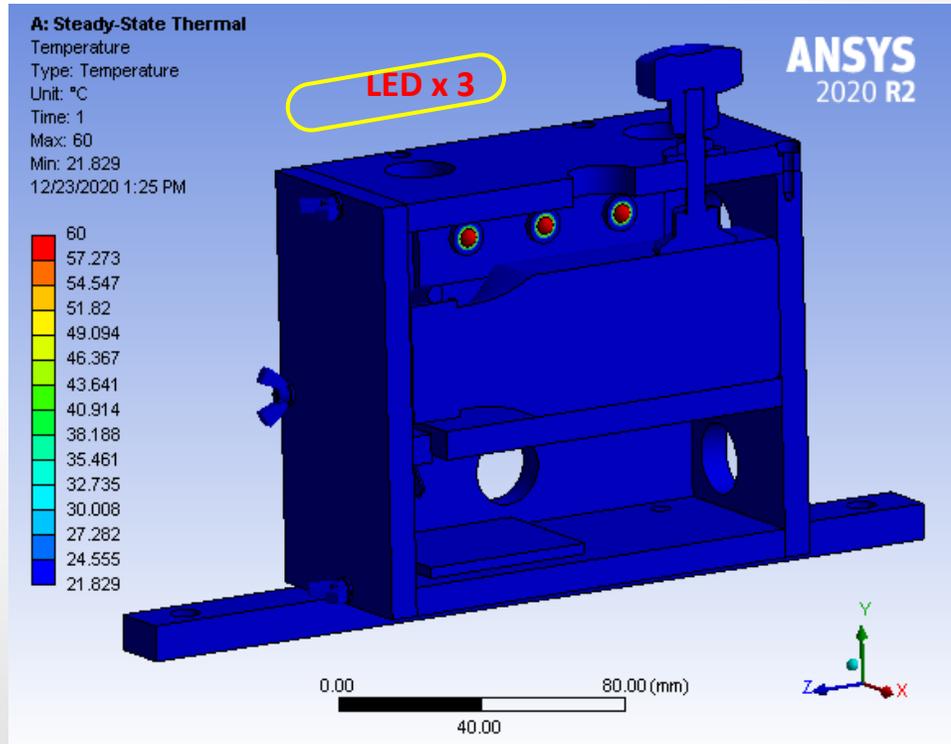


Faculty of Science
Mahidol University, THAILAND

Watermeal Chamber Development Design #1

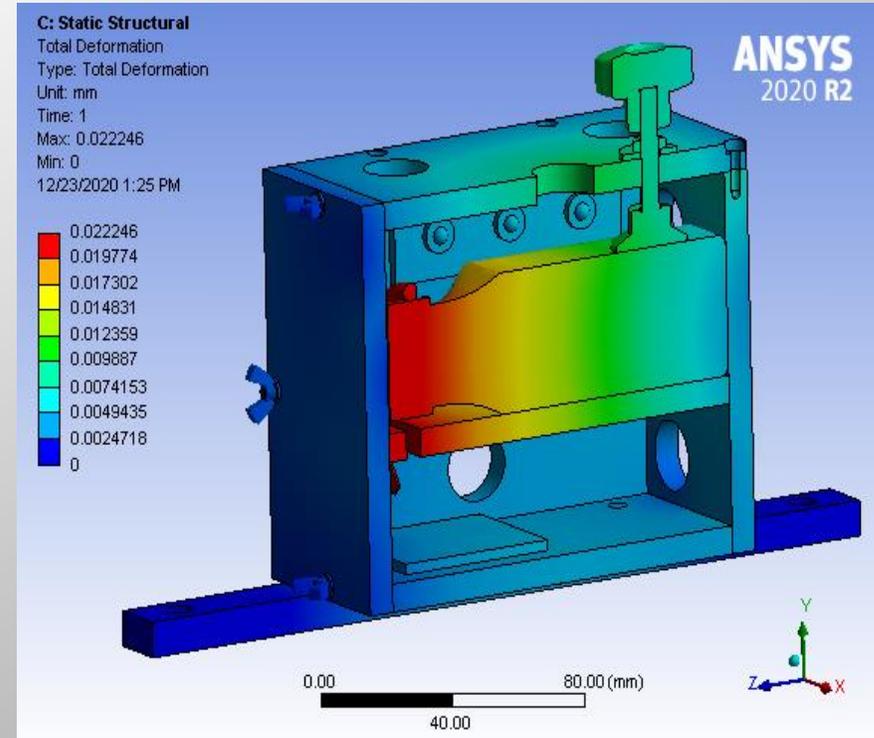


Temperature effect from 1W LED x 3 (max. $\sim 60^\circ$)



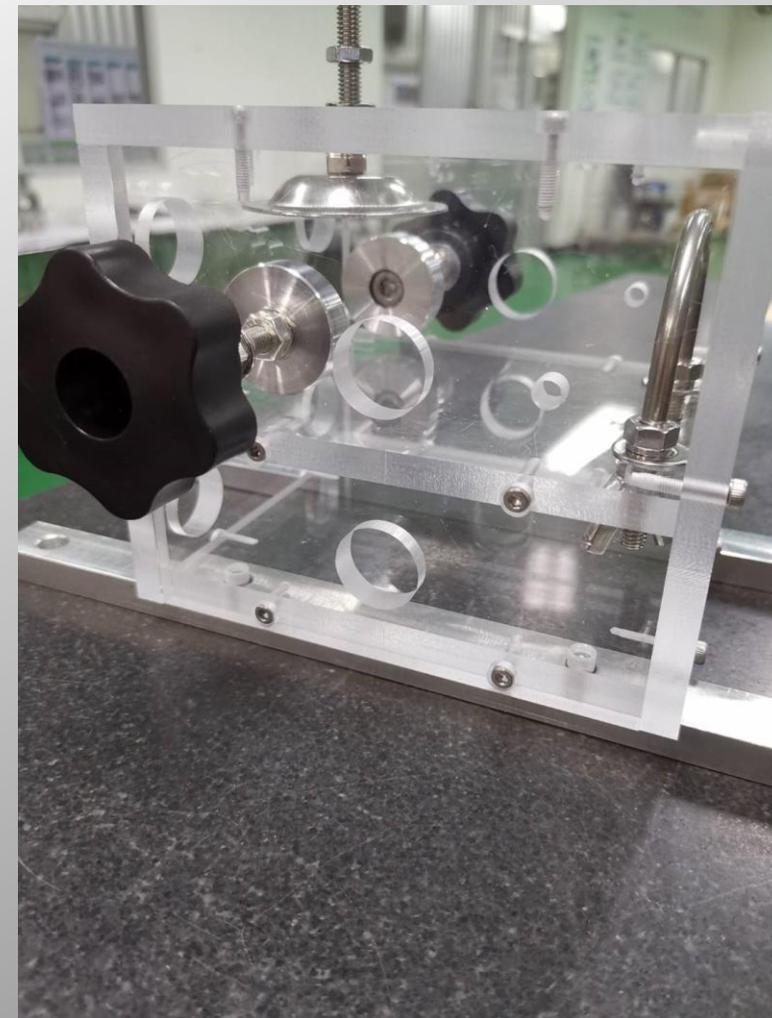
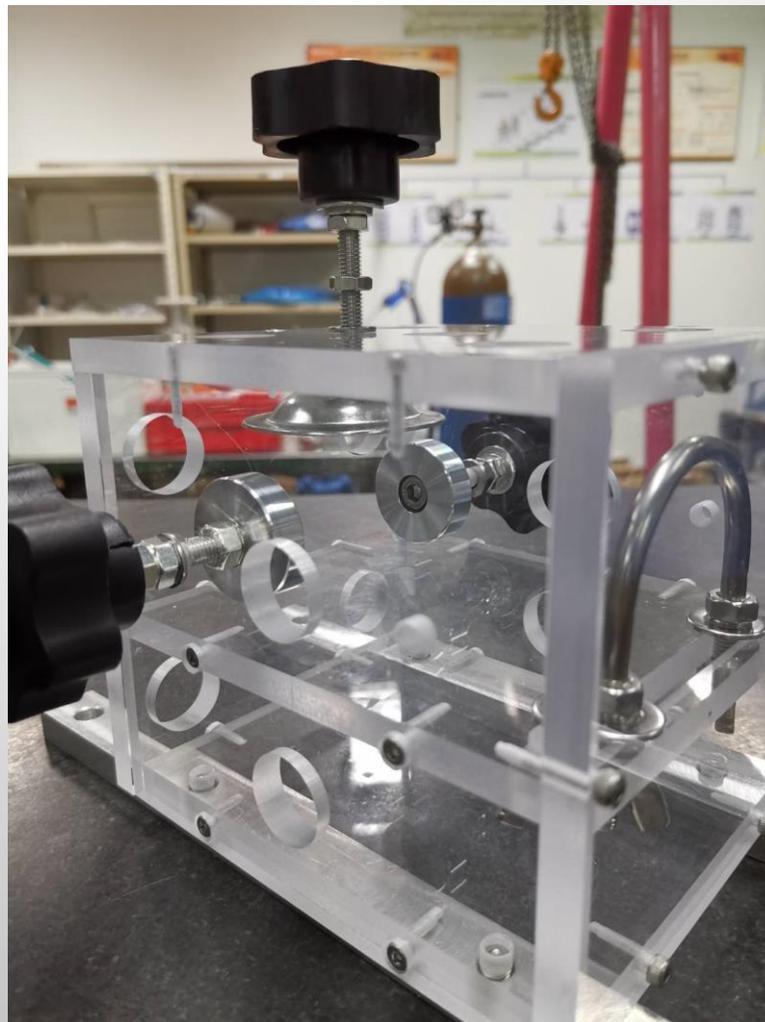
Simulation result for 4g load

Total Deformation





Manufacturing Facility at SLRI

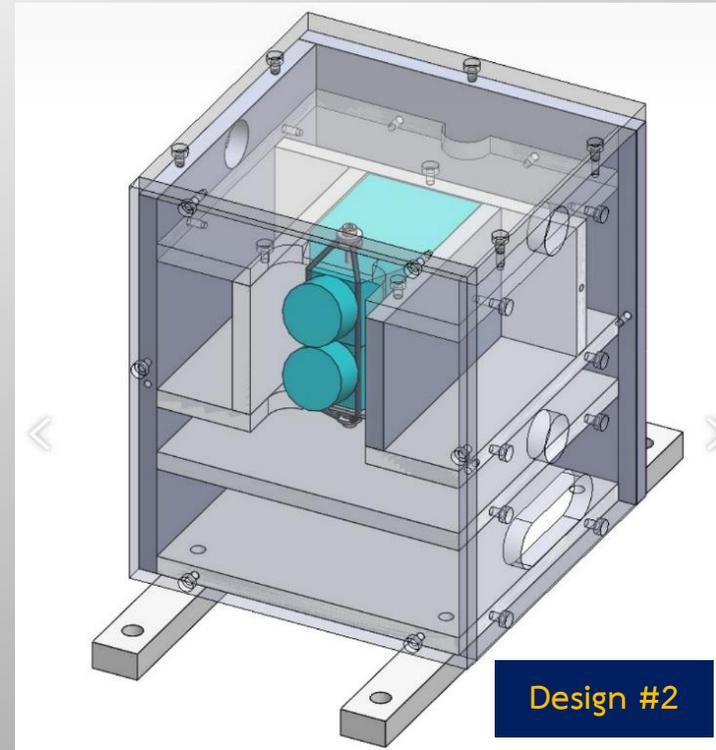
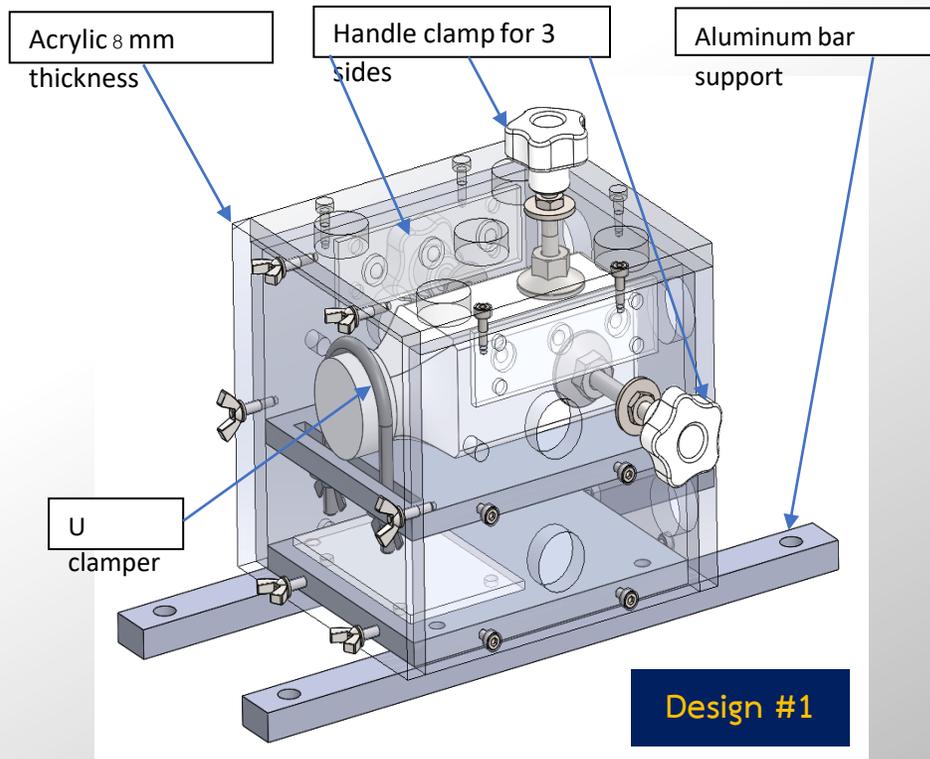


Watermeal chamber design #1 limitations

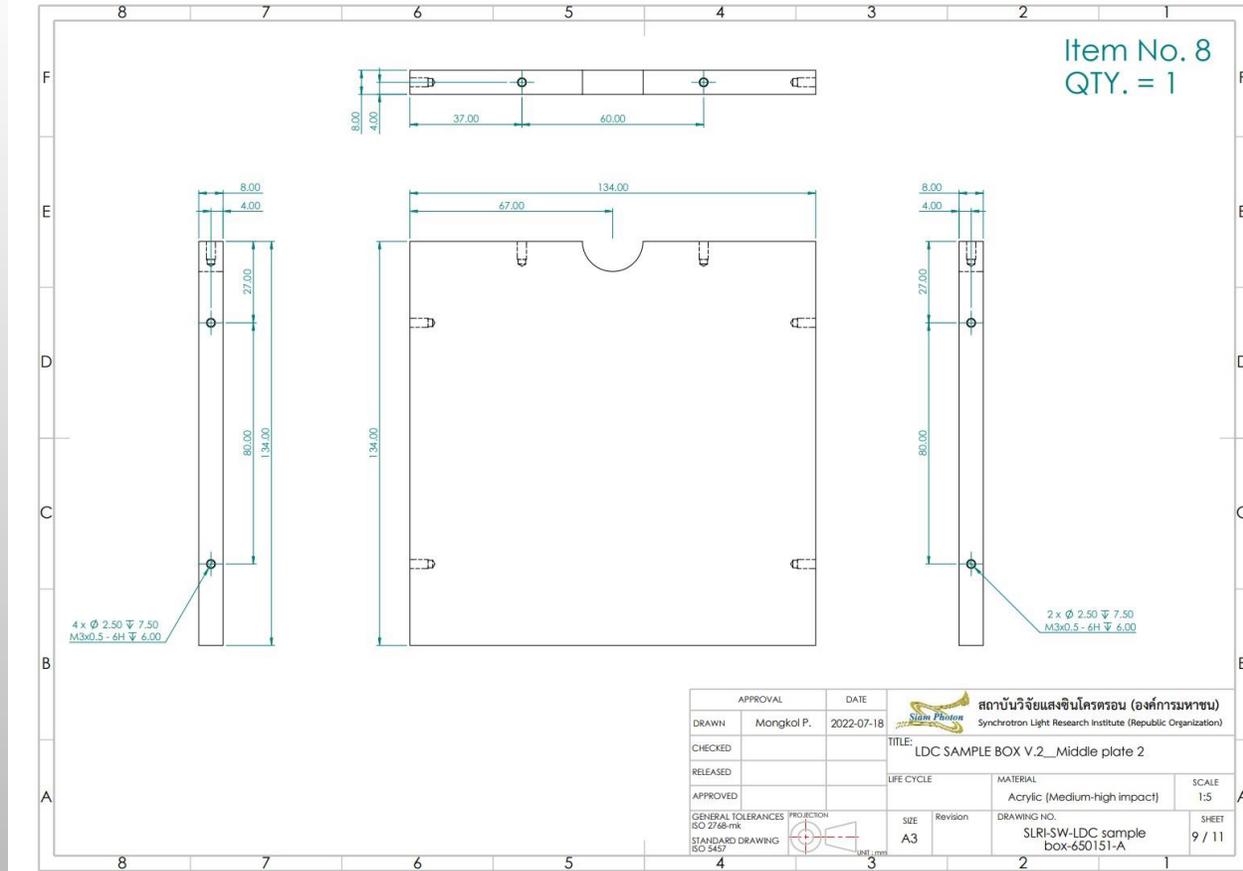
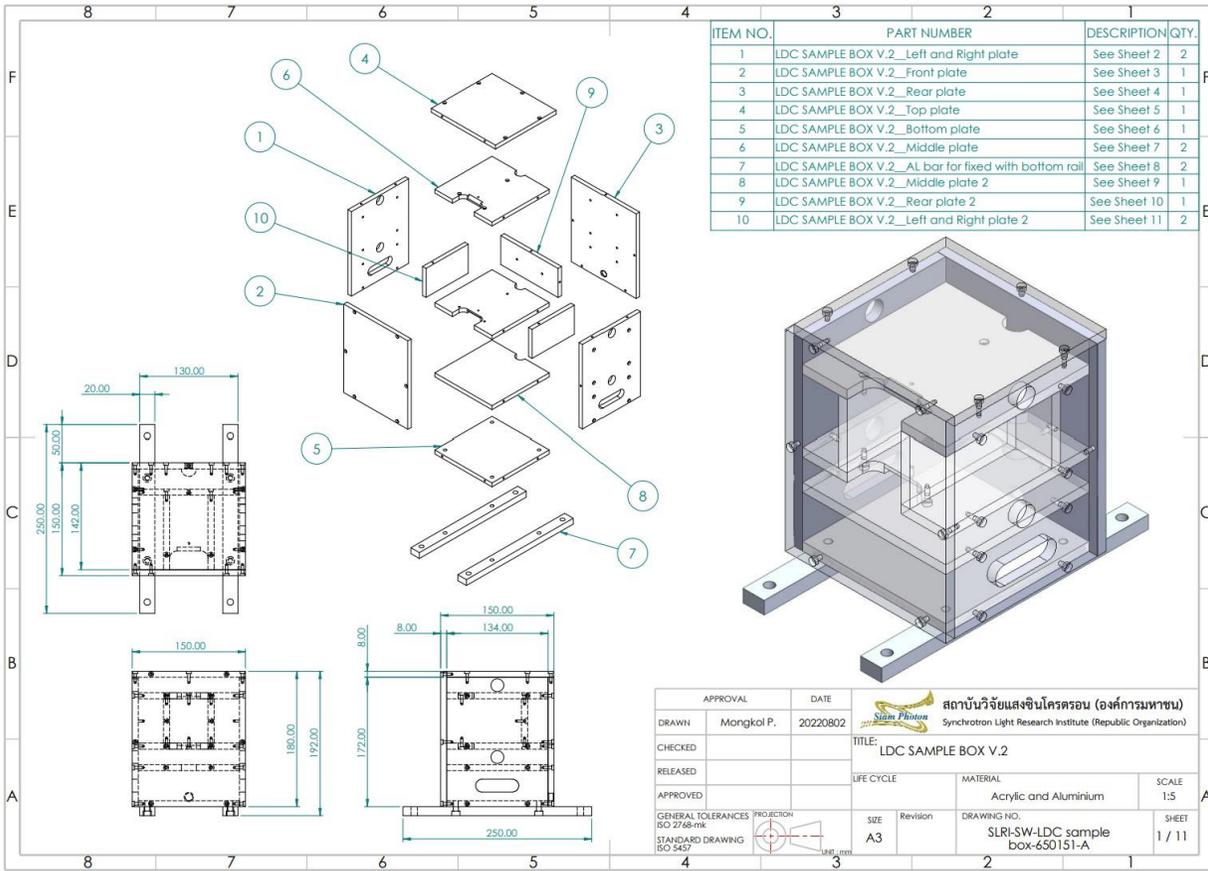
1. Low internal space
2. Fit only single plastic flask
3. Flask holder design is finicky
4. LED light panel will be too close to plastic flask

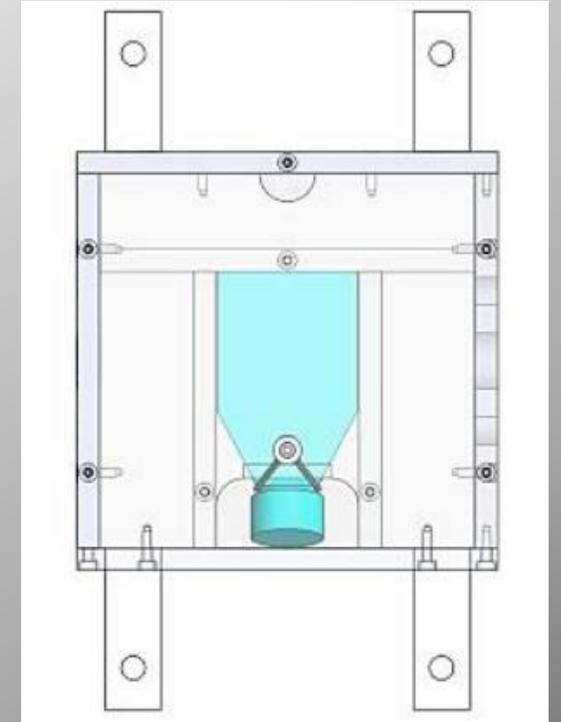
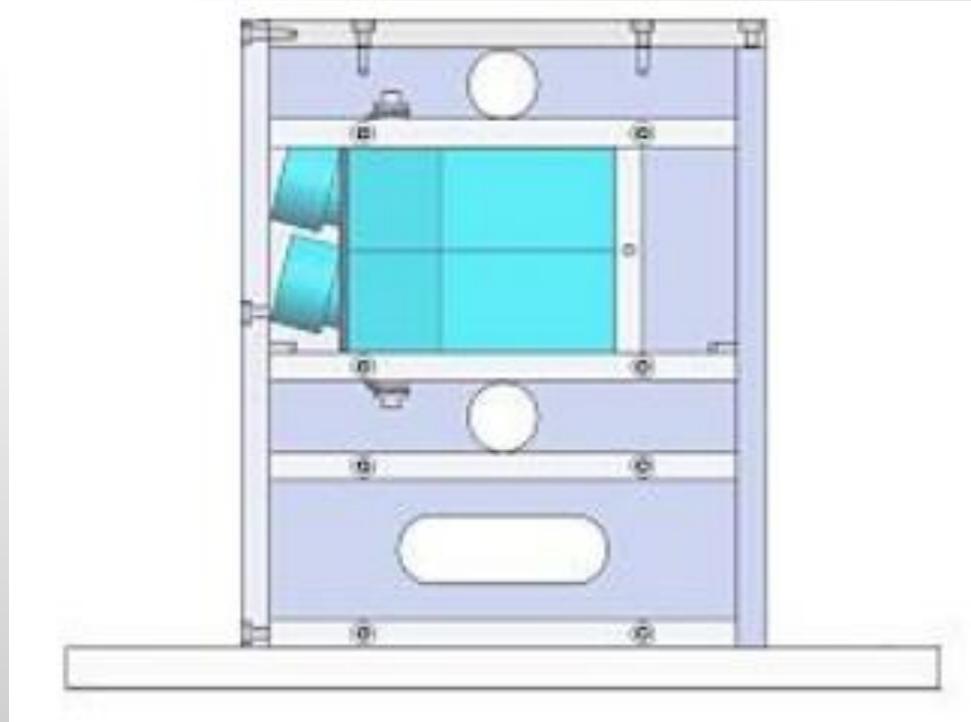
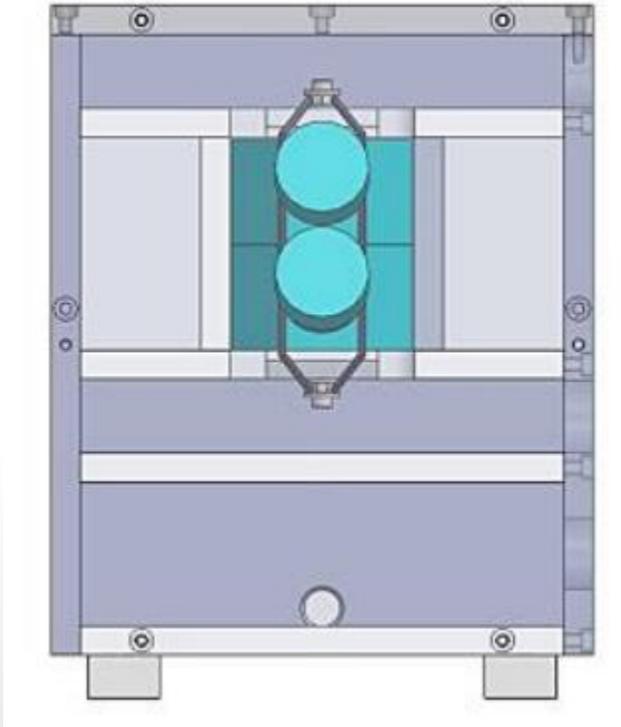


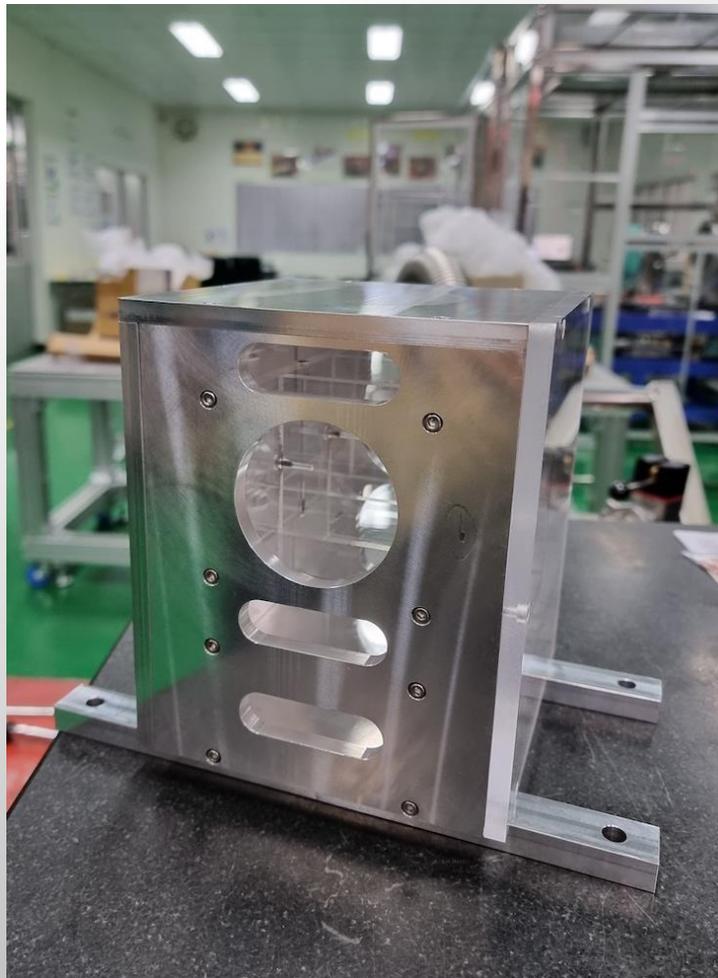
Watermeal Chamber Development Design #2



Watermeal Chamber Development Design #2

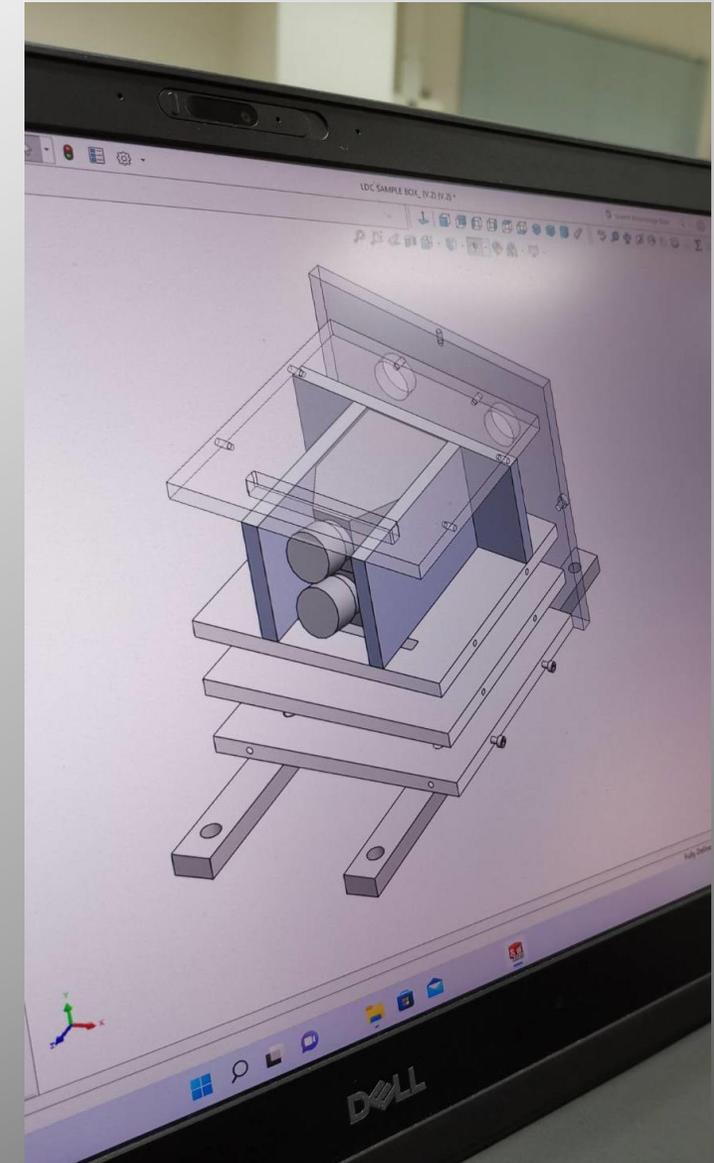




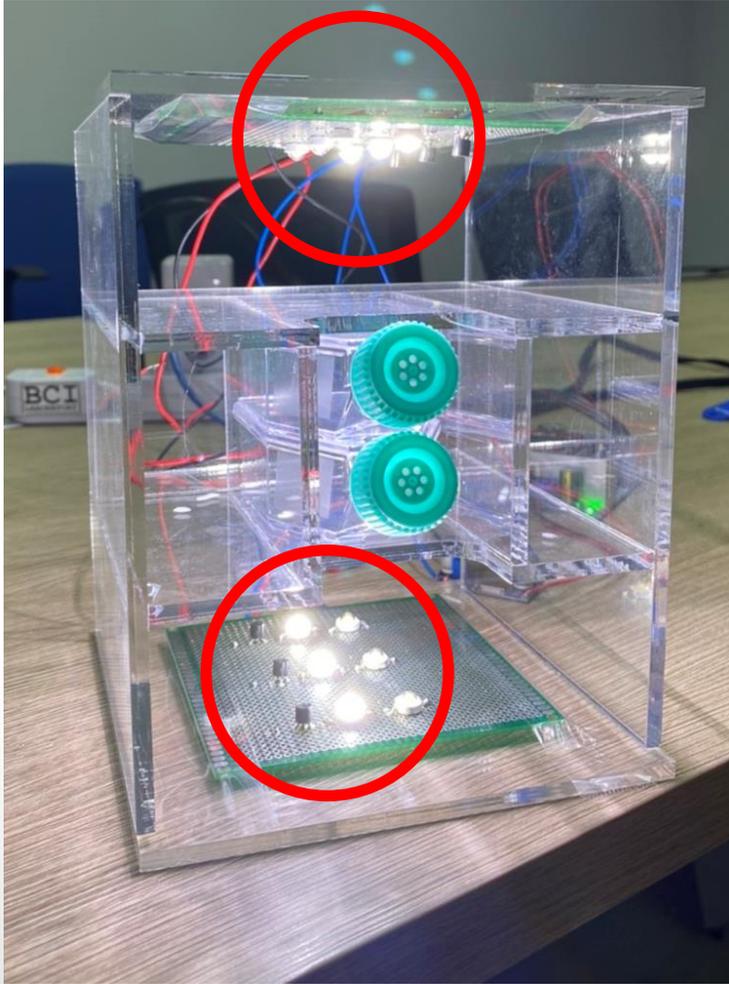


Watermeal chamber design #2 improvement:

1. Much more spacious
2. Fit 2 watermeal flasks
3. Metal side panels to strengthen the construction
4. LED panel driver now in separate compartment for safety and heat dissipation



Watermeal Chamber Development LED light



With improved design, we can use double side LED panels with separate LED driver board and control board compartment for water damage prevention inside gondola

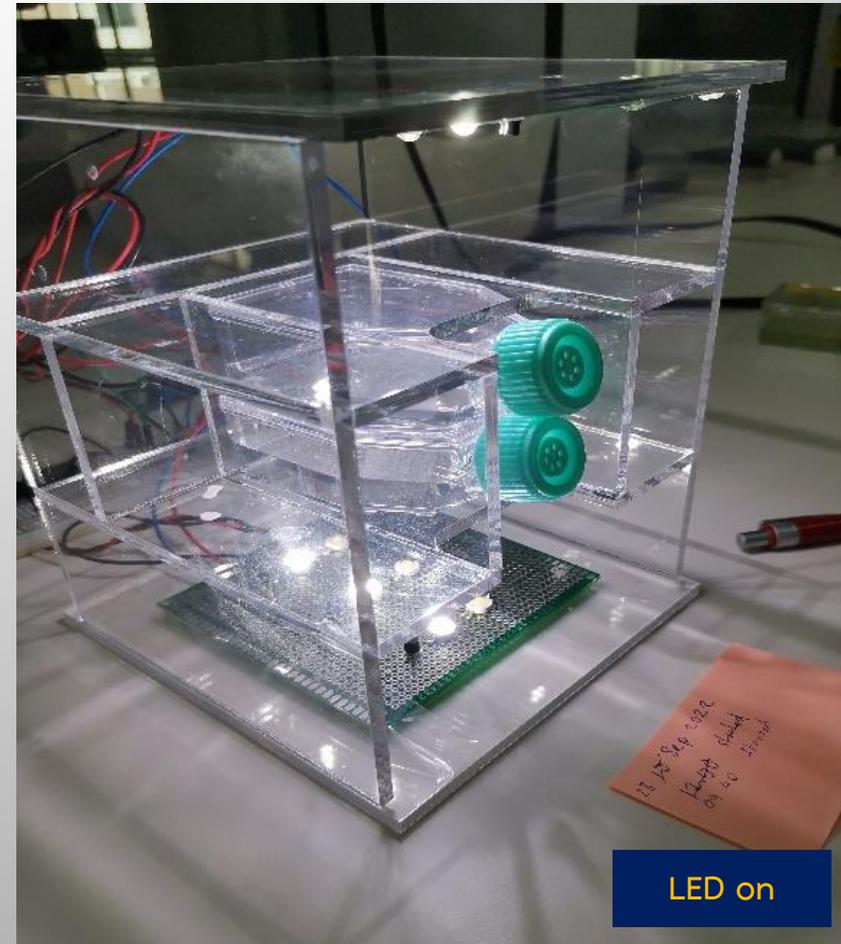
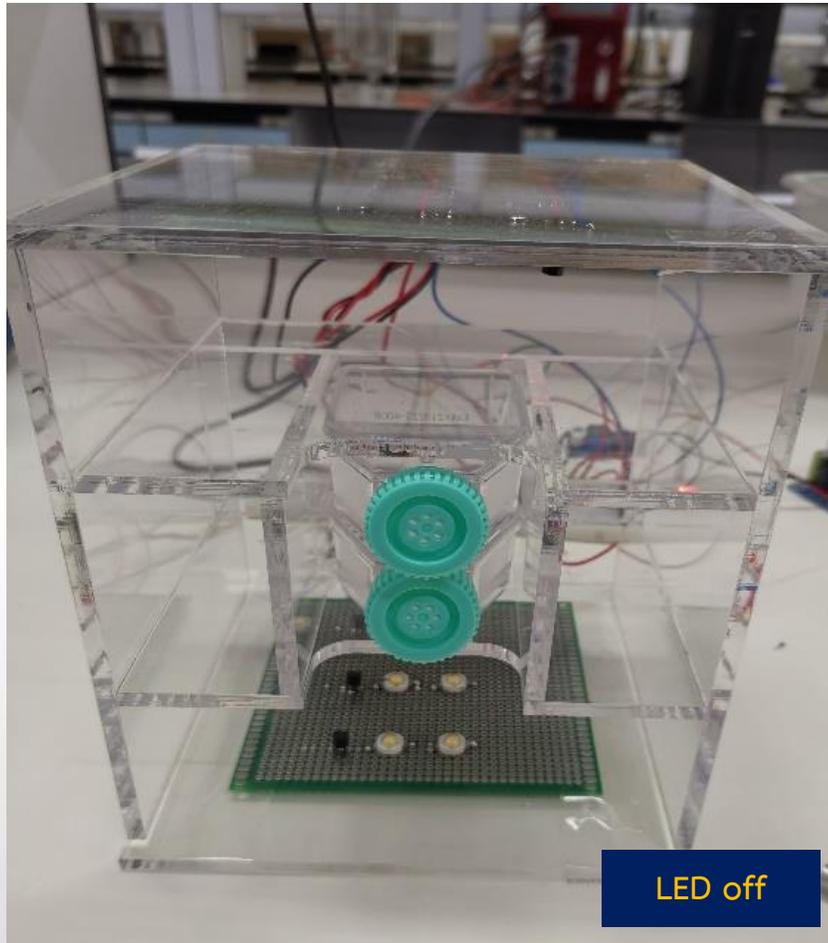
Watermeal Chamber Development LED light



Department of Plant Science research greenhouse



Watermeal Chamber Development LED light



LED light system testing

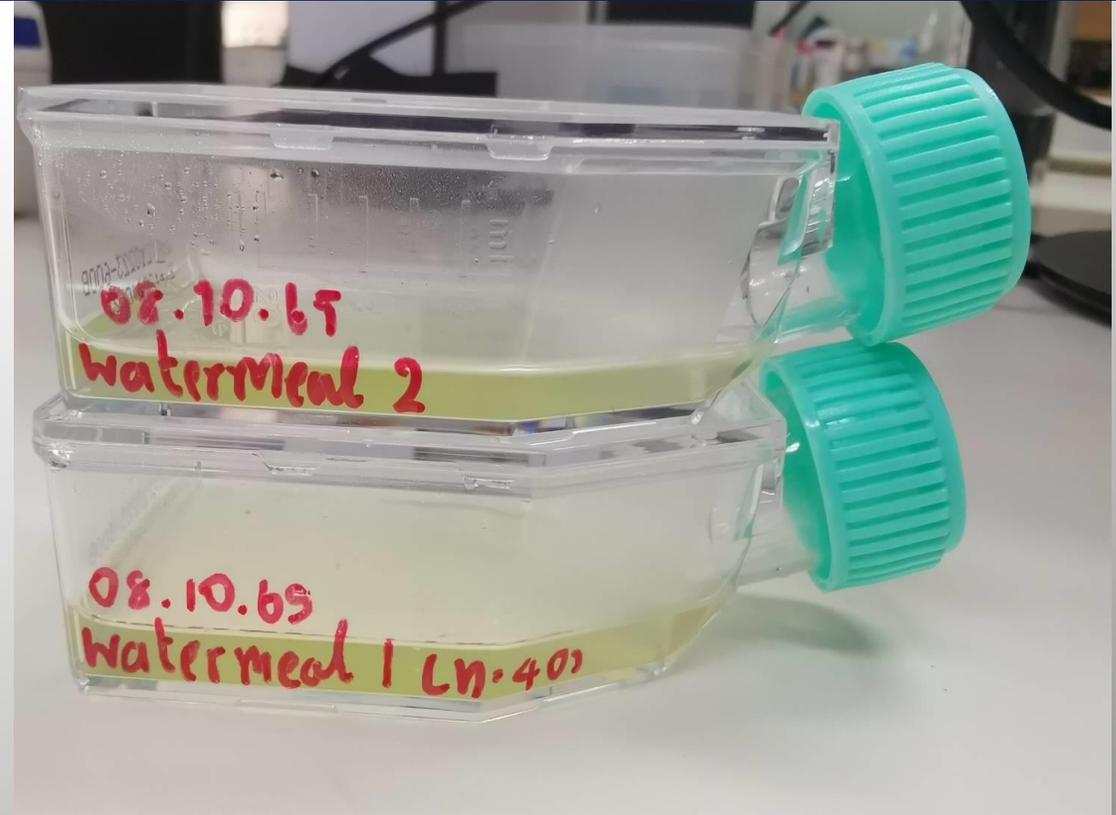


Table 3: Average counting from 2 flasks starting from day 0 until day 10
(SD = 5.01 and 4.39)

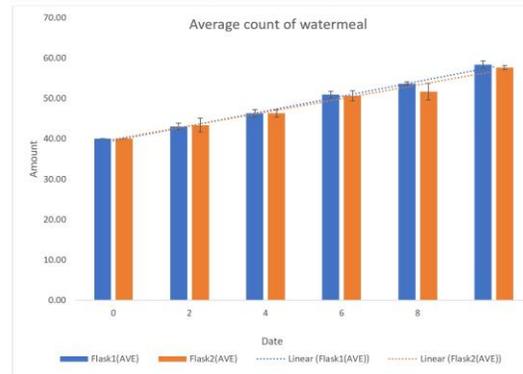
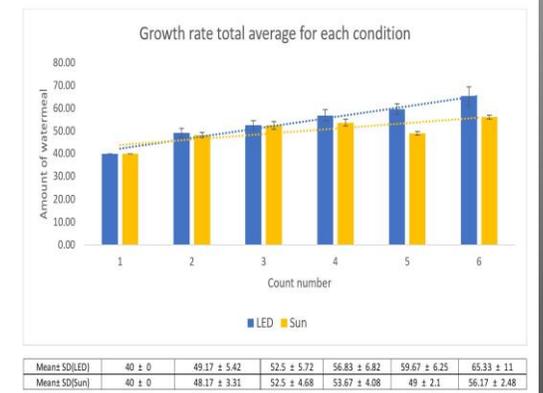


Table 6 Growth rate total average between LED and Sunlight



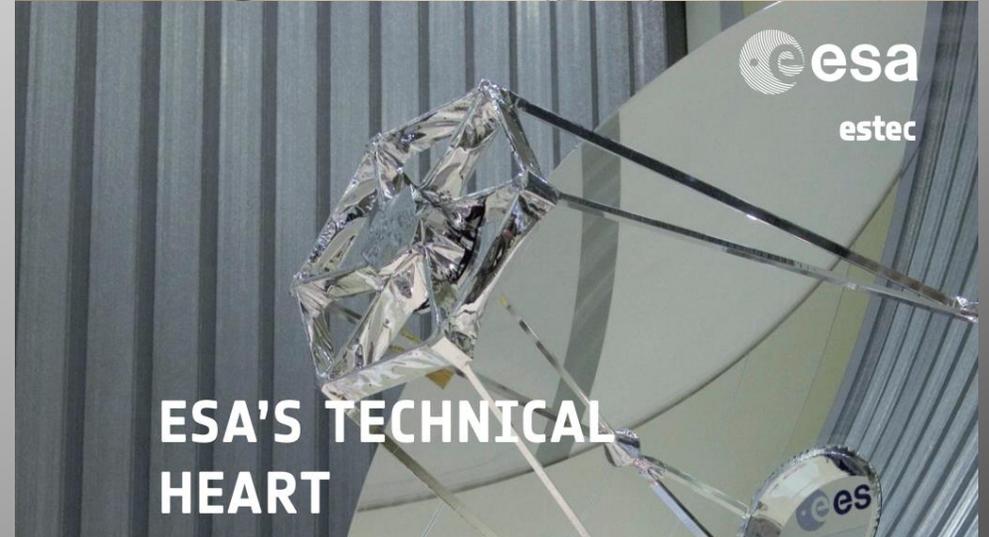
Watermeal chamber preparation summary

1. LED system is proven function and reliable for at least 1 month
2. LED yield watermeal growth comparable or better than natural light
3. Watermeal grow and develop well in low light, indicated its suitability for closed system with artificial light environment



Experiment design highlight at ESTEC

1. Total of 4 watermeal chambers per gondolas plus 2 controls chambers, 2 watermeal flasks/chamber.
2. Study watermeal growth and survivability for 10 days under 1G (control) and 20G of hypergravity.
3. Analyze chlorophyll, carotenoid, protein and nutrition content.



HyperGES and community impacts in Thailand



- Students stepping out of comfort zone
- Expand space biology research opportunity and awareness
- Collaboration with top organizations
- Government research grant opportunity
- Preparation for space economy through space ecosystem development in Thailand



HyperGES and community impacts in Thailand



National Innovation Agency (NIA) report

- About 1,000 of space-tech-ready enterprise in Thailand
- More than 50% investment increase annually in start-up
- Annual growth rate no less than 10%



SPACE ECONOMY

LIFTING OFF 2023

Gateway to Growth in Space & Aerospace Industry

เปิดประตูก้าวสู่โอกาสในอุตสาหกรรมระดับโลก ขับเคลื่อนธุรกิจให้เติบโตใน **อุตสาหกรรมอวกาศและอากาศยาน**

โครงการพัฒนาวิสาหกิจเริ่มต้นที่ใช้เทคโนโลยีเชิงลึก ยกระดับการพัฒนา **SPACE TECH STARTUP** สู่อากาศทางธุรกิจในระดับนานาชาติ



UPSTREAM

- Launch Systems/Service
- System Infrastructure
- Satellites Design & Manufacturing
- Ground Systems
- Space Explorations

AEROSPACE

- Aviation Hardware & Equipment
- IoT, AI, Software for Aviation
- Unmanned Aircraft Systems (UAS)
- Aviation Operations & Management Solutions

DOWNSTREAM

- Communication & Tracking
- Data & Satellites Services

OTHERS

- R&D in Space
- Value-added Services
- Non-space Application e.g. energy, advanced material



สมัครได้ตั้งแต่วันที่ - 15 พฤษภาคม 2566



HyperGES Outreach Activities in Thailand



HyperGES Outreach Activities in Thailand





Thank You

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