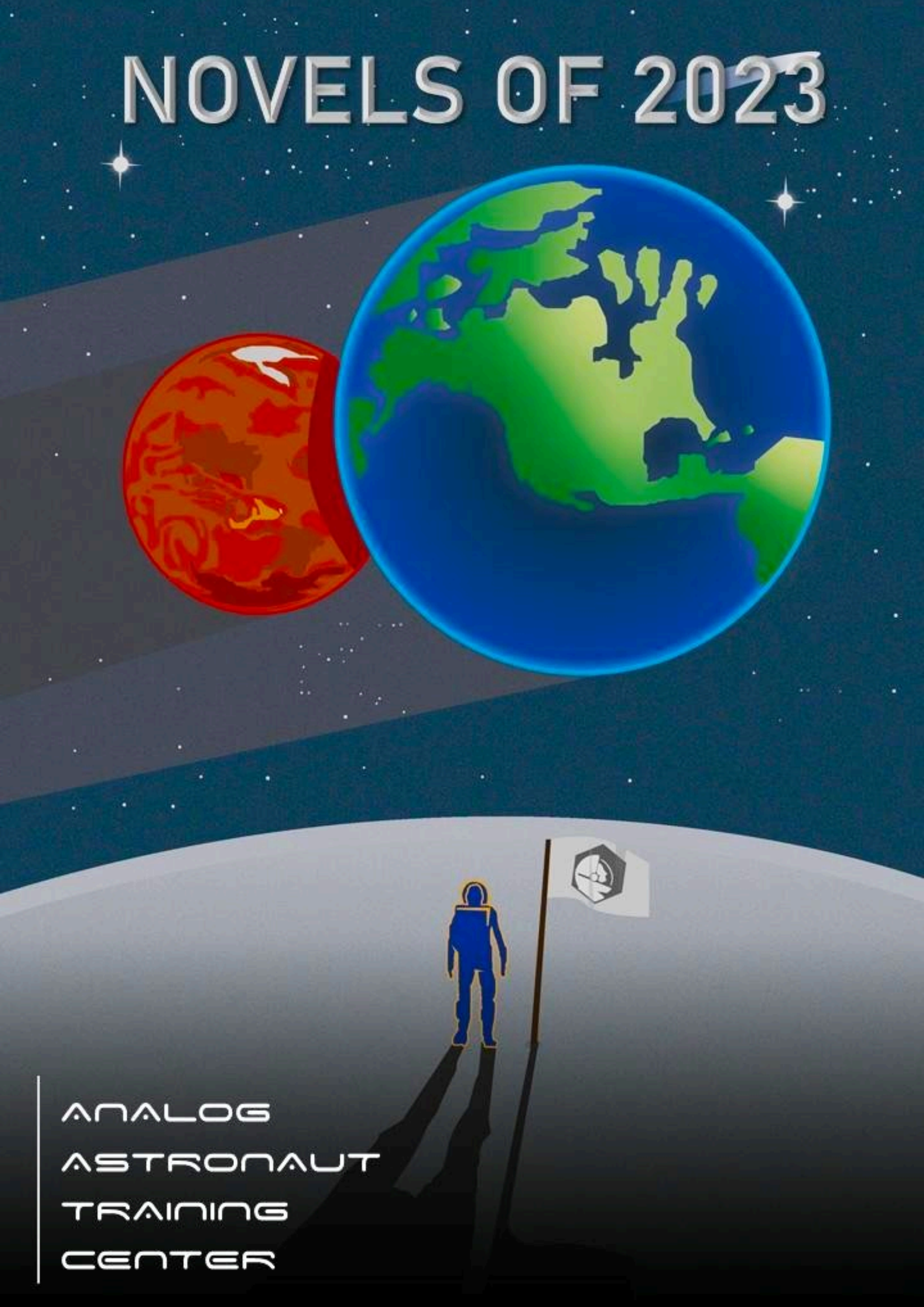
NOVELS OF 2023



ANALOG
ASTRONAUT
TRAINING
CENTER

NOVELS OF 2023

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Foreword

This book is a documentary result of analog research and hands-on space education activity at AATC in 2023. We are happy to share this collection of daily and experimental original reports related with stay in the habitat, which were written by exceptional analog astronauts and our mission control centre. Why? Because the diversity of voices of unique people from all around the world is the most efficient inspiration to create new interdisciplinary projects. "Novels of 2023" represent new stories which in fact have nothing to do with novels as a literature species. We selected reports from 15 analog missions and prepared specially for all, who want to develop in space sector. The character of documents is not standardized. Sometimes it is more observational, other time more dry resembling synthesis of data in isolation. Some works presented here were composed inside the habitat during the mission, others were written after the mission in retrospective way. This diversity mirrors extraordinary character of analog missions in general.

Year 2023 was the best until now considering number of organized analog missions by AATC. We organized 2 week mission, one day missions, and multiple one week lunar and martian missions. We had another two only woman missions, also only man missions. We had two very unique missions of a single people like in the Martian movie. Finally, we had missions with more than 6 participants.

Editors would like to thank authors for their hard work in hard conditions. We are sure that people like you challenging to exceed limits, will change this world in a positive way. You are more givers than takers. You are strong. You are not afraid of thinking big and high. We welcome you and other readers to read this book, inspire and the most important: to enjoy!

Editorial Board

Psychological Adjustment in Analog Astronauts, Celia Avila-Rauch, Spain

Self-control is primarily about preserving life. The core threat (fear) and the core (need) are the two regulators of human experience and action. If I know a person's primary fear and core needs, I will know the most central motives of his behavior and predict the cause for his actions and what should not be the cause. Research confirms that our feelings have a significant influence on our decision-making. We are unaware of how we feel or how those feelings influence our behavior. The aim of this work was to analyze adjustment process in EMMPOL analog astronauts from a psychological perspective.

Adjustment

For many people, change implies challenge; for others, loss of control. We believe that human beings live and experience change throughout their lives, and each change generates a specific fear or

excitement to escape from their comfort zone. It forces us to put into action our capacity to adapt to the environment. Uncertainty causes anxiety until we adapt again to the new situation. Human beings must make decisions by bringing emotions and thoughts to the fore, even if they seem contrary. To understand a person, we need to know what moves him, positively and negatively; what about wishes, goals, plans, values, fears and dislikes?

Adaptation is the physical, mental, social or another process by which an element modifies or transforms itself to better respond or react to a purpose, obstacle or situation. The experience of being confined and isolated in a hostile environment will influence our behavior, mood, and perception of realities and require a complex adaptation process. In these missions, exceptional experiences are shared and require good communication, collaboration, cooperation, compromise and commitment.

Analog missions training allows the assessment and analysis of crew performance, psychology and interpersonal relations to develop preventive measures to deal with dangerous situations while improving the efficiency and safety of space missions. The human brain has an incredible capacity to adapt to new conditions. This plasticity enables us to learn continually and overcome injury and loss of function. Adjustment is the meaning of these missions to visualize and experience fear from a dynamic, non-paralyzing perspective, using our natural resources and offering evidence for what blocks us and stimulates us in leadership. Our plastic brain will learn to see solutions and not to dwell on the problems.

For two years, a colleague and I observed the weekly encounter with "Earth" of the analogue missions at the Analogue Astronaut Training Centre in Poland, run and organized by Dr. Agata Kołodziejczyk and Matt Harasymczuk. There were about 18 EMMPol missions. All participants were from the University of Leiden, TU Dublin, KU Leuven, and IPSA, ISU, recruited through the EuroMoonMars group.

The cognitive process is the one that allows us to decode the information that comes to us through the senses. However, not all processes are equally complex. There is a difference between

primary and higher cognitive processes. All mental processes are essential to adapt to our social environment and survive. High-performing teams must be prepared to make decisions in a matter of seconds, with the analytical skills, concentration, calmness and resilience to make decisions quickly and correctly. Our research in the Team EuroMoonMars and ILEWG campaigns aims to demonstrate that Emotional Intelligence Skills could be a tool to support the Cognitive processes that will be influenced by the complexity of the tasks required by high-performance teams. The cognitive system is spatial orientation, attention, memory, learning, executive functions, video-spatial skills, social cognition, decision-making, language, problem-solving, reasoning and thinking. In psychology, we must take into account how we learn, how we remember, how we feel and how we forget. A series of questionnaires will be used. In the pre-campaign, EQ skills training will be offered: (TMM24) emotional meta-awareness scale; GES group cohesion scale; HEXACO personality questionnaire; TECA cognitive and affective empathy scale; DASS stress, anxiety and depression scale; WAIS cognitive assessment of digits scale; SCL-90-S scale of the psychological state of individuals. ALQ leadership scale of attachment theory. We chose a leadership scale designed by the social psychology department of the UNED (Spanish National Distance University). It is based on Bowlby's attachment theory (1982), which describes and explains the emotional attachments between children and their caregivers in the first years of life. These questionnaires will provide comparative and indicative data. Usually, these professionals require an exhaustive selection process, with continuous training in different areas before starting their professional careers and developing their activities. However, they have not been trained in emotional intelligence and have not analyzed emotional parameters.

The selection of a leadership questionnaire was prompted by the differences in group cohesion between the different missions, and we wondered whether leadership was a relevant factor despite the short duration of the task. For better performance of the team, we will have a group leader who will give good guidance in the daily tasks, being aware and respecting the experience and ways of working of each one and making them aware that in the end, they are a team with a joint mission. On the other hand, technology is

constantly changing and developing. Hence, the group needs to learn faster, be open to collaboration, listen actively, and recognize that complex mission activities can be stressful or tedious. Still, individual personal factors can also arise because of stress. All of these can affect cognitive performance and, therefore, the tasks.

High-performance teams must understand their personality characteristics and qualities to foster their resources in everyday and critical situations. That is why the space psychologist is there to help the crew create lifelike environments and experience the interrelationships between them, accompanied by experts who can guide them to improve their skills, knowledge, and attitudes.

Our research at the Team EuroMoonMars and ILEWG campaigns aims to demonstrate that Emotional Intelligence Skills could be a tool to support the Cognitive processes that will be influenced by the complexity of the tasks required by high-performance teams. The cognitive system is spatial orientation, attention, memory, learning, executive functions, video-spatial skills, social cognition, decision-making, language, problem-solving, reasoning and thinking. In psychology, we must consider how we learn, how we remember, how we feel, and how we forget. It is easier to remember what has been previously known. Training is fundamental, as these automated processes will help reduce the risks.

As a psychologist, we need to observe how the crew is developing. We are looking for the psycho-bio-social homeostasis of the individual. The conditions in which they are will lead to stress, fatigue, fear, boredom, and conflicts. The first step to being aware of emotions is the perception of a situation and being mindful of what happens to us, so I tried to create a mood assessment programme and the selection of questionnaires related to personality, emotions, empathy, group cohesion, how we relate to people, in some groups we integrate the control of executive functions, to also observe the level of coincidence of the differences between the "should be" and "expectations", to be able to differentiate in anxious expectations that activate the main fears.

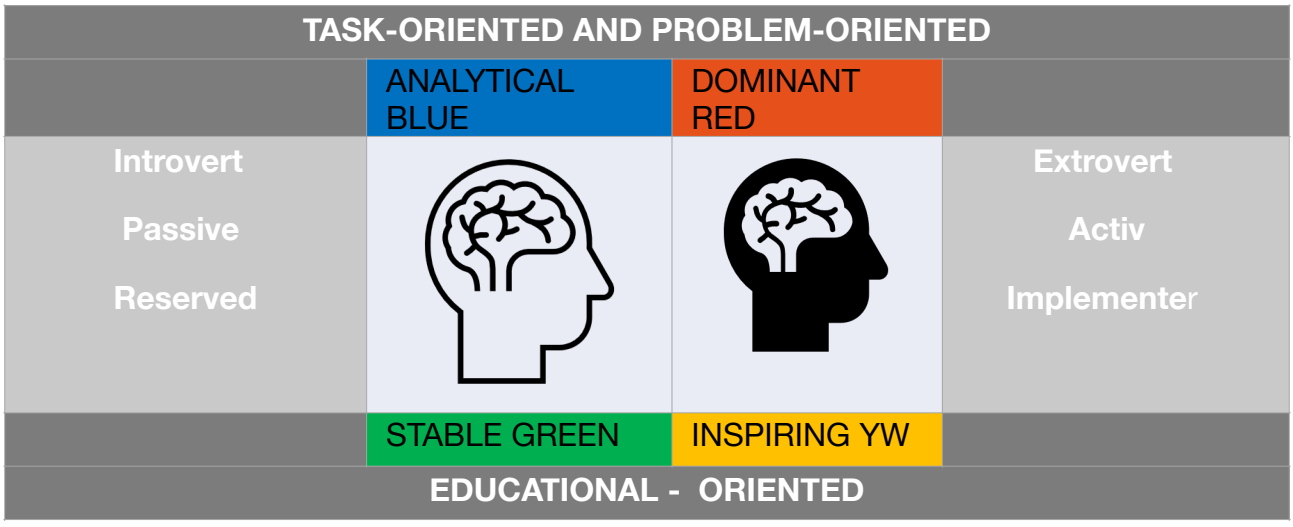
We can also look at the level of personality maladjustments and resilience.

Psychological safety in teams goes beyond interpersonal trust; there was evidence of a coherent interpersonal climate within each group characterized by the absence or presence of a blend of confidence, respect for each other's competence, and caring about each other as people. The study shows the usefulness of the construct of team **psychological safety** for understanding **collective learning** processes and **motivation.**

How we should act will be indicated by our self-esteem, ability to adapt and be aware that we are in danger, and knowing whether our ego is our values or our dignity. **Personal competence** is about knowing yourself and doing your best with what you have. It's not about being perfect or having absolute control over your emotions. It is about allowing your feelings to inform and guide your behavior:

- We must develop empathy, sympathy and emotional intelligence skills.
- Individual well-being under stress and confinement
- Hierarchy and autonomy in communication
- Group dynamics
- Psychological adaptation

Human behavior



Behavior is a response to motivation, reflected in personality and how we treat others, while comportment is a response to specific situations or moments.

- How well do you know yourself?
- Are you conscious of who you are and the impact that you are having on other people?
- How do we interact with other people?
- A conscious brain gives us the ability to change our outcomes
- Conscious awareness: if you know who you are, knowing yourself, you can communicate and relate to others.
- What is your natural personality?

Hadfield (2013) says, "Astronauts are taught that the best way to reduce stress is to sweat it out. For him, competencies mean keeping your head in a crisis, sticking with a task even when it seems hopeless, and improvising good solutions to difficult problems when every second counts." But they are trained to be good team players and to survive in particular conditions. It's a long training. He says "it's mostly a matter of changing your perspective and being prepared for change." They also need to be assertive, and it's a matter of ATTITUDE."

Managing emotions in a team is one of the most challenging of the team EI skills because most group members have yet to be comfortable expressing their feelings in public or discussing emotions in a group setting. After feeling the emotion, the vital step is to link it with reason and action—ideally, a team member's ability to interact constructively with all other team members. A high-performing team can celebrate a little too vigorously, forgetting to thank those outside the group who helped make their achievement possible. Awkward interactions happen for a reason. Teams need to take time to discover the cause. EI means that all team members have and use EI skills for the group's good. That means group members can be human and have days when they feel discouraged or overconfident. The other team members must balance emotions that may not be realistic or helpful to the situation by helping the group stay aware. If team members have opposing views, the group should discuss these views from each

team's perspective. Together, team members should focus on what the group can control.

The elementary feelings of anger, fear and sadness result from fundamental unfulfilled needs. For instance, anger arises when someone feels restricted in their need for self-determination. Anxiety increases when their need for security is not sufficiently satisfied, and grief when their relationship offers rejection or existing relationships, are hurt or not respected enough.

The human brain has an incredible capacity to adapt to new conditions. This plasticity enables us not only to learn continually but also to overcome injury and loss of function. Adjustment is the meaning of this project to visualize and experience fear from a dynamic, non-paralyzing perspective, using our natural resources and offering evidence of what blocks us and stimulates us in leadership. Our plastic brain will learn to see solutions and not dwell on problems.

Team emotion management is one of the most challenging team EI skills because most group members are uncomfortable managing their emotions in public or discussing them in a group setting. After feeling excited, the vital step is to couple it with reason and action. The idea is for each team member to interact constructively with all other team members.

When stressed, a person tends to resort to habitual actions unconsciously. Instead of focusing on one goal, they do several things at once. Human activity coordinates aspects of human behavior such as perception, thinking, emotion, and skills to classify goals as attainable or unattainable and then to engage or disengage to reach those goals. According to Heckhausen & Heckhausen (2010), "Research based on the Rubicon action model phases has provided a wealth of empirical evidence for the mental and behavioral resources that are orchestrated in this way." Commitment and disengagement to goals affect personal distress about the unattainable. "By having new plans available and recommitting to those original goals, a person can reduce suffering while gaining a sense of purpose by finding other value goals. Stress is designed in our brain for survival when danger appears; we must react. Each of us has a specific relationship with anxiety, but Stress influences each of us differently. Stress prepares the

body to flee or stay. Hormones play an essential role; when we are under Stress, the organization focuses on these hormones and in reaction, the immune system slows down. The organs are primed to focus energy on oxygen and the pumping of the heart, the blood supply. When we think we are losing control of the situation, then Stress begins. Today, Stress increases, and we have no recoveries; that lack of improvement affects our metabolisms (affects chromosomes and neural connections) and could damage our bodies in the long term.

The AATC team created emergencies to observe how the team members solved them and to assess each other's problem-solving and decision-making capabilities. Hazard is usually used to describe a potentially harmful situation, although not usually the event itself - once the incident has started, it is classified as an emergency or incident. There are several types of hazards that this type of high-performance mission usually faces, including:

- **Latent -** The situation has the potential to be hazardous, but neither people, property, nor the environment are affected.
- **Potential -** Also known as "Armed", this is a situation where the hazard is in a position to affect people, property or the environment. This type of hazard usually requires further risk assessment.
- **Active -** The hazard certainly causes damage since it is not possible to intervene after the incident occurs.
- **Mitigated -** A potential hazard has been identified, but steps have been taken to ensure it does not become an incident. There may not be a guarantee that there is no risk, but it is clear that steps have been taken to reduce the hazard significantly.
- **Public -** A public hazard poses moral or physical harm to people, such as an epidemic, a natural disaster, a murderer, a psychopath, etc.

In conclusion, on paper, everything was more or less according to our expectations. It is an ongoing project, but in terms of the information provided off the record and in the meetings on Mondays and Fridays, we could observe the conflicts, frustrations, and types of leadership that made the mission a success despite the adversities or the task was not so successful in terms of group

cohesion by itself as a leader. In any case, the individualized projects were always carried out.

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Expedition 56, Danniel Osoianu, Ireland

EMMPOL 14

17.02.2023-27.02.2023

Day 1

I was awoken by a wake-up phone call from mission control. It was then up to me to wake up the rest of my crew. The morning felt rushed, everybody trying to make sense of the tasks required for the morning. This included a bio-impedance test, chimp test, STP test and urine sampling, all for the first time for all of us. Time felt like it flew by with all of us rushing to do all the tests as quickly as possible. Because of the rushing and the novelty of the tasks, we made a decision to make a quick breakfast smoothie. This consisted of milk, peanut butter, dried apricots and oatmeal. While having a very pleasant taste, the texture was a little lumpy and some of the powdered milk and oats were not fully blended, causing us to both drink and chew the smoothie.

After a quick briefing with Mission Control Center (MCC), we set out to perform our experiments. I used some time to get used to the Movisens software, and performed my first experiment with Mirella. After obtaining the results, I attempted to extract data from the device but it was very difficult. I attempted to export the files to

Excel, but the Habitat laptop didn't have Excel installed. I spent quite some time in finding the most efficient way of extracting meaningful data, and decided to send the files to my personal laptop so that I am able to open the Excel files. At this moment, it was lunch time where we ate Russian pierogies with tomato sauce. The pierogies were expiring soon due to them needing to be frozen while we didn't have a freezer. This meal was delicious and very filling.
After lunch, I did a workout in the gym. I used resistance bands with weights to create a tougher workout, and finished it with 10 minutes on the cycle. After the gym, I made a coffee and joined the crew where we were all sewing our patches onto our flight suits. This was my first time sewing, so Jacinda helped me through it. I quickly adapted to it, and it was a very calm and enjoyable experience. This went on into our dinner preparation schedule, so we quickly had to make our dinner of Greek Salad with vinegar dressing. We had a debriefing with MCC during dinner, but people were still up and about from the table. This made the debriefing slower than it should be, as we waited for some of our crew to finally settle at the table.
After dinner, we did an activity known as the Space Dragon, where we outlined our hand onto a piece of paper and used the colors green, blue and red to paint a story of the contrast between us, and everything else that is not us. This is how I interpreted this creative activity. After this, we went back to our experiments. My sewing unraveled, so I decided to continue with that. After a while, I finished gathering the rest of the crew for my experiment and obtained all of my data for Day 1.

In the morning, I felt happy and excited to begin this once-in-a-lifetime journey. As the day went on, I felt myself becoming more agitated, and low-energy; more than what I would typically feel. I believe the diet and environment had a huge part in this mood change. Some stress was caused by the experiments and the tasks we had to do, but I believe it is only today that it will feel overwhelming. I am once again very excited and motivated to continue through this journey, knowing I passed the hardest part of the mission.

Day 2

Like yesterday, I was awoken by MCC. From here, I woke up the rest of the crew. We then proceeded in a timely fashion to do all of our required tests and reports for the morning. Unlike yesterday, this process went by quickly and well, so much so that we had prepared breakfast ahead of schedule. The morning briefing went well, but the breakfast did not. Although nice tasting, the texture of this smoothie was even more lumpy than the previous day's. Drinking at the same time as chewing.

After breakfast, we did a photoshoot for MCC and the social outreach. Many photos were taken, and after some lighting improvements, a photo was approved. For the photos, I had to pin my flag onto my flight suit with a needle, but I made time to sew my flag onto my suit after. I once again performed my first experiment with Mirella, and then Jacinda and Sirine. Lunch was amazingly prepared by Jacinda, a nice blend of vegetables with pasta. We had difficulty with the pasta, as we discovered the pot was leaking water.

After lunch, I finished my experiments on Solene and Sean, and was looking at trying to make the data extrapolating more efficient. I then went to my workout where I worked with weights and cardio. When I came back, I set up the sensor display to check our air quality and CO2 levels. I went back to my experiment and started taking data into Excel. Dinner was the same as lunch as there were some left over. The debriefing was tiring to say the least. I did not take part in the hydroponics, but I was responsible for the communication between the hydroponics team and MCC. Issues arose, faults from both sides, and the hydroponics experiment was cancelled until further notice. What shocked me was the responses from the hydroponics PI. I understand that it is our fault that the system began to leak, but many times I asked MCC for missing equipment with little to no helpful advice. The response felt to me unprofessional and childish. I believe if they could, the team would reverse their actions. When this is not possible, I don't believe outbursts and saying 'Ok abort the experiment. You failed. You did everything wrong.' helps the situation.

After dinner, I had a phone call with my parents. ***It is very, very difficult to release pent up anger and stress inside of the***

habitat, so the phone call helped me immensely. I drank a nicely prepared cup of chamomile tea as part of Solene's experiment, and it helped me feel relaxed and sleepy.

In the morning, I felt happy and excited to start the day. I tried keeping this positive attitude until the debriefing hit quite an uncomfortable nerve. I felt it was my responsibility to stand up for the team in the situation, but I also felt there was no point. The PI was correct, the only thing that irked people was the attitude. Not being in the hydroponics position, I empathized with them to the best of my ability, but also let them know that if we are to comment back, we should fully think both sides through before giving a nothing response. This situation I found myself in stressed me.

Day 3

Today, I woke up to a phone call between Agata and Jacinda, as Jacinda was up earlier than usual. I woke up the rest of the crew as usual, and we all swiftly began our reports and experiments. We finished rapidly, even having breakfast prepared before the 02:00 hour mark. When we sat down for breakfast, we informed mission control that we were ready to begin the briefing. MCC informed us of a new experiment called Heart Time. This involves the Movisens Ecgs and increasing heart rates by use of the treadmill at different speeds, and seeing how these rates affect time perception. Since it requires the use of the Movisens Egg multi sensors, which my experiment heavily utilizes, I took the role of leading the experiment. Another group experiment we were introduced to was to prepare a kombucha sheet that we can do origami with.
After breakfast, Sean had his gym time, so I helped him do the Heart Time experiment and at the same time, help me with my experiment. All went well, except when I plugged in the Movisens device into the computer, there was no data. I specifically remember setting up the device in the Movisens sensor manager as I had to create a new folder for this. We had to move on, as Solene had gym time after Sean, so I set up the Movisens device for her for my experiment and for the Heart Time. This time, the data was saved all fine. We then prepared lunch. This consisted of

an omelette with potato and courgettes. The food turned out very delicious, and it left us all very satisfied and full.
After lunch, it was my turn to perform the Heart Time experiment in the gym. The data was collected all good. Then, we set out to tackle the kombucha experiment. We set a table full of paper towels and I laid the hydrogel biomaterial as flat as possible onto the towels. We patted the biomaterial with more paper towels to carefully dry them. The crew painted glycerin onto both sides of the kombucha, and I laid the kombucha sheets onto a plastic bin. We then left the kombucha to dry. After this, we sat down and did Jac's origami experiment. This was very difficult for us, spanning more than an hour. We eventually got it done, and it was then time for dinner. We had leftover omelette that we ate, but it wasn't enough for us all, so we made instant noodles for us all.
After dinner, we all settled and relaxed as we drank chamomile tea from Solene and ate a small portion of chocolate while we began to write our final reports for the day.

I woke up in a groggy, sleepy mood but throughout the day, I began to feel better. We turned on a sun lamp while we were making lunch and I believe that helped my mood. I end the day with a positive, but inquisitive mood, wondering what tomorrow could bring.

Day 4

Today I set my alarm for 00:00 as I felt it was only right for me to be able to wake myself up. After waking everyone up, we all proceeded to swiftly do all the required reports. We again had breakfast prepared early, and made contact with MCC. For breakfast today, we had yoghurt with muesli. After a short period of time, we conversed with MCC, and then the breakfast period and briefing ended.
After breakfast, I performed my experiment with Sean and Solene before their gym times, in which I set up the Movisens Ecg for their Heart Time experiment. While the experiment was happening I began completing my Excel full of the data. It is not complete yet, but the data unnerves me. It doesn't seem to me that the Movisens Ecg is working properly. This could be due to a broken connection

in the band, or the Movisens device, or that the band is not attached securely. I have not completed the sheet yet, so I will see at the end what the data shows me. I was asked by Jacinda to perform her origami experiment. Today, it was much easier than yesterday. Jacinda lended a hand in providing me data too for my experiment even though she is terribly ill. I feel bad for her in her condition. Of all the times to become ill, now is not ideal. For lunch, we made rice and chickpea with curry sauce. This meal was very delicious.
Due to preparing lunch a little late, my gym session was shortly after lunch. During my session, I performed the Heart Time experiment. When I was finished, I relaxed with the crew while I gathered my last bit of data for the day from Sirine and Mirella. We made dinner from the leftovers of the chickpea curry and some tortellini with cabbage and mushroom. The tortellini left a lot to be desired, so I mainly focused on making a wrap with edam cheese and the chickpea curry, which was satisfactory.
After dinner, me, Sean, Solene and Sirine spent some time setting up the projector and a sheet so we could all watch a movie. The movie we watched was Shrek 2. However, MCC recommended a movie called ‘Moon’. I watched the trailer for the movie and I was quite intrigued, so I will definitely have to watch it in my spare time. During the movie, we drank chamomile tea from Solene, which really relaxed me and made me quite sleepy. After the movie, we finished our reports and went to sleep.

When I woke up, I was still extremely tired. I was in a very apathetic, zombie mood. After lunch, I was so exhausted that I almost fell asleep at the table. I believe the gym session and a quick stay in front of the sun lamp boosted my mood, as I began to feel a lot better. Then, throughout the rest of the day, I was happy.

Day 5

Today I woke up with my alarm and woke up my crew. I can see the improvement in the crew’s speed and efficiency when doing the morning routine with the experiments and the tests. Like yesterday, we made breakfast earlier than the time it’s supposed to be finished by. Today we had scrambled eggs and a berry kissel for me. The eggs smelled like chicken nuggets to me, and to Sean too.

The vegetarian diet is healthy, but I still miss the protein rich meat I used to eat before. The first steak I have after this mission will probably be the best I'll ever taste. After breakfast, I was very tired due to not having enough sleep last night. I decided to take a nap between 02:00-04:00. When I woke up, I helped Sean with my experiment and also the Heart Time experiment. After Sean, I did the same with Solene, then with Jacinda. It was then time for lunch. Lunch consisted of bulgur groats with sun-dried tomatoes and feta. This was of course a very nice meal, but the sun dried tomatoes were a little too sour and strong for my taste. Nonetheless, I finished the meal. After lunch, I began my gym time and started the Heart Time experiment. After my gym time, I began filling in my Excel spreadsheet with my experiment data. After a long while of this, I participated in Sirine's experiment. It was then time for dinner. For dinner, we had yesterday's leftovers, which were the chickpea curry and mashed potato. I made a Greek tzatziki sauce and ate that and the mashed potatoes with bread. After dinner, we drank some of Solene's chamomile tea and then began to write our nightly reports. When I woke up, I was extremely tired and exhausted. After my nap, I still felt tired but I gradually began to feel better throughout the day. I end the day in a happy and connected mood.

Day 6

My alarm didn't go off today even though I set it. Regardless, MCC called me to wake us up and that is what I did. Like the past couple of days, everyone got up swiftly save for Sirine and Solene, and we all rapidly did our morning reports. Today for breakfast, we made apple pancakes. It was a very nice meal, especially with chocolate spread and jam. However, the equipment in the habitat does not support such food. There is no frying pan for the pancakes, so we had to cook it in a deep pot, one by one. This of course took a long time, and even at 03:00 we were not finished, 1 hour after breakfast. After breakfast, we took a photo where we all posed as if we were in zero-gravity in front of the Moon picture outside the gym area. Then I completed a questionnaire that MCC sent to us. This questionnaire is based on a real astronaut questionnaire. After completing the questionnaire, I helped Sean and Solene with their

Heart Time experiment. After this, I began my experiment report. This went on until lunch, which was spaghetti with tomato sauce and fried tofu. The tofu tasted almost exactly like chicken, and the entire meal was expertly cooked by Sirine. It was immensely delicious to say the least.
After lunch, it was time for me to do the Heart Time experiment. Sean helped me take pictures of it to send to MCC for their social outreach program. After the gym, I finished exporting my data to Excel and continued writing my report until Jacinda's experiment. During the experiment, something strange happened. An emergency finally happened today. MCC was down, so the connection was automatically broadcast to Chinese MCC. The immersion was slightly broken when the siren wasn't working, and we had to replace the batteries so that it could ring for us. They helped us prepare in case of other faults. We checked electromagnetic waves, and alpha, beta, and gamma radiation in each of the modules. For dinner, all we had was leftovers as there was still a lot of uneaten food. I must inform the AATC team about the food portions when I egress. I dislike seeing food waste, and most of all, waste of money. The money spent on the food we throw out could've been better spent on equipment, either for experiments or for kitchenware, gym etc.
After dinner, I went back to writing my report until the day was finished.

I woke up in a calm mood. I was happy socializing with the crew. The emergency was novel and exciting for me to be a part of. I felt all good throughout the day today.

Day 7 (Final Report)

The whole week was filled with many different emotions and a lot of ups and downs for me. I learned a lot about science, other people and about myself. There are many things that are taken for granted on Earth that you can only begin to realize how much you need or desire when it is taken away from you. This entire experience for me has garnished new-found respect for all of the astronauts in the world who live like I have lived for even greater periods of time, more than 20 times over even. Astronauts must be

truly resilient and disciplined to be able to withstand immense stress in isolation. In all honesty, looking deep into myself, my life desires and goals and my personality, I slowly began to realize the work that astronauts do in space and to become astronauts. This leads me to believe that maybe pursuing a career as an astronaut might not be for me. I realized an astronaut's goals differ from mine. However, although this experience made me realize an astronaut career might not be for me, it made me realize even greater how much I wanted to pursue a career in the study of physics. Maybe I will not be going to the ISS myself, but I sure will pursue a career in which I can help safely and efficiently put astronauts there. Living like how astronauts do definitely gives me a great insight into their conditions.

Day 1 was just a day of familiarization to me. Everything was new to me and it seemed very daunting to say the least. Being put into a new environment in isolation with a lot of new tasks and people was very, very challenging to me, especially when considering that only 24 hours ago, I was a normal human, on normal Earth, living a normal life amongst normal people of relative normalcy. An intense change into a hostile, simulated unforgiving habitat. Never previously have I ever tracked my caloric intake, water intake and urination amongst other things so intensively as I had then. Even so, the prospect of learning new things that have never previously been accessible to me was very exciting and I used this energy to try and symbiotically understand the new environment around me. The energy was used to discipline myself in terms of the bi-hourly circadian rhythm report and all other tasks that are to be completed at a certain time frame. Throughout Day 1, I slowly aligned myself to fit into the space and time of the habitat. However, I realize now the drawback of using so much energy to completely change my habits and daily occurrences. I began to feel exhausted, stressed, my body and mind suffered to understand what my senses felt. Stress, anger, weariness overcame my better judgement. Adjusting to the environment was no easy task, and the feedback effect with my rapid loss of energy did not help either. Looking back, I said that Day 1 was probably going to be the hardest day as it is the freshest and most novel day, and I can say now that that was the truth.

Day 2 arrived, and I began to devote less total energy towards the morning checks and reports. I began to feel the muscle memory

and familiarity of doing the tests and reports from the previous day guide me into the beginning of the new one. Almost a complete momentum shift from the previous day. The energy saved from this was put towards more sound minded tasks and ideas, such as preparing meals and helping others with various tasks. This was a huge benefit to me as I finally managed to get my emotions under control and focus more logically on my tasks. There were times where this was challenged, especially being the Comms Officer and Vice-Commander at a time where the Commander was sick and unavailable. I had to keep communications between the crew and MCC as understandable and professional as possible while also keeping order, civility and rationale in the crew. I resorted to a phone call with my parents at home where I vented about life in the habitat and it calmed me immensely.

Day 3 came about and I started to get the hang of things. As soon as the clock hits an even number, I know it was circadian time. This soon became a reflex, and no longer an active thought. The day was mostly autopilot. The rhythm of things became instinct. I believe this is what was expected to begin happening to us. There was an emergency that happened later in the week to test our ability to adapt to surprise circumstances. More on this later.

Day 4 was the same as the day before. The only thing differing and exciting was the food. This kept habitat life fresh and less monotonous. While I was living here, I was eating foods that I have never eaten before, such as tzatziki sauce, caprese salads and bulgur groats.

Day 5 was no different than the previous two days in terms of workload and daily routine.

Day 6 again was no different, except for the fact we had our first simulated emergency. European MCC lost connection with us and we were transferred to Chinese MCC to help us out. Communications at times were rough, as we took time to translate their messages, and for us to translate our messages for them. We flipped our non-essential circuit breakers to attempt to restart our connection but it was no use. CMCC let us know that their government will let us know in 3 hours the status of our transfer back to EMCC. We were asked to measure the Electromagnetic fields and the alpha, beta and gamma radiation in each module. We took haven in the shelter as high levels of radiation were mentioned by CMCC, so we played the scenario safe and sent out

our Commander in EVA to measure the radiation in each module precisely. After a while, we were cleared by CMCC and we left to have a personal debrief of the situation amongst ourselves. The surprise emergency was both fun and interesting to learn about. After that, it was back to monotony.
Day 7 is our last day, and we spent the entire day cleaning and writing our reports before we land back on Earth to prepare to egress.
A very fun, challenging and insanely different from normal life experience throughout the entire week. Never was I comfortable not doing work. I can say that I will not miss this place for its lifestyle, but miss it for its valuable lessons it taught me, both personal and educational. I was happy to serve as Vice-Commander and Comms Officer for EMMPOL 14. Danniel Osoianu, over and out.

Expedition 56, Jacinda Cottee, Australia

EMMPOL 14

17.02.2023-27.02.2023

Day 1

Captains Log

Embarked on the voyage with keen interest and excitement. I now understand what Shackleton et al. must have felt for the last push to get underway of their great voyages. Climbing into a well worn saddle of comfort yet experience to know better. It felt like being back flying; living to someone else's clock and and running like a sled dog. Not good not bad, just is. Spent the day one searching for the most efficient way to carry out operations, navigate hurdles especially with a crew with no Crew Resource Management Training. This is a vital step that has been missed. The team is keen

and in the forming stage. Everyone enjoyed their time in the gym and time to establish their experiments. Having the unique opportunity for cultural exchange amused all and such a beautiful experience learning about them and their heritage. The crew are challenged by the food pickles for breakfast????? We are making adjustments and ease into things. It was wonderful to share my experiences as crew with poor airline food, the science behind it. They unknowingly did what most astronauts and pilots do - add spice to very bland food to tolerate it. I saw the acme lightbulb come on for most when I share the pepper oil the astronauts use on the ISS. Space dragon exercise i posted their hand prints on the wall. Eventful day of following the schedule, learning how and when to carry out the experiments. Enjoyed the gym time and Sean's experiments. I had the opportunity to complete the fine motor skills test on the crew and look forward to the origami session with them tomorrow. Observed and enquired about crews experiments, wellbeing and general mood to provide insights into optimizing the experience for all. Breakfast as an education of how to use dried and powdered foods to much things more palatable. Despite being lumpy and the oats should of soaked over night and the powdered milk made first the crew are learning and keen to do so. Lunch; dumplings with some pasta sauce with capsicum/chilli the crew enjoyed. Group activity and snack time bonded everyone and gave a few an opportunity to learn a new skill and whilst others shared their sewing skills. Dinner a Greek salad; Mirella made a wonderful salad dressing. The crew laughed at their dessert of 3 dried apricots.All in all a good day was had by everyone.

Day 2

Starting to feel run down. Participated in peoples experiments, it's always wonderful to support the crew in their goals. Wonderful to see that habitat experiments/measurements are flowing with greater ease and the crew backing each other up with taking measurements. Less manic today. Problems with the hydroponic system continues to a great frustration to all. It was truly a mess and stank so the crew had quite a job on their hands. Also lots of missing elements. Took it easy in the gym and feeling very run down. The fevers started this evening and not much fun went to bed early. Crew enjoyed the origami. Good food today; breakfast -

lunch - moussaka style and the crew decided to add pasta (I enjoyed cooking it. Prep times are unreliable).

Day 3

Woke up feeling sick. Deteriorated rapidly. Went to sleep at 03:00 and in and out of sleep most of the day. Fevers began at around 09:00 not much fun. Top temp. 39.2 degrees of Celsius just got to ride it out. Given that I was sick, they left they crew unsupervised to do the origami - never again, but we live and we learn. They did try and they did complete it despite the levels of frustration; so I'm very proud of them. Not very hungry had breakfast salad and tortilla Mirella made but really struggled to get through it but it was super yummy. I love how their crew is bringing their culture into our meals. Couple of dry biscuits around 13:00 but can't stomach food.

Day 4

Woke up sick and weak. Have energy for short periods. Crashed for 2hrs and skipped the gym session to increase recovery rate. Crew beginning to get run down too and for this I feel very bad for. I'm beginning to feel weak again and feel the fevers advancing. So off to sleep again for another couple of hours. Crew sharing wonderfully, operating and backing each other up. Experiments and measurements have become apart of daily life. Despite voicing their frustrations with yesterday's origami they were keen to go again and also looking to challenge themselves with it in the future. But today something fun a jumping frog. They each took great delight in seeing how far their frog would jump. Happy Jac Dance. Decided to make a money Rabbit as it is the first day of lent.

Another good food day - breakfast - granola and yogurt, Lunch - curry and rice. Trying to drink heaps but it's challenging. I have to remember how young these guys are. It's been interesting to note little life experience; first time sewing, first time cooking rice without a machine and so many more. But the crew are keen and willing to learn with others there to support and teach.

Day 5

Finally I'm out of the woods less fever, still very run down. The very flat mattress where I can feel the frames planks since day one is now wearing very thin; not conducive to a good nights rest. Found inventory list for chemicals but not for other things. Unfortunately as I come good, the crew is catching what I have. So trying to manage mission fatigue and crew illness is a fine balance. I feel yesterday, when I was at my worst, "the cat was away so the mice did play" so getting everyone back on track today has been a tough ask. Slowly slowly catchy monkey. The crew are not happy about the Heart Time experiment eating into their gym time but if they didn't do it then finding other time is greatly difficult. They understand my reasoning. Only 2 days to go. Trying to keep things in perspective for them; days, reports, food etc they tend to lose sight of the big picture and live very much in the now. Glad I brought my sun lamp with me. The crew has really gravitated

towards it and I've definitely seen changes in behavior after exposure. Which has been great. Yeah! Due to illness I have not carried out gym activities or Heart Time experiment. My experiment is going well, despite some frustrations and struggles for those new to origami only 1 is not keen. Today I decided to make it before them and give them an opportunity to feel, look and investigate. All but 1 showed interest and avoidance and resignation has set in with this one. The rest beg for more despite the challenges I put before them. It's interesting to watch how they persevere, give up or other and other motivational tells. Food does seem to be the central focus of the crew. Breakfast they made scrambled eggs (I had dry muesli, I'm still not up to much). Struggle to drink more water as directed by the medical officer. I usually drink 3 liters per day but being asked to drink 4.5 liters has been a struggle. Lunch - bulgur salad. These are very high carb rich foods I'm not used to and my stomach is not processing them well. I won't have dinner tonight. I'm still digesting lunch. The struggle is real to drink more water. Still I persist.

Day 6

Still feeling very run down and tired. Everybody is really tired and trying to motivate them to stay on task is a challenge. I have always believed in "lead by example" which has been tough when I've been sick. The food has been a great source of joy and frustration on this mission. The recipes require amendments and things take longer to prepare. Also not having the right tools such as a frying pan or spatula etc. Taking 2 hours for breakfast and the task prioritization for the crew has been challenging. They did flick into gear but real fatigue has definitely kicked in. We co-ordinated the microgravity photo and the crew came alive. A lovely photo resulted. I worked really hard on my report but it was difficult to finish as I am awaiting 2 crew to complete the fine motor skills assessment. Interesting observations thus far but will have to be completed in the morning.

Emergency procedures

Comm issues - followed protocol. Transferred to China MCC. Increased ration levels - as it was not a listed checklist prepare for the worst hope for the best thinking. Utilized the CME checklist as

a precaution. The team comments were - fast into the shelter. Things to learn for the future isolate into teams; keep comms person separate and sole job be comms. Should have paired Sean with someone else to conduct EM checks allowing Dan to run comms. Another team to review radiation levels. Upon completion one team to empty the shelter where we had stored rubbish, another team to organize 2 days with of food, other team to run a checklist and execute items. When we reviewed checklist and emergency procedures the other day we should have organized a FOOD GO BAG for situations like this, at the very least a list. We rechecked radiation levels until deemed safe and returned to normal ops. Too many carbs in this menu, feeling very blocked. Limiting food intake; didn't eat lunch, 2 small pancakes and 6 dumplings with tomato sauce. 5 liters of water drunk in plain water or herbal teas.

Final Report

Reserved. Further reflection required. Need not to be in the habitat to process the experience.

Expedition 56, Seán Molony, Ireland

EMMPOL 14

17.02.2023-27.02.2023

Day 1

Today was the first official day of EMMPOL, commencing suddenly at 00:00, being awoken by our Communications Officer, Danniel Osoianu. I was first groggy and disorientated, jumping out of bed quickly in a show of my eagerness, the tired spell quickly vanished.

The crew and I enjoyed milkshakes consisting of apricots, peanut butter, oats and powdered milk. After breakfast we underwent our first Circadian Rhythm test scheduled for 02:00 and also prepared our individual experiments.My experiment involved exploring the flexibility of all crew mates on board through the use of the sit-and-reach test. A simple apparatus of a stool, masking tape and markers was utilized. Participants would first conduct a sit-and-reach test as soon as they entered the gym without any kind of warm up. Then, various stretches were performed and the same test was repeated. Participants would mark the masking tape as far from their torso as they could, a visualization of their maximum reach. The length of the participants leg's was documented and the distance from the stool (against which the participants laid their feet) and the maximum reaches were recorded too. Through simple maths, a ratio of the participant's leg length and flexibility was made. During the day, there was an announcement for an aquaponics experiment. Being the crew biologist, I felt inclined to attempt this experiment but it would prove to be immensely difficult and time consuming. At one point while the water ran through the system, I noticed the top layer was beginning to flood and showed no stopping. I was able to clear the blockage and prevent any damage, but this event made me hesitant to allow the apparatus to operate through the night-despite the fact it had not occurred again afterwards. If a similar blockage occurred while the crew slept, I feared that water would flood and cause an electrical fire with the nearby extension lead. The experiment will have to be continued tomorrow. Overall, I was in a quite optimistic/relaxed mood. I thought I would be overwhelmed with the change of surroundings, but the first day was quite alright for me. The crew seems to get along well and I am bonding with a lot of them, but an argument was noticed in the later hours of the day, caused from a misunderstanding of vocal tone. Hopefully this isn't a recurring trend.

Day 2

Waking up today was easier than the day before, as well as completing the tests scheduled for immediate wake up. For breakfast, the crew and I enjoyed a nutella, oats, apple and

cinnamon smoothie, which went down easier than the previous day's breakfast due to my dislike for peanut butter. The flavor was enjoyable, but the texture had much to desire due to the fact that the hand blender lacks the power to thoroughly blend the oats, so the end of every cup becomes a gauntlet of constitution. I improved the layout of my experiment today, adding bottles of water behind the stool, so that there was more distance between the feet of the participant and the wall. This was a much needed improvement as I came to realize that my crew mates are much more flexible than I am, and can reach well past their feet while the best I can do is give the hairs on my shin a scratch. I also utilized a large 1.5m metal ruler I found next to the kitchen. This made measuring results incredibly easy compared to the flimsy measuring tape I used the day prior. The water bottles are just a temporary solution as we are steadily moving through the bottles each day and I dread the day I lose my stool supporters. Lunch was amazing today. We had various fresh vegetables, spicy bell pepper, garlic and tomato on a pasta base with shredded buffalo mozzarella. It was incredibly savory and one of the first meals that made me forget my insatiable cravings for meat. One problem I have is the size of the portions and the time in between meals. I do not know the exact calories that this vegetarian diet has for each day, but I can for sure say its not enough for me. Almost constantly I find myself hungry and thinking about my next meal. I eat seconds, thirds and sometimes fourths in every meal, but I still find myself needing more. I understand that this is an analogue space programme and not a hotel, but I fear that my weight may drop considerably over the course of EMMPOL 14 and 15. According to my bioimpedance test today, my maintenance calories exceed almost 3500-while I'm skeptical to how accurate those numbers are, I still believe that I need to start incorporating extra food that we have in abundance. My aquaponics experiment was aborted by Sebastian Hettrich during this evening's MCC debriefing. He was agitated at the fact I was having trouble following his procedure and was extremely passive aggressive, While I'm sad and ashamed my experiment was cut short, Im also partially glad as the missing components made the whole experiment impossible to work with.

Day 3

Once again, waking up in the morning was easier than the day before. We were given an extra hour of sleep from MCC, which definitely went a long way for myself and my crew mates. Today we had a salad for breakfast, which would not be a breakfast of my choice. Although, I still crave meat in my diet, I can appreciate the health benefits of becoming a vegetarian, and despite what these reports may indicate, I've held this belief for a long time, but EMMPOL is helping me experience this lifestyle in-person.The gym sessions today were not as enjoyable as they may have been in the past. It was the first day Danniel began conducting his heart-rate experiment, and between conducting my experiment as well as his two experiments, my gym session was intense to say the least. I've started to notice a slight, dull pain in my right ankle which has me worried due to the fact I have had problems in the past with a pronated right knee and hip. As for now, the extent of my problems simply include discomfort in my knees when I stand for too long and clicking in some of my joints. I believe that running on the treadmill in socks may be causing my arches on my feet to fall-a lack of medial arch support was what caused my problems, so I feel as if I'm right to be concerned. On a lighter note, Mirella came to me and asked if she could do third measurements with my experiment; as someone who does yoga regularly, she knew how much more flexible one gets after a long training session. I have been doing three measurements myself since the start but not asking anyone else, as to let them rest after their training. It was honestly really nice to see such enthusiasm and willingness to help in another person's experiment. I obviously don't hold a grudge on the others for not doing the same, my experiment objectives just happen to lie within a passion of Mirella's, and she wanted to see exactly how much she could improve in a week, she loves to push past her previous best results.

Today I have been "snacking" a lot more in an attempt to fight my declining weight and muscle mass. I have had four servings of the omelette, crackers with peanut butter and more, resulting in a much happier crew biologist. I repeat myself in saying I understand this is an analogue space programme and not a hotel but myself and some of the other crew members talked about how we all have lost muscle mass and even bone mass in Sirene's case. A personal

hypothesis blames this on a lack of protein and a decreased amount of movement and sunlight. I'm curious for when or if there will be an emergency simulation during our mission. Perhaps it will be tonight…

Day 4

Today began like all others, suddenly being awoken at a time you don't know, in a rural cabin with no windows, surrounded by people you just met that week- home for me these days. As I sleepily ran through my scheduled tests, I wondered what the day might hold. The crew and I ate muesli and yoghurt; mostly in silence or "un blanc" as Sirene and Solene might call it. This didn't phase me or the rest of the crew it seems, maybe because we've become so close, but most likely because everyone was exhausted. After debriefing, everyone went about their separate ways to do their own personal chores. My experiment sessions have become much more difficult due to the decreasing supply of drinking water. I of course told people that we had more in the gym when I heard some of the crew discuss the issue, but today was absolutely the last day I can rely on the water bottles as a support. Once again, my gym session was mostly occupied but Danniel's Heart Rate experiment, but today was much more different. The time during the walking and jogging portions seemed to fly by and my ankle was in perfect condition. I've obviously become more accustomed to running since travelling to Poland, but I also believe my music choice had a massive impact; classical music. I studied music for six years of school and played the flute for just as long, and I've developed an appreciation for it because of this. I was able to tune out the walking and jogging and relax my heartbeat as well. I listened to William Tell's Overture during the sprint, and the climax of the piece gave me an amazing second wind and the BPM of the piece was the same as the rhythm of my footsteps which really helped me keep my pace as I tired. I get that it sounds corny, but hey it helps. Work-wise, today was peaceful and relaxed, which is what we all needed after the first few days. Jac's origami experiment was much simpler than yesterday's and was actually enjoyable to do. Mirella fashioned a functioning sink out of an old 5L water bottle and a spigot. It has a simple design but it can't be overstated how useful it is, she is a great engineer for the crew. I've

been learning French from Solene and Sirene as a way to bond and make them laugh, but Mirella seems to appreciate the effort just as much, even if it means saying ”Ay Caramba'' for a laugh or asking how to say “excuse me” in Spanish. It's trickier for me considering I’ve never spoken Spanish before whereas I have 6 years of French classes, even if they were poor. EMMPOL has made seeing the fun in learning new languages. After dinner, Solene, Sirene, Dan and I wanted to watch a movie for entertainment. We invited Mirella as well but she insisted she finished her work instead. We watched the immortal classic “Shrek 2” with the projector in the kitchen. I offered to use my curtain as a blank screen so now I have to re-install my curtain before I can go to sleep. Oh well, it's a small price to pay for a happy team and Shrek 2.

Day 5

Waking up today was a herculean task if anything. I was immediately groggy and I could tell it wasn't like any other morning. I was still able to complete all my tests with similar results and I had six hours of sleep, so I’m not particularly sure why today I was so exhausted. After breakfast I decided to have a forty-five minute nap before my gym session, and I had the most surreal sleep of my life. I immediately fell asleep, and began to have a lucid dream with multiple layers. The crew made a few cameos throughout the dream, as well as other friends outside of EMMPOL, with their personalities and actions perfectly within their normal behaviors. After some random and somewhat boring lucid dream antics, I felt I was being awoken by Sirene and Solene, only for me to actually still be in my dream, realizing this, I made myself fall asleep again and started a completely new dream, all the while knowing I was in two layers of dreaming. It was definitely a fun experience and it felt like I was sleeping for much longer than I actually was, and it was the first time I could vividly remember a dream during EMMPOL. Maybe the chamomile tea from Solene’s experiment slightly dampens one’s ability to remember dreams.I was finally able to find a replacement for my stool support thank God. As long as people don’t go insane and start voluntarily drinking sparkling water, no one should touch these supports, but

it's a shame that I only found these cases near the end of our experiments, it would have saved me a lot of stress. In Danniel's Heart Rate experiment, I had a similar approach for tackling the sprinting section. Although the tempo and feeling isn't perfect, "The thieving magpie" from Rossini was just long enough to listen from start to finish and encapsulate the whole sprint, knowing which improved my morale. I also went on another run later that night to clear my head, this time listening to Tchaikovsky's "Marche slave, Op.31, TH 45". I thought I'd include the piece name just in case Evandros reads my report again. All-round, today had no reason to be tough, but I had a heavy, tired feeling all throughout, maybe burnt out. I still have the same attitude to everything and my crew, just not the energy to keep it up. Ah well, tomorrow is a new day, I'll be right as rain then.

Day 6

It comes to a surprise to me that today is the last full day of EMMPOL. With no personal experiments to do, today kind of dragged on, only the heart rate experiment and circadian rhythms were there to keep us company. The running was by far at its easiest today and I can't wait to continue to improve in EMMPOL 15. Today's music recommendation is "Jupiter (from the planets)" by Gustav Holst. We finally also had our emergency simulation. I would say more but I'm exhausted and its the last night so bye.

Day 7

This is it. We've survived seven full days in isolation from the rest of the world, bombarded with new tasks, responsibilities and adjustments to our usual life, with near strangers that we knew nothing about and still, we managed to beat the odds and come out on top. Truth be told, I definitely think I will miss the EMMPOL 14 crew. Despite slight language barriers and age differences, we were all able to work as a team and bond with great chemistry. We've talked about meeting each other again outside the simulation and I definitely plan to, regardless of the cost it takes to make that happen. We plan to get drinks after any potential debriefings or shenanigans Matt and Agata might have in store for

us. Not to reinforce the stereotype of Irish people but Christ almighty I could do with a drink right now. I wonder if I have personally changed much over the course of this mission. I myself wouldn't think so, I do usually come off as shy first and open up into the annoying and sarcastic bastard that I am, but I already knew that about myself. I do wish I could have performed better as a crew biologist for my team. Being the only crew mate to have an experiment aborted still does bring a sting of shame, and besides from my experiment being health based, I might as well have been any other role. I tried my best to help others when I could, be polite, and tend to my own spaces and work well, but I know I could have done more. I noticed further on in the mission, I became more and more clumsy. I think it's safe to attribute this to fatigue, nourishment and/or lack of quality sleep, but excuses are excuses, and nothing else. I like to think I performed "ok" during the emergency, but once again, I should have been able to perform better. I do not see the attitude I'm writing about myself as pessimism or a symptom of low self-esteem, but objective faults I can improve about myself and help me grow as a person. I will be in this habitat for two EMMPOL missions, and if I can't improve myself, then I will be wasting the time, effort and even potentially those around me and in mission control.

Socially, I'm proud of the effort I put in. As an introvert, I used to struggle with opening my emotions, and would just come off as rude or mute. I've since mostly grown out of that, but I am still very much a reserved person and can get in my own head in places like clubs/festivals, but weirdly enough my social batteries seem to deplete much slower in more personal scenarios like this. Overall, I loved the whole mission and I'm grateful that I have the rare opportunity to do two EMMPOL missions in such short succession, I will definitely make the most of this.

Expedition 56, Sirine Asfour, France

EMMPOL 14

17.02.2023-27.02.2023

Day 1

Waking up was kind of hard… It took me a lot of time to fall asleep specially because I decided yesterday night that It was the last night I would talk with my relatives. Thankfully, my family and my boyfriend are both supportive and really curious about how this analog mission will go and what it will bring me at the end. During the day, it took me a while to get into the mood… in fact I woke up with painful symptoms of urinary infection which have gone better thanks to medicine. I feel at ease and definitely enjoying the habitat and time spent with the crew. Time has flied but this day feels like a week. I fulfilled all the experiments required. As a data officer, all day I made sure everyone was going through their measurements and then went through the data to verify any typing error or if anything had been forgotten. I cleaned, had a gym session in which I ran and did some fitness. I also fulfilled my experiment today and the results are for now what expected.

Day 2

It was even harder to wake up this morning. The night was longer but the sleep seemed so light...I can't really remember the day, which is rather destabilizing... I remember the meals, which I really enjoyed, the gym session and the good time spent with the crew. We managed our time well overall, at least more than yesterday, we were particularly efficient in the conduct of the daily experiments. The days are so tense, i'm going through so many emotions but none are negative except when tired. I had to do a 25 minutes nap today. We had one disagreement and we all saw how frustration in this environment can quickly escalate tension. But we all took the

time to talk to each other, state our position, understand each other's position and then vote. We were able to find a stabilized atmosphere. I conducted my experiment and the results now also verify the hypothesis.

Day 3

Today was great…I was about to get bored but thanks to my crew mates, I laughed and enjoyed a lot this day. We've been having great times together, having discussions, playing cards, I'm definitely feeling comfortable and surrounded by caring vibes. I've been really productive, so productive that I could have personal time to chill and relax which was desperately needed. I realize that I am eating more and more and specially sugar before going to bed. It's definitely comforting. I'm also getting emotional. In fact, I realize how proud I am to be here and to see how I feel and react. I'm not used to getting out of my comfort zone. In real life, I also trigger to open up and especially when it is about communication. I have never dealt with disagreement like I did here which makes me proud. In fact, I'm used to internalizing everything every time and to let the frustration grow until it explodes. This experiment is also making me realize how awful my everyday routine is outside, how awful my habits are. On the outside, I'm struggling with school, 2 student jobs, leading my own space law association and being in some other… I have no hand on my time and the first thing not being taken care of is my health. I do not take time for sport neither for cooking neither to just chill. This experience helps me to reclaim time for myself and to realize how effective a day can be when well organized. I've been doing a lot of things today, more than the other days and more than the needed things. My experiment is in progress. Today I was a bit disappointed that my gym session was taken by the heart time experiment, we didn't really understand that it could have been done any other moment of the day… I'm definitely worried about Jac… she's getting worse and worse. I hope she'll get better tomorrow. She was hoping so much from this experiment, it makes me sad for her.

Day 4

Jac warned us that day 4 was the hardest and she was not mistaken. Mentally, this day was hard. I had to take a nap and it was harder to enjoy the day as usual, to not be bored. Even though I said I wouldn't, I had a call with my family then with my boyfriend. Hearing their voices, telling them about here, answering their questions and hearing how relieved we both were to hear that everyone was doing good made me feel balanced and enjoyful again. I've done my experiment, I've prepared lunch, cleaned, did others experiments as well as the one asked daily. I've also had a gym season which was a yoga one. Despite the fact that the day was harder in terms of mental health, I really enjoy my time here. I enjoy feeling healthier as days pass. I enjoy having time for myself, to be aware of my physiological data and to do sport. As I explained yesterday, this is new for me and I really appreciate all the good influence this routine has on me in terms of well being. I've been thinking of certain things in my life differently… it might be weird but it feels like this routine brings clearance. We had a movie together tonight although Jac and Mirella were missing, it was so great. i'm so blessed to have theses crew mates, i know that i'll cherish every moment that I had the chance to spend with each of them. Even though I might be too talkative… Tomorrow is our last experiment day, we are getting closer to the end and i'm already getting nostalgic… only 3 days left. This mission is a deep and powerful experiment. i've never thought this adventure could be that much life changing.

Day 5

This day was great, I really enjoyed it. I can't really remember everything but I remember having good times with my crew mates. I had to take a nap this morning…01:10…and I'm still feeling tired. I don't really understand why… I now gathered all my data and will start my report tomorrow. I also prepared lunch and helped prepare dinner. I cleaned. Did all the experiments and also had a yoga session. I don't really want this experiment to end…time is flying. I feel so blessed, so thankful for this…

Day 6

Tomorrow is the last day and I’m already feeling nostalgic. I'm going to miss the moment spent here, my crew mates and having the chance to have a healthy routine and the time to focus on me and my body. Today I felt sleepy but I decided to not take a nap to work on my report. I'm now in the middle. I've done my graphs and analyzed my results. I have to prepare an introduction, the conclusion and a literature review. I better go to bed, so much to do tomorrow. But before, I'd like to thank you for being here, for reading me, for marking this experience feasible. Thank you, this was life changing I already know it.

Final Day

Here we are on the final day. I'm sure you’ve seen it on the cameras. I definitely enjoyed my time here. Days were tense and quite long, but I never felt the isolation, I never felt the need to go out, which definitely surprises me. At some point, we missed nature, the environment, feeling the breeze on our skins, seeing life, smelling the grass but still, the absence was more than bearable. I’ve never felt that tired but I've never been that efficient, that productive in fact. I learned a lot about organizing days and especially about my physiological data. I've never learned that much on my body. I've never felt that peaceful and calm, I usually am so stressed. I'm surprised by the way this experiment went, and especially when it comes to my crew mates. I had the chance to be with crew mates that are open minded and empathic. Since the beginning. Life will take us to different places but I'll never forget them. Each them were inspiring, each of them challenged my personality simply by being themselves. We all were so different and had so much to learn from each other on how to deal with everyday life in this habitat. I’ll miss them. All this experiment I've been feeling blessed and thankful. This experiment happened at a turning point in my personal life and has definitely sealed the improvement I've been trying to do on myself to get better. Life is not a linear adventure, nor is mental health but still, this is worth a lot for me. I've noticed some personal accomplishments in terms of communication and resiliency. I've been feeling so proud, I can't wait to share it with my relatives… but in fact how could I explain ?

I am surprised by the direction my experiment took. To be honest, I was not completely convinced by it at first, which doesn’t resemble me. But now that I have the results, that I have the graphs, I now realize how far I could get this experiment. I wish I could have more time to read more on my hypothesis and develop a stronger literature review to be able to compare my results and specially to get their analysis farther. I want to go through it, I want to know the conclusions, I'll get this experiment report done. Now time to leave is about to be. I'll be home again in two days. It feels like I could never be able to go back to my routine, my stressful routine. I’ve been spending so much time going on holidays when in fact circadian and heart time experiment was what needed to be reenergized. I can't wait to see what changes I will notice in my life after this experiment, which habits will stay. I used to drink less than 2 glasses of water per day, I've been drinking 2 liters. I stopped playing sports months ago. I've been doing sports everyday for a week. I've been managing my time every hour when I couldn't fight against procrastination at home. I am so grateful, I never thought I could live through this kind of experiment. I've worked so hard to get access to these opportunities, but still I can’t believe it. I've now realized a dream and I made the child that I was proud of.

Expedition 57, Ava Hutchison, USA

EMMPOL 15

Communication Officer Report

01.03.2023 - 09.03.2023

MCC and the crew have decided on a more relaxed method of communication where other crew members can communicate with MCC in the Signal chat when addressed specific questions regarding sleep, experiment status, etc. and not just myself as Comm Officer. I feel that except for a few missed messages on Day 1 and 2, I have been regularly checking Signal throughout each day

and making sure that any messages received by the crew are communicated to the crew. Again during the initial adjustment period it took longer than ideal to communicate MT to MCC upon waking, but I had resolved this issue and for the vast majority of the mission have successfully fulfilled my obligations of announcing MT and organizing briefings in the morning and evening. I also collect a list of running questions that the crew has for MCC to ask during these briefings. On Day 5, MCC requested that we provide hourly updates on our activities, and I felt that I did a great job keeping the crew on track with their messages by setting a personal timer for every hour. Before and during the webinar with Hi-SEAS, I was in contact with their Communications Officer Serena Crotti, I rehearsed what we were going to say as a group, and prepared the space and crew members for presentation via Zoom. Danniel and I found a good balance between his role as Commander and mine as Comm Officer, and all of the essential information that MCC requested we discuss was mentioned (except for one of Sean's experiments). During the Day 6 emergency, I kept in near-constant contact with MCC except for brief moments where the crew was deciding what to do, but even then I communicated that we were in the process of deliberating. I was surprised to read about the 30-minute update obligation for the Comm Officer Role while writing this report, as the manual states that "If not otherwise agreed upon, a brief update on the crews' activities (e.g. which experiments are ongoing, which activities have finished, and if there were any issues) has to be sent at least every 30 minutes." I figured that if MCC wished to have 30-minute updates, similar to the request on Day 5, they would have made a specific request during morning briefings. If this is not the case, then I made a serious error, but assuming that this is what MCC intended, I think that (besides an early adjustment period) my overall performance as the EMMPOL15 Communications Officer was successful.

Day 1

I woke up at 00:00 with Danniel's alarm, and I was a bit groggy but otherwise alright. I didn't realize to the extent to which I was unprepared to do all the necessary morning tests, thank god

Danniel and Sean were there or I would've been very lost. Thankfully because they were, it went fairly smoothly. My left calf muscle has been aching since I got that terrible charlie horse cramp during the ice plunge, and it was really bad in the morning and through the afternoon today. I tried stretching but my hamstrings are incredibly tight as well, I think because I didn't warm or stretch them before the ice plunge or hike during pre-training. Breakfast and everything went rather smoothly, but I did feel a bit useless not knowing where to find things or how to collect urine data etc. but it's also my first day and I'm here to learn from my crew mates so I was really grateful for their experience. I am worried a bit about my workout hour, the treadmill was rather small and rickety and I felt like if I ran too fast I would break it. The whole time I felt like I was shaking the whole habitat and everyone could hear me (they couldn't, I was definitely overreacting, but I was the first to exercise so I had no point of reference). My ankles combined with my aching calf muscles and hamstrings made it really difficult to maintain a run, and I had to do 5 minute cycles between walking and jogging. I'm really concerned that my muscles won't fix themselves before Day 3 and it'll affect the heart rate data, so I've decided to stretch every morning, before exercise, and at night. At around 06:00 I got really tired and it was really difficult to focus on the data interpretation aspect of my experiment work, but luckily I have a lot of time to do this and I successfully collected all Table Set 1 data recordings for all subjects. At night I prepped the Mouselab Web with Table Set 2 so that tomorrow I can begin collecting data from Danniel and Wojciech in the morning. I forgot to mention to the crew that I needed to conduct my experiment immediately after they finished exercising, and so by the time I administered the test to Danniel, he had cleaned off and changed clothes already. I told the crew at dinner and now they know to come to me immediately after their workouts. Wojciech made a delicious lunch, and I felt like it was the perfect lead up to taking the group picture because we had all been chatting and joking as a crew, and then we were a bit slap-happy from all the food during the photos. I'm so grateful that Nic is really skilled with that amazing camera, I think the pictures came out very professional-looking (although I definitely don't look my best, but I'm in isolation so that's not really a main concern of mine). I like my string belt that I've manufactured, I think the gold

spices up the flight suit with a little extra flare and fixes how the pants fit me. During and after the pictures were the best part of the day, I felt like I was getting to know the other crew members really well individually and we were settling into a comfortable dynamic as a group. Dinner was also wonderful, I felt like we all worked together to make a fun dinner with the materials we had instead of following a strict recipe.

Day 2

I had the same experience waking up as yesterday, I woke up on time but I was pretty groggy and cold. I still woke up really sore and tense in my calf muscle and hamstrings, and even a bit in my back. I stretched again and I think it helped a bit, but tomorrow I am going to diversify the types of stretches I do. The morning tests went much quicker and I felt more in step, so I'm hoping that by tomorrow all will run like a well-oiled machine. Breakfast was also great, I'm really enjoying eating together as a crew because we can lapse into comfortable chat and silence smoothly. After breakfast I got into a groove/really focused on interpreting my data from yesterday, but I was upset that I had to go to my exercise hour just as I began to make some really good progress. I unfortunately didn't use the full hour as I got caught up in my work and I had to interrupt frequently to talk with the crew about MCC messages, but that being said my exercise hour was better than it was yesterday. My ankles are still clicking when I run and my calves and hamstrings are still making it hard to maintain a good pace for a long time, but I found that it was nice to run and walk or pause in shorter intervals. I also was restricted by the fact that I was wearing my weakest bra which made it painful to run without holding my chest. About 20 minutes afterwards though I got a rush of endorphins and felt fantastic, although I am still worried about beginning the heart rate experiment tomorrow. Around 06:00 my computer crashed and I had to restart it, which normally isn't a problem but it reset my Mouselab Web programme that I needed to use to run Table Set 2 with Sean immediately after his exercise at 06:00, so the timing was a bit ruined. I wanted to reset it quickly and run it with Sean anyways, so I had to input the table info code by hand, and I rushed myself so I made errors and didn't notice that the matrix open and close setting was mouseover and not

click. When I ran it with him, the data was useless, so I decided to change his testing schedule to complete TS2 later in the day today as a non-post-exercise data recording, and rearrange TS3 and TS4 to be run immediately after his workout as it was supposed to be today. The rest of the test sets ran smoothly, but I did hit a wall focus and energy-wise at 08:00, I think due to digesting the heavy bulgur groats. Afterwards the crew time definitely lifted my mood and I was able to work and enjoy the time until I got really tired during dinner at around 13:00-14:00, likely because I didn't sleep as much last night as I did the night before Day 1. I didn't initially enjoy the Wim Hof Breathing Experiment but it did reorient how I was thinking about my body and its stress and tiredness so I think I will have a very easy time going to sleep.

Day 3

This morning it was definitely more difficult waking up than yesterday, but I did get the least amount of sleep so far on this mission. Although I don't particularly enjoy the Wim Hof breathing experiment I do think it had a sort of euphoric effect on me when I was actually falling asleep. I think it takes me a while to actually begin to have cognitive function in the morning which is why I'm kind of grateful for the rhythm of the tests until breakfast. I also think that the crew is falling into step in terms of mood, we generally are silent and calm during breakfast and then are concentrated on work, then we all start to tell jokes around lunch, become concentrated or tired again, and then get into a good mood around dinner. My cognitive experiment is running smoothly after I rearranged the testing times for Nic and Sean so I'm no longer worried about that. The heart rate experiment was frustrating today, not because of the experiment itself but more so me, because I only realised afterwards that we were supposed to do the phone as well as the computer test. I know it's only Day 3 but I think I still get very frustrated with myself when I make mistakes, like with the heart rate test and also when I failed to respond twice to MCC messages and they had to ask for me to copy. I'm keeping my phone notification sounds on and very loud to avoid this in the future, but I'm still slightly embarrassed for messing up my one job. My heart rate experiment itself went

alright, I was able to manage the exercise intervals including the sprint for around 3 minutes before my ankles were clicking too hard and my calf started to tense up. I hope it will get easier tomorrow, but I do need to keep stretching in the morning and at night. I had to take a break in the middle of the sprint but I still finished the 5 minutes, but I think a factor was that I had a more rapid escalation (5 min walking, then pause, then 5 minutes jogging, then pause, etc.) then my body is used to when working out. I had a big lunch and a nap afterwards though and then my muscles felt better. I don't really miss nature too much yet, and I got to call my brother today so that really lifted my mood. In general, my mood is only really affected by how tired I am but otherwise I'm pretty happy. I feel really comfortable with all the crew members and I feel like we're building our individual and group rapports. I'm honestly very grateful that we all have a very similar sense of humour (although I do worry that Wojciech feels excluded by our conversations when we make too many anglophone references or jokes). Tonight's dinner was really funny and enjoyable but I felt terrible that the risotto took so long to cook and it delayed Wojciech's sleep, I feel sad that he tries to get more sleep but there are always so many tests in the way. I think tomorrow I need to 1) prepare better for the heart rate test so that I don't begin late again and 2) unfortunately focus on my non-EMMPOL work just to submit it to ELS and LPSC and get it out of the way. I also need to remember to report the mission time as soon as I wake up, and copy over the heart rate experiment data sheet into the Google folder.

Day 4

Last night I had a really fun dream, I don't remember the specifics but the whole crew and I were all living in a mansion and agreed to move to California together, and I felt really excited to start the day when I woke up because of it. I'm kind of surprised by my consistent good mood, I'm not by any means emotionally volatile outside of isolation but it's rare that I wake up in such a good mood, and so consistently. Sean had told me earlier that EMMPOL14 hit an emotional wall on their Day 4, so I was a bit wary about how everyone would feel today but it turned out to be another great day. I don't have much of a frame of reference for

what is normal and abnormal behaviour in the habitat, so in the morning I was concerned that MCC reached out to me about Wojciech acting distant and Danniel being unfocused. It confirmed my existing suspicions, but again I felt like the past couple of days have been fantastic and I think the better it seems to be going the more worried I am that something bad is going to happen, or that my other crewmates are going to have some trouble. Everyday I feel more comfortable around them, although I really miss having a longer gym time for myself because I think it allows me to focus better on my work later. I feel very focused in the moment, but reflecting on the day before bed I am having more and more trouble recalling everything that happened and I tend to feel like time slips by really quickly. I was glad that the cockroach habitat experiment allowed the crew to work collectively and creatively, and I think it got Danniel and Wojciech out of their funk. Sean and I agree that boredom is the enemy in the habitat, and I think the fact that Wojciech's experiment unfortunately didn't work out and Danniel's experiment takes very little time gives both of them more time than the rest of us to get lost in their exhaustion or any possible negative thoughts they might be having. Sean, Nic, and I all seem to be on the same page where we feel very busy, but also like we could live in the habitat for months with no major problems. I think it's great that Wojciech is making an effort to occupy more of his time with working out and a new cockroach experiment, and Danniel seems to be just fine, maybe antisocial in the morning but ultimately very social in the evening. After my chat with MCC I made an effort to engage them more and I think it worked, Danniel is very excited about shooting a crew video tomorrow and Wojciech was helpful with the cockroach habitat and in the evening he opened up and was joking with everybody. Regarding my experiment, everything is moving along smoothly. Most of their decision-making style remains the same regardless of their heart rate which I kind of suspected, although their overall decision-making time changes a bit. Wojciech and Danniel barely read any of the matrixes before making a decision, and I was worried that it was possibly because Wojciech didn't understand some of the vocabulary I used, but considering how straightforward TS4 was I think its just his nature to self-select preferred attributes and disregard information about the ones he doesn't find important to his decision. Similarly, I've observed that he spends a lot of time

analyzing our urine data (which as a chemist, makes sense) the same way I spend more time analyzing our mood data (which as a social scientist, makes sense). Danniel appears to have a similar DM pattern, while Sean and Nic are definitely more systematic and rigorous. However, now that we are halfway through the mission I am interested to see if that is going to change.

Day 5

I definitely didn't get as much sleep last night as I wanted, but I still woke up on time with no problems and feeling okay. I fell into step again with all of the tests and although I had a bit of brain fog during breakfast, I was able to focus much quicker than I think I have in previous days. In the morning briefing when Danniel and Wojciech got assigned more work I felt guilty because they seemed very frustrated with it, and I knew that MCC probably did it because of my recommendation. That being said, I think Wojciech felt more in his element and was more engaged with all of us throughout the day because he spent more time in the gym/dirty lab. I wasn't able to see much of Danniel's reaction beyond his early frustration because I was in the gym while he did his task. I spend the most time with Nic and Sean, and my theory is that we have different reactions to meal times that result in circumstances where we three feel more social and focused at the same intervals, whereas Danniel and Wojciech tend to use that time to nap or work privately. Nic's ability to understand and fix all the technology in the habitat is insanely impressive, it kind of inspires me to want to make things from scratch like him (although I don't know if my cardboard and duct tape sandals count). I think Sean and I are the most easy-going out of the crew so I get along with him really well, and today after the webinar and reading some of the little paper notes from previous crews I felt extremely grateful that our crew is getting along so well and that we might come out experience as genuine friends when we (Sean, Danniel, Nic and I at least) get back to the Netherlands. I felt really physically fatigued before, during, and after my workout, I think because of my lack of sleep my muscles felt heavy and slow, even though I had barely eaten anything for breakfast. I had no calf pain but my hamstrings definitely felt worse than yesterday, and my ankles felt probably as

good as it is going to get. It did feel amazing to have a proper exercise and sweat with the extra gym time, and I think it helped me physically and mentally reset before preparing for the webinar. I thought as a crew we did really well, and I was only slightly stressed just because I wanted to make AATC and Agata look good for any potential candidates watching, but I could tell that it really stressed out Danniel to lead the talking and he took some small mistakes really hard. I think he can be a great leader, but perhaps public speaking just isn't a strong suit of his and that's absolutely fine. I feel guilty to feel this way in light of his reaction, but I can't deny that it was nice to feel like I could provide a service to the group (presenting to the webinar) that no one else could. The rest of my day flew by really quickly, I was very calm but productive. I had no problems running Test Set 5 with the boys, and I'm kind of sad to leave the rhythm we've all fallen into. I was really looking forward to watching a film tonight, and I emphasized doing it so much to MCC that now I feel weirdly bad that we didn't end up doing it, almost like I missed a homework assignment. I could tell that the boys weren't particularly in the mood, and we can also project something onto the sheet tomorrow and Day 7 while we all write reports, so it's no harm done. I would be lying if I said I wasn't apprehensive about the upcoming emergency, but I have a lot of faith in my crew that if I forget a protocol, they will be able to help and we will operate really efficiently as a team. Side note : I think that the disjointed breakfast today was bad for the crew dynamic because it separated us from the outset by having different meals, volume of food intake, and time spent eating. Interestingly enough, I think the webinar today helped reinforce this group dynamic that was a bit out of shape, because being forced to confront external actors and people from "out-groups" naturally forces us to socially emphasize our crew as the "in-group". I could tell this goes on all the time at AATC in the dynamic of crew v. MCC, but I think it was reaffirming for the group to feel like a single unit in the face of Hi-SEAS and other people.

Day 6

I slept better than I did last night, and I had two dreams that I remembered when I woke up that unfortunately quickly

disappeared but it still put me in a good mood in the morning. I was really glad that we had a delicious breakfast together after our disjointed meals yesterday, and I think the crew agreed that having meals like that affects our dynamic. It's nice to observe that Danniel and Wojciech really enjoy planning and cooking meals, I think it puts them into a good headspace at key points in the day and activates that caveman instinct to want to see the tribe well-fed. I have been eating much less than normal but I have also been less hungry, likely because I'm using my body less than normal. I knew that not eating before my heart rate experiment yesterday did make me feel off so even though the food was delicious I could barely stomach more than one pancake, but I still forced myself to eat a couple. My gym time went alright, my ankles and legs feel great during the jog (except for a couple clicks here and there), but I can still feel that the sprint grinds my ankle joints and I had to make a couple breaks (but I still managed to fulfill the experiment luckily). My experiment went great as normal, although I had a lot of non-EMMPOL work to do today so I am a bit concerned about the volume of analysis and writing I have to accomplish tomorrow. I think I'll just let the boys know during breakfast that I really need to focus and I'm sure they'll respect that. I feel like everyone was in their best mood today even though we knew the emergency was coming today. I was a bit annoyed that we had reviewed all the manuals and gone over procedures, but we hadn't spent any time reviewing the materials in the shelter beforehand beyond the food and medical materials we had already placed there. It seemed like too obvious of a mistake to make, and that combined with the fact that we didn't think of opening the airlock made me kind of sad with our performance. Ultimately I just wanted to be a really successful crew and I feel like this threw a wrench in that plan. It was really affirming that MCC thought I did a great job handling communications during the emergency, but again I felt frustrated at myself for not being able to help with the airlock problem, and then for messing up my EVA suit. Even though it ended poorly, I still got a great adrenaline rush from the experience and I wasn't emotionally too sad about our performance because I got to laugh a bit about it with the whole crew and MCC. I think Sean and Danniel were a bit annoyed at not having survived another emergency, but they recovered after our makeshift dinner and chat with MCC. I'm definitely a bit sad that tomorrow is Day 7, but I can

tell that my brain fog is getting a bit stronger everyday and I think I'll only understand the full extent of the effects of isolation only once the simulation has ended. Physically, I can see and feel a couple effects of isolation, notably that my dark circles under my eyes are absolutely atrocious, and my facial skin is very sensitive to touch and temperature because if I so much as poke a pore it flares up very red and my lips get very chapped when it gets cold. My chest and back muscles are also really sore from wearing bras for so long, because outside of isolation I normally have some hours of downtime after work to bedtime where I don't wear one (I'm comfortable with the boys, but not to *that* extent). For now I'm just going to enjoy the time that I do have in the habitat with my crewmates, and enjoy our movie night!

Day 7

Today flew by really quickly because I didn't adhere to the normal routine of the past 6 days. I woke up feeling pretty well rested, I slept like a rock with no dreams or small wake-ups during the night, but I also didn't get much REM sleep at all. It seemed like the crew all woke up on the same page that we needed to focus on our report-writing today. Again this morning I had problems with eating the food, it smelled and looked delicious but I felt so full from even one bite. I forced myself to eat a whole tortilla with egg and beans because I can feel that my brain fog gets really intense in the morning and night, and I didn't want to lose any report-writing time. I ended up feeling a bit sick after doing that, so I took a 400 mg Ibuprofen that helped my stomach pain. I fell into step with my writing after breakfast, but I was once again really frustrated with myself that I couldn't fix my data output code before coming to Poland, just because I knew it would have made writing up my results so much quicker today. It was still do-able to calculate my transitions and other data by hand but it still took up a lot of my time. Sebastian was really helpful in organizing my report, I definitely will have to finish adding my data and making it look presentable. I think my findings were interesting but primarily I think I've gotten a much better perspective on how individualized decision-making patterns are according to personal interests, so I think I need to include a section in my discussion or conclusion

talking about how the questions need to contain less fun/personality/creativity so that participant subjectivity doesn't hinder their information searching effort. It was interesting to observe that Sean and Nic had the most systematic search patterns and Wojtek and Danniel had the most efficient search patterns, and they also tend to adhere to these pairings in terms of energy/focus throughout the day. I don't know if there is any correlation between the two metrics, but much of an individual search pattern is the degree of search engagement, and Nic and Sean barely ever took naps throughout the mission whereas Danniel and Wojtek took one almost everyday. I'm excited to leave the Habitat tomorrow, although I could definitely stay here longer if I had a more engaging experiment to keep myself excited. Going to see Kraków, having a big delicious Polish meal, and spending time with my crew mates outside of the Habitat is keeping me motivated to push through the not-so-fun parts of the simulation.

Expedition 57, Danniel Osoianu, Ireland

EMMPOL 15
Commander Report
01.03.2023 - 09.03.2023

I have previous mission experience (EMMPOL 14) as Vice-Commander and Comms Officer. I have to the best of my abilities kept an overview over the personal experiments of each crew member and the experiments given to us by MCC. MCC once asked if I can pay particular attention to a certain crew member and try to integrate them into the crew more. After a day, I believe them to be greatly more comfortable with the rest of us from my efforts. There were no major disputes within the crew. However, as opposed to my last crew, this crew did not naturally gravitate towards splitting shared responsibilities, such as washing dishes, cleaning work surfaces and floors etc. Thus, I had to adapt and assign small but achievable responsibilities to crew members for these instances. I have to the best of my abilities lead and take responsibility for the crew in difficult situations. For the emergency I made sure we weren't overloaded and that people were taking responsibilities that they could achieve more efficiently than others. For example, I made sure Ava stayed in constant contact with

MCC, and that only the necessary number of people exited the shelter at one time depending on the workload requirements.

Day 1

As opposed to my previous mission, we are not woken up by MCC. Instead, we choose how we wake up. This could be naturally, which would be difficult to assess how it could be done. We chose to set an exact time period for sleep, so eight hours from when we all decided to go to sleep was the consensus. When my alarm rang, I woke up everyone for their first day. Me and Sean explained to the newer members what information to report and where to find the devices needed. As opposed to my previous mission, the first morning went quite quickly, with everyone adapting rapidly and efficiently. Breakfast was prepared earlier than the designated time. Today, we had an oats and apple smoothie. A pleasant enough taste, considering the grotesque and lumpy texture. After dinner, the crew began working on their experiments. The crew members were familiarizing themselves with the new reports they encountered. I studied how to create agar. The process is quite simple, but due to inexperience and a missing manual, the autoclave was unusable to me. After quite some time figuring out alternatives, it was time for lunch. Lunch was chickpea curry with potatoes and peppers. It was very delicious, and there were some leftovers that we had for dinner that day also. After lunch, we began the process of taking group and individual photos for MCC. We tried many settings and position configurations until we finally settled on a half-smile side turned group photo. We each decided on our best individual photos that we used for the document. I then had to go to my gym session, where I worked out my upper body with weights. Due to lack of adequate equipment for this style of workout, I had to get creative with holding two weights in one hand with also a resistance band to maximize strength. After this workout, I joined the crew for dinner where we had the curry leftovers and an apple for me as well. After dinner, everyone went their own ways to work on their personal experiments and reports. This went on until we all started getting a little peckish for food. There was a unanimous feeling of hunger throughout us all, and so we all made some food. I had two ciabatta breads with tomato

sauce, cheese and herbs, similar to a pizza. This was very delicious and filling, and at that moment, it felt like the best food in the world. After the meal, we all hunkered down and began writing our reports. When I woke up, I felt emotionless. I knew what to do, when to do it, but I was more than thrilled to help my crew mates with these reports. However, in my own ego, I felt nothing towards these morning reports, nothing towards the habitat. It was no longer novel to me, which uninterested me almost entirely. I now feel slightly worried that this uninterest will impact the surprise 'emergency,' a supposed 'punishment' for a failure that never occurred. I have lost my initial amazement towards this habitat, and I have certainly never heard of an astronaut getting punished due to a translational misunderstanding between two 'countries.' I can only wait and see what there is to come.

Day 2

I was woken by my alarm that I set for 8 hours from when we all decided. I turned the lights on, and everyone woke up from that. The whole crew were up doing the reports and everything was finished one hour from when we woke up. Breakfast today was French-style scrambled eggs and bread with hummus. We had a briefing with MCC while we were eating. I washed the dishes at the end. After breakfast, I felt tired so I went for a nap for one hour. I had a dream during the nap. As with all of my dreams, they are usually unexplainable to anyone other than myself who can clearly see it. It was me, Sean and the EMMPOL 14 crew save for Jac, and some friends from back in Ireland. We seemed to be celebrating something, perhaps a reunion? We were all reminiscing in a room I've never seen before about events that have never occurred during our time together. I don't remember Solene drinking shots of tequila, but it felt like this was a vivid memory in the dream, and something we all agreed happened. After waking up, it was time for our bi-hourly circadian rhythm report. MCC had given us a new task, something to do with ophthalmoscopy. Me and Nic tried different photos of the eye to see which kind of photo MCC preferred. Then I began to prepare lunch which consisted of bulgur groats, sun dried tomatoes and various other vegetables. The meal was quite delicious and very filling. After lunch, it was time for my

gym session. Before, however, I did Ava's experiment as I had to do it before my gym session. I worked with weights and finished with cardio. Afterwards, I had some tea and chocolate with the crew while we worked on our individual reports and experiments. Then, it was time for dinner and the debriefing. We made ruskie perogies, and it satiated my hunger. After dinner, we all sat together and wrote our reports to finish the day. At the end of the night, before going to sleep, we performed Wim Hof style breathing. I was unfamiliar at first, but as I went through, it became more familiar to me. I used this method (without knowing its name) to be able to hold my breath for 5 minutes once. I remember watching a famous 'magician' explain how he used this method to hold his breath underwater for close to 18 minutes. I adore breathing techniques, as they are immensely helpful regulating all kinds of factors in your body, including emotions. I regularly use the physiological sigh method to relieve stress buildup. Like yesterday, I felt very neutral. I struggle to recall my mood throughout the day. There were periods of laughter I'm sure, but I find difficulty in identifying an overarching mood throughout the day.

Day 3

When everybody woke up, we all did our reports quickly and efficiently. This continued until an early breakfast, where we had a staple Irish food, but more like a snack. It was beans on toast. It was desperately needed, and very delicious. After breakfast, I performed all necessary morning experiments and I then had an hour-long nap. No dreams today. When I woke up, I worked on report writing. This continued until lunch. Lunch consisted of spaghetti and tofu with some feta cheese. Again, a very delicious and filling meal. After lunch, it was time for my gym time. Today, we started the Heart Time experiment. I pushed myself this time, as previously it wasn't very enjoyable. I prefer to train with weights, and light cardio after for active recovery, so medium to heavy cardio is new to me. Afterwards, I got blood samples from everyone for my experiment. Then it was time for dinner. For dinner we decided to cook risotto with vegetables. We used this meal as an opportunity to use all the vegetables that we had lying around. We then wrote up reports, then did the ophthalmology experiment

and finally ended with the Wim Hof breathing. I was neutral throughout the day. Maybe it's the people, maybe it’s me.

Day 4

Today I woke up before my alarm and decided to roll with it. We all swiftly did our morning reports. Breakfast today was scrambled eggs, sausages and a tortilla. We made a breakfast burrito with all the ingredients. It was well needed. After breakfast I had a 2 hour long nap. It too was well needed. No dreams. I worked on my reports until we decided as a crew to work on the cockroach habitat. Using my knowledge of the design, communication and graphics module I took in school, I produced a detailed orthographic projection of a concept cockroach habitat. We discussed this concept over lunch, which today was cheese and spinach tortellini with bolognese sauce. After lunch, I did my Heart Time experiment in the gym. It went well enough, but I’m torn between listening to music or listening to podcasts. Yesterday, I listened to music and felt like I could go for longer than I could today when I listened to a podcast. Need more research. After the gym, I helped paint three cockroaches and named two from the painting. I named one Sticky, because as opposed to other cockroaches, every time I painted it, Sticky would stick to the tweezers I used to paint them. I named another cockroach Prince, because they kept moving around when I painted them, so the mark looks like a crown. Then it was time for debriefing. I didn’t feel particularly hungry, and I need to watch my weight since I don’t have access to a proper weights gym yet. I collected blood samples from everyone successfully. I have many concerns with this practice. There are no disposable gloves in the habitat that I have found so as to prevent blood from making contact with my skin. There are also no more clean glass slides and clean glass slips to view blood from. The 100 x objective lenses on the light microscope are also very dirty, which shows up very clearly in photos and could be hard to make out the image. Also, a bunsen burner could be useful if preparing agar and/or doing microbiology experiments, however I understand the fire risk and the risk of using too much oxygen due to the nature of the burner. All in all, with the equipment I had at my disposal, I did the best I possibly

could. After my experiment, I continued working on my daily reports. After my ophthalmology experiment and Wim Hof breathing, I started getting ready for the end of the day.

Day 5

Like yesterday, I woke up from my alarm, turned on all the nights, and the crew began waking up too. We quickly finished our tests, had breakfast and went through the briefing with MCC. They told us of new experiments to perform. I was in charge of a project called mikroPura, but the folder gave no indication as to what it would be used for, only what the housing looks like and what it would contain, like the circuits and heating pad. I have no idea where to even begin doing research on this. Another task that I was given was to clean the hydroponics system. After breakfast, I did the ophthalmology experiment and began researching the hydroponics system. After doing adequate research on the system, I began working on the cleaning. I removed the substrate from the trays, and began the pump. The water was not powerful. In fact, water was not pumping through some of the tubings connected to the top trays. Dirt was built up inside the tubes. I cut some of the zip ties that held the tubes together so I can attempt to squeeze the dirt through them. I managed to do this to all tubes and then cleaned the trays after. It was so clean, in fact, I could eat my dinner off of the trays. Then it was time for lunch. We had rice with tomato sauce and vegetables. It was very delicious, although I believe a little bit too much salt was added. After lunch, we prepared for a social outreach event with HI-SEAS through Zoom, where it was streamed to a live audience of whoever was interested in watching. We all explained our roles, gave a quick tour of the habitat and listened in on HI-SEAS doing the same. It was interesting to see their living conditions compared to ours. I was very nervous throughout as I was not prepared, and the insane brain fog did not help at all. After the meeting, the habitat schedule was undone, so I did my gym cardio in the bedroom. I skipped dinner for the same reasons as the previous day. I wrote a full page about my thoughts and feelings here, but felt better after writing it so I decided to delete the portion, the contents of which I feel don't represent me now as heavily as they did when I wrote about them. I

have trouble writing about my emotions without feeling pretentious and undeserving to feel that way. I feel neutral, balanced and apathetic. I finished my reports, and headed to bed.

Day 6

I woke up from my alarm clock and everyone woke up from the alarm too. We rapidly completed our tests for the morning. I prepared today's breakfast of apple pancakes. It was calming to make the pancakes while everybody sat at the table. It was just me and my music, and occasionally I conversated with the rest of the crew. I only had two pancakes as the coffee suppressed my hunger and made me feel satiated. After breakfast, I worked on my reports for both the EMMPOL mission and my college weekly reports, as due to the business of my last mission, I was running late on them. I felt like I needed a little break after a while, so I relearned a song I had previously known but simply forgot. After a while, we all got together and made lunch together. We had some leftover sauce from yesterday’s meal so I made ramen and mixed it in the sauce. It was very delicious, and I felt like I needed a quick and filling meal. After lunch, I was with Sean and Ava doing reports for a while, until our emergency simulation hit. EXPERIMENT REPORT - Crew. A warning was received from MCC about a micrometeor shower heading for the base. The crew began suiting up in preparation for the emergency and awaited further instructions from MCC. The shelter was restocked with plenty of water and food in case of emergency, so there was no time wasted preparing this during the emergency. MCC warned crew to head into the shelter and to shut down all non life-support systems. Sean flipped the necessary switches, but still some lights were on. When the crew was in shelter, they noticed the gym and geo lab lights were still active, and MCC required the crew to quench the lights. Danniel headed out without proper gear to switch off the lights, but due to improper gear, suffered poisoning. MCC informed the crew that a nitrogen leak was detected in the bedroom module, and told the crew they had 5 minutes to repair the hole. Health parameters for Danniel had to be measured, but the necessary equipment needed to measure parameters were not in the shelter. Danniel was required to send pictures of his eyes and then to lie down. Sean

and Wojtek geared up in proper gear to head outside of the habitat for the equipment and to fix the leaking coolant. Due to improper footwear, Sean and Wojtek suffered leg damage, and had to bandage their legs. Health equipment was obtained and Danniel's vitals were measured. The MCC informed their crew they had to ozonate the bedroom module. Sean and Wojtek headed back out to deploy the ozonator in the bedroom module and return back to the shelter. The crew were then told they had to survive in the shelter for one hour before being able to return outside to allow the ozonator to remove the poison that was built up in the habitat. The crew's health parameters were measured and reported by Ava to MCC. The beginning of the hour was fine, but then CO2 began rising inside the small shelter. MCC alerted the crew of the rising CO2 levels, and tasked them with finding ways to remove the CO2. They hinted at an 'accumulator', and Sean and Nicolas, in proper EVA gear, went outside to bring back the machine. Unfortunately the device's battery was dead, so the machine could not be started. MCC then tasked the crew with coming up with a way to quickly dispel the rising CO2 levels. The crew thought about many options, such as chemical reactions to produce oxygen, or plants to absorb the CO2 and release oxygen. However, MCC informed the crew that those options were impractical and too slow to have any immediate effect on the already too high CO2 levels. The crew pondered and thought about other options, while also trying to keep speech at a minimum to conserve oxygen and not give out CO2. Eventually, MCC offered a hint to the crew about possibly using the airlock. Sean and Nicolas in EVA gear went outside to tape down loose equipment around the airlock before opening the airlock. The air quickly rushed out to rid the habitat of the CO2 infested air. After a few moments allowing all the air to exit, the airlock was closed shut and the remaining crew in the shelter donned EVA gear and went to the bedroom module as the rest of the habitat was being ozonated. Ava forgot the hood part of her EVA suit, and had a close encounter with death, but the team quickly sealed the opening with NRC foil. After more seconds allowing the ozonator to work, the crew was informed by MCC that all is well again in the habitat, and the emergency simulation ended. The emergency was extremely engaging and fun as opposed to my previous mission's emergency. I really enjoyed the procedures and life-or-death risk of it. While we weren't perfect, the

whole team was really focused and alert, and we all put our heads together to try to come up with various solutions. After the emergency procedure, we all decided to relax with a movie and dinner, and that was the end of the night. My mood began gradually picking up in the morning. I really enjoyed cooking for the rest of the crew, even though it wasn't much.

Day 7

I woke up in a decent mood today. Everyone started waking up when I switched on the lights. We performed our reports and various tests rapidly, and I began making breakfast of scrambled eggs with tortilla wraps. It was quick and delicious. After breakfast, I assigned responsibilities to each crew member and we began cleaning the habitat. After I cleared and wiped the tables, I began working on my reports. I sat down at the table with Sean and we worked on our experiment reports together. This went on until I felt hungry, so I heated up some baked beans with tomato sauce and ate it with some crackers. I then continued working on my experiment report until dinner. Dinner was farfalle pasta with vegetables. I had a huge portion, a feast for kings. After dinner, we cleaned up a little. After a little bit of cleaning, I finished my reports and went to bed.

Expedition 57, Nicolas Barker, USA

EMMPOL 15

01.03.2023 - 09.03.2023

Day 1

The day began with the alarm on my watch vibrating, after which the commander Daniel stood up and turned on the lights. I got dressed, and started to familiarize myself with the morning activities. We realized the STP test and blood glucose were not working. I felt quite rested after my six hours of sleep. For

breakfast, Daniel cooked an oatmeal apple smoothie, which I found easier to eat with a spoon than to drink. After asking countless questions to Sean and Daniel about how everything worked, we started to get into a rhythm after the third circadian measurement. I'll begin working on my glasses project, developing the control, software and interface, as well as considering different ways it may be possible to mount the camera in front of the face. Next I went to the gym, unsure of how much I wanted to push myself physically, mainly due to the fact I won't be able to properly clean off my sweat for a week. I started off running, while watching some fascinating videos on YouTube. Once I started to sweat heavily, I reduced the pace to a jog. I went back and forth between jogging and walking for the remainder of the hour, totaling 5 km. Being in the gym did restore the feeling of individuality, but that is not necessarily something I am craving yet. By the time my gym session was over, lunch was made, and it was delicious. We ate and continued to work on our projects. I still feel quite motivated, and did not feel the need to nap throughout the day, even though we all felt a bit sleepy after lunch. Two hours after lunch we ate a bit of the leftovers, washed dishes, and ate an apple. I continued to work and listen to country music until we got hungry again, but instead of making a communal dinner, we each had some smaller food. I had some corn and peas with Ramen noodles, which was basic, but tasted quite good. Everyone making their own meal at dinner was chaotic and messy, but it created a fun atmosphere. After doing my final tests and making an amount of progress I am happy with on the glasses, I went to bed late after staying up to work on my experiment and finish the last of my daily tasks.

Day 2

It was harder to get out of bed today, but that was very likely due to getting less than 5 hours of sleep. I got out of bed at 00:20 and proceeded with my morning tasks somewhat groggily. For breakfast I cooked some scrambled eggs and we ate them on bread. Overall time felt like it was passing faster today than yesterday. After working on my eye project for an hour or two, other projects came up that took priority. Come gym time I changed and went to go jog and called a friend during it. Because

of the call I went for a short sprint and then walked and jogged the rest of the hour. After gym I joined the others for a bulgur and vegetable lunch which was also delicious. After lunch I redirected my attention towards getting the 3D printer to work and figuring out how to consistently light the ophthalmology images. After an issue with the lamination of the first layer and then an issue with the filament jamming, the third print finally succeeded. Meanwhile I found a light source and experimented with different flash settings. I am quite happy with the results, I think they will be useful.

Day 3

I had trouble waking up today and felt quite groggy getting up. This feeling lasted until breakfast, when I started to feel better again. I had a few slices of bread with butter and Nutellalla and an apple for breakfast. After breakfast I started collecting eye pictures of my crew mates. Next I designed and 3D printed a piece for Wojtek's experiment setup. The print turned out quite well, although with a caliper or second prototype I could have done a better job. After that we ate lunch which was a vegetarian spaghetti bolognese. It was delicious, Wojtek always gets the cooking right! Right after lunch it was time for the gym, and the heart rate experiments began. I enjoyed doing them, but I did miss the peace that the free hour of gym gave. When I got back everyone was still napping from after lunch, so I decided to start working on my own experiments again. Now that I had become familiar with the 3D printer, I started to tackle my big obstacle with the glasses project, which was mounting the camera in front of my face securely. I spent the rest of the afternoon until dinner printing prototypes of the camera mount, and after 3-4 prints I am quite happy with the result. Next I have to finish off the last part of the software that will allow me to track my blinking continuously. Dinner was also quite good, I had a lot of the risotto. Everyone was in a pretty giggly mood through and after dinner. Before sleeping we all did the Wim Hof breathing, and this time it worked better for me. During the breath holds I somehow had no urge to breath, and I could feel my skin being cold and my hands were tingling. For the breath hold I stayed for 02:43, however I think with some focus I could easily do much better. After the breathing I took eye pictures of everyone again,

and then ran the final tests for the day, aiming to get a somewhat early night of sleep.

Day 4

Today's sleep was much better. Emotionally I feel fully adapted by now, as if I would have no trouble continuing this rhythm for months. The ophthalmology measurements went well today as well. The crew's enthusiasm about having pictures taken is not very high, but they are very helpful regardless, always volunteering to take the time to have them taken. I hope the results will be useful for my iris experiments as well, however I am not sure that the given setup provides the required iris resolution, as the requirement of taking pictures lying down came with a compromise in resolution. This compromise is of course not inherent to the experiment, however while designing the setup I had limited resources available and also wanted to make sure the process wasn't too strenuous for the crew, as laying under a bright light and being flashed multiple times is already enough of an ordeal. Side Note: The reason for the bright light is to minimize the effects of ambient lighting changing, because the ambient level is negligible relative to the light. As a relaxing and artistic exercise, I painted my nails with a space theme. This nail polish came in handy when we were tasked to observe and build a habitat for the cockroaches. We devised a marking system and painted them one by one. Now that the physical assembly of my glasses project is adequate, I can focus on the software, which is coming along quite well. I just need to optimize the recording format for the recognition engine, and speed up the recording frequency. Additionally I tried to fix up things around the habitat. I repaired the treadmill which was falling apart from use, replaced a light bulb in the shelter, and started to begin repairing the clinostat. I very much enjoyed the Wim Hof breathing, and was surprised I could hold my breath so long (03:30) after it! In the past I thought I could only hold my breath for two minutes or so. I rushed to finish the rest of my tasks today, because I wanted to get an early night of sleep.

Day 5

These days go by quicker and quicker. Today I woke up feeling more refreshed, although according to my watch I had the same amount of sleep as yesterday. For the online webinar I managed to get my glasses prototype to function similarly to how it will in reality. In the evening I spent a while modeling a new design for the clinostat petri dish holders. The previous design required a lot of support material to print, and had a clear weak spot since two of them have broken in that spot. For my design I aimed to fix these two issues, as well as add the functionality of supporting various sizes of petri dishes. For Wim Hof I once again surprised myself by breaking my breath holding record with a time of 04:30. I think I will continue this method at home before sleep, because it is such a fascinating demonstration of being able to unlock abilities I didn't know I possessed.

Day 6

Today I woke up once from the cold at night. We should not forget to leave a heater running overnight. After having delicious apple pancakes for breakfast, I again set out to get the clinostat fixed. Because the 3D printer's print bed is heavily damaged by people using scrapers too aggressively, I had quite some difficulty getting a large print like this one to succeed. After playing around with various settings and a few calibrations, the print finally succeeded. I can think of a few good improvements to the design already after holding it in my hands and trying the fit with a few petri dishes. After doing this and the heart rate experiment, I had to attend an unavoidable meeting with Earth, after which we had the misfortune of being hit by a meteor shower, causing a coolant leakage and various near losses of life. Fortunately the leak was repaired and the habitat is fully operational again. After this the rest of the day was devoted to celebrating this harrowing experience, and the nightly ophthalmology and Wim Hof routines.

Day 7

Today I woke up groggily, sleeping in for another half hour. For breakfast we had scrambled eggs in tortilla wraps again, which was quite good. We then cleaned the habitat, because it was still in disarray from yesterday night's emergency. Next I took the ophthalmology pictures of everyone and started to get working on the various reports. I then took a break to design another iteration of the clinostat piece and printed it. This revision is more flexible, better at holding the dish, and uses less material. I then started to organize the ophthalmology pictures and sort out the duplicate and bad ones. After that I decided to go for an hour walk in the gym which was refreshing but a little sweaty. Then we all just wrote the bulk of reports and edited them based on Sebastian's excellent comments. After that we had dinner, cleaned the habitat, and did our final tests.

Expedition 57, Wojciech Guziewicz, Poland

EMMPOL 15
01.03.2023 - 09.03.2023

Day 1

I woke up a little tired as I was waking a few times and didn't have a strong sleep. I dreamt a little, the dreams were neutral and I could barely remember them. I learned how to take all the required tests. For breakfast we had smoothie which looked terrible but was okay, I've had 400g of it. Later on I tried to seal my apparatus with Nicolas and we sort of succeeded. I took a nap since I was sleepy and woke up feeling better. I decided to make a chickpeas curry for the whole team while they were either helping or carrying on with their tasks. There was quite a lot of curry (I ate 500g), so we didn't make dinner later but sticked to the snacks. After the dinner we

decided to take a group photo which took like an hour, but thanks to Nicolas, the photos are really great. At T+11 I went to the gym and ran for 30 minutes with intervals being between speed 4.0 and 11.0. Since I was running barefoot my ankles were in a bit of pain so I ran just 3 km and later started to do weight training. I pushed up 30 times and made 40 repeats of different shoulder exercises. After that I ate around 100g of leftover curry and cleaned up myself. After that I started to set up a filtering station, adding around 100g of MMS-1 and around 100g of basalt rocks and started first filtering. After the first run I was satisfied with the test so I left the apparatus for tomorrow. After that I had pretty much free time so I rested for 40 mins or so. After that time I joined the crew to eat some snacks which were 400g ramen, 4 sliced bread with 4 cheese slices in my case. After that I proceeded to before-sleep tests, brushed my teeth and went to bed at around T+17:30

Day 2

I woke up better rested than yesterday, although the sleep monitor showed that my sleep was worse. The breakfast was really great, way better than yesterday. I had 300g of scrambled eggs and six slices of bread with hummus. Later I unsealed and emptied my apparatus, then sealed it again so it's ready for the next test. I was drinking more water to collect my urine and try to filtrate it and so I collected around 400ml of it. Later on Danniel prepared a bulgur groat for dinner and I had 450g of it. After dinner I was trying to read and think about other possible experiments I could do with materials in habitat. I also decided to update the chemicals list, however it turned out to be impossible as the mass of the packings were nowhere to be found so I could weigh how much of them is still unused. Then I went to the gym where I'd ran for 3 km and cycle for 7 km, burning around 260 kcal, sweating a lot and as a result raising CO_2 level to red level for a while. Also I've got a bladder on the sole of my left foot due to barefoot running so I would probably have to stick to cycling from now. After the gym I wanted to start filtrating, however I discovered that we have more precise water testing kit, so I had to figure out how it works and also Nicolas, who was about to photograph the experiment was busy so I decided to postpone it for the next day. Then we had

dinner. I drank 450ml of fermented beetroot juice which no one seemed to like. On top of that I ate 150g Russian dumplings and one ciabatta with peanut butter. After that I tried to rest and calm down as much as I could before going to bed, so I might possibly have a deeper sleep this night. I go to bed at T+15:30 and wait 30 minutes to take the tests, then I immediately go to sleep.

Day 3

I woke up a bit tired as I had to go to the toilet during the night. Made all the measurements, ate 6 slices of bread with hummus, 7 dried tomatoes, 1 fermented cucumber and went to rest a bit. After that I gathered around 400 ml of urine and started to clean up the lab glass. Then I proceeded to check my urine for NH4 level. I've added 4 drops of solution 1, 4 drops of solution 2 and 5 drops of solution 3 and waited for 15 minutes. After that time it seemed that something precipitated out of urine which meant that unfortunately water tests in habitat are useless for testing urine as they react with some chemicals in it and make it impossible to read the concentration from the color of the solution. Despite that me and Nic designed flask adapter (because filter and flask sizes were different) and started printing it in 3D printer. After that I started to make spaghetti for lunch of which I've eaten around 550g. After that I went to the gym, conducted STP tests and then went onto my workout which was 17km of cycling on maximum load, burning 900 kcal. Then I went to clean up myself and drunk 450g of fermented beetroot juice. I ate 550g of risotto for lunch, drunk herb tea and get my eyes photographed by Nic. Then I went to bed at T+16, did Wim Hof breathing and tried to sleep.

Day 4

I woke up at T - 01:00 and went to do a urine test while the rest of the crew was still sleeping. I went back to my bed and laid there for an hour napping lightly, until everyone was awake. After that I made morning measurements and tests and prepared scrambled eggs for everyone, from which I ate 400g rolled in tortilla. After that I went to the gym and cycled for 40 minutes, burning 1000 kcal in

20 km. Then I had to rest and dry out for a few minutes. After that time I asked Sean about cockroaches and started plans on how to arrange space for them. Later on I cooked tortellini for lunch of which I ate around 350g. After that I went to rest and had a short nap. Then I mopped the sleeping room and proceeded to plan with the rest of the crew how we would build habitat for cockroaches. After doing so I cut down the box, crushed some rocks to sand and put it into the box. Also I thought about reproduction of a social facilitation experiment on cockroaches by R. Zajonc to which I should proceed on Day 5. At T+11 I went to the gym, did STP tests and then proceeded to cycle again, for 40 min, burning yet another 1000 kcal in 20 km. After that I had to dry out again and eat dinner, which for me was 300g of leftover risotto from Day 3, rolled in a tortilla with 2 slices of cheese. Then I went to clean up myself, drink herbs, spend some time with the crew, conduct tests and analysis for the evening and went to bed at T+16:00.

Day 5

I got out of bed at T + 00:20 as I woke up a few times and had to go to the bathroom once. I made all the standard measurements and read the microPura schemes. I ate three rice waffles with Nutella for breakfast, pretty late, at around T + 02:50. Then I proceeded to update chemical inventory list, carefully checking each chemicals, noting mass left and any notes if there were some. Also I've added a few chemicals that were not on the list. That took me about an hour, after which I made another attempt on my experiment with tests for water that I've found on the shelf. They were way less accurate, but didn't react with urine which allowed me to get some results. I gathered around 200 ml of urine and checked its parameters. After that I ran it through a filter under vacuum and checked parameters again, also taking photo of pre and post filtration. I repeated the procedure once again and wrote down the results. After that I cleaned up my workstation and took some rest. Later I prepared curry for lunch with chickpea, potato and red pepper with rice. After lunch I prepared with others for a meeting with HI-SEAS, after which I went to the gym to do STP tests and my own workout. I followed STP procedure and after that I went to cycle for 60 minutes, reaching 30 km. After workout I ate

pudding and semolina for dinner, cleaned up myself and made evening reports. I got to bed at T+15:50 and did Wim Hof breathing with the crew.

Day 6

I got out of bed at T + 00:20 as I didn't sleep too well. I did all the morning tests and ate 4 pancakes with curd for breakfast. After breakfast I started to filtrate urine, taking 200 ml of mine, Ava's and Sean's. I checked the parameters before and post filtration, washing the filter with distilled water in between. After I finished my measurements I started to write the experiment report. After that I ate 300 g curry soup and continued to write the report. At T+10:30 we had an emergency involving micrometeorites rain. We all moved to the shelter, turning off the lights and non-life support system, however Danniel stayed longer to make sure they were turned off and got slightly sick. It turned out that our cooling system got damaged so I put on an EVA suit and went to locate and seal the breach with Sean. It was located in the bedroom, near the MCC cameras and got sealed properly, however too late. Because of that and lack of enough protective equipment, me and Sean got light frost bites on our feet. After sealing up we went back to the shelter to protect our feet. Then we went back to the bedroom zone to put ozonators there, to clean up the air. We came back to shelter but we started to have problems with CO2 concentration. After a few non-effective attempts we decided to open the airlock. Nicolas and Sean went out in EVA suits to secure all equipment and open the door to remove excessive CO2. During that time me, Ava and Danniel put out EVA suits and went to the bedroom with Sean and Nicolas, since the ozonators already cleaned the air to the level it was okay for us. We sealed the bedroom and waited for the pressure to rise. After that emergency was controlled. After the emergency I went to the gym to do heart rate tests. Later I had a small dinner, made evening reports and proceeded to prepare for the sleep.

Day 7

I woke up good and rested and made all morning measurements and tests. We had breakfast with the crew on which I had 300g of scrambled eggs in a tortilla. After that I washed the dishes and went to the gym for 30 km cycling. Then I got myself a bit of rest and started to make finals reports and put all the missing measurements from the gym. I cleared my apparatus and put it into the habitat museum. Then I carried on with my role and experiment reports. The crew didn't have a normal lunch as everyone was focused on his reports, so I ate 250g of tortellini and 150g of feta myself. Rest of the day flew by on finishing reports till debriefing at T+13:00. After that time I started cleaning up the habitat and ate 300g of bolognese pasta for dinner. I finished all my tasks before T+16:00 and watched a movie with the crew till eventually going to sleep.

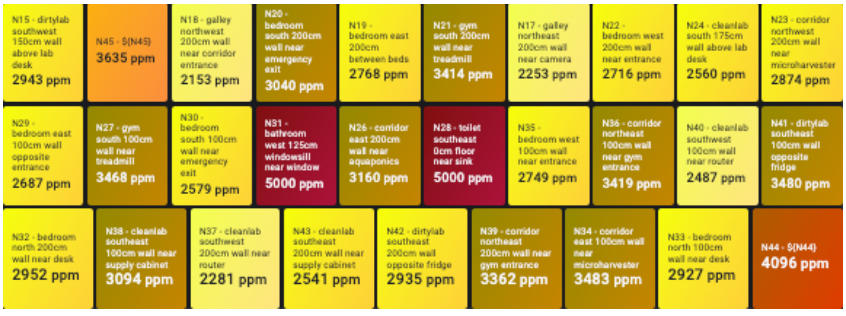
Expedition 57 Emergency Report

EMMPOL 15 - Day 6
00.00 - announcement about danger - the meteorite shower in 5 min.
00:05 - siren activated, meteorite shower
00:07 - lights off, fuses off, astronauts relocated in the shelter
00:08 - poisoned crew commander because if switching off lights without body protection, request for his medical check up: HR, BP, body temp.
00:09 - LLS systems detected leakage of liquid nitrogen in the bedroom module
00:10 - 5 min. To fix leakage, two people
00:12 - request to make a photo of the eye of poisoned commander
00:13 - photo received, no need to correct the quality

00:16 - hole taped (1 min. Delay), request for a photo
00:18 - frozen legs because of liquid nitrogen, photo obtained, request for leg protection
00:21 -activate ozonation in the bedroom module
00:22 - nice siren shoes photo accepted, 1h of having this protection
00:26 - request for physiological parameters of the rest crew members
00:32 - ozonator activated
00:34 - 1 h in the shelter
00:38 - collecting all medical check ups
00:40 - announcement about activating extra ventilation, one 5000 in the shelter
01:28 - opening the airlock, very bad air conditions in the base
01:36 - another hour in the shelter until problem is solved
01:46 - getting more green
01:47 - new helmets found to leave the shelter
01:52 - finally shelter gets green
01:53 - closing the airlock - 5 min. Recompression
01:56 - AVA must cover head with NRC foil
01:57 - done
02:00 - photo sent
02:01 - end of the simulation - 25 min. DELAY

Before

After



During the emergency

Hydroponics in Isolation

EMMPOL 15

10-17.03.2023

1. Introduction

Photosynthesis in plants is divided into two stages: a light reaction and a dark reaction. The light reaction produces the ATP and NADPH necessary for energy production. In a dark reaction, CO_2 is assimilated at the expense of this previously generated energy. Plants, due to the way they carry out the dark reaction of photosynthesis, are divided into two types: C3 and C4 plants. The names come from the number of carbon atoms in the molecules formed during the Calvin cycle [2]. C3 plants are the most common ones. 95% of all plants belong to the C3 type. In these plants, photosynthesis at night does not convert CO_2 into organic compounds, because their stomata are closed [2]. Instead, a process called photorespiration occurs, producing CO_2 and O_2. Therefore these plants aren't doing great in too dry environments. Examples of C3 are soybeans, rice, trees, or wheat. C4 plants can convert CO_2 into organic compounds at night. It is possible,

because of fixing CO_2 in the mesophyll cells. About 5% of all plants are C4. Examples of C4: corn, sugarcane [2].

Differences

- C3 plants are cool-season plants; C4 plants are warm-season,
- C3 plants possess one CO_2 acceptor; C4 plants possess two of them,
- C3 plants performs photosynthesis only when stomata are open; C4 plants also when stomata are closed,
- Optimal temperature for C3 plants is quite low; for C4 plants is high.

Similarities

- Plants of these fix energy from sunlight,
- They require chloroplasts for photosynthesis,
- Both consist of the same light reactions,
- CO2 is accepted by RuBP in both C3 and C4 plants.

2. Aims of experiment

The aim of the experiment is to investigate the impact of the built CO_2 fertilizer on the environment inside the system. It is also the observation of the hydroponic system and drawing conclusions about the mechanism of its operation and impact on C3 and C4 plants, which may help in its improvement in the future.

3. Methodology

Hydroponics are a type of horticulture and a subset of hydroculture which involves growing plants without soil, by using water-based mineral nutrient solutions in aqueous solvents. It offers many advantages, notably a decrease in water usage in agriculture. That's why it could get a good use in space [1]. The hydroponic system available in the habitat consisted of several important elements: an illuminated basin with water containing hydroponic medium, a pump or a set of pumps, larger and smaller pipes, a heater and two illuminated trays (picture 2) for planting plants there. For the purposes of the experiment, a CO_2 fertilizer (picture 3) was created, supplying this gas to the tested water. Preparation

of the equipment began with preparing all the necessary materials, pumps and pipes for use. Trays, pumps and pipes were cleared of plant debris and soil. Then the time switch was set to 16 hours of daytime operation and 8 hours of night operation. Lights have been connected to the switch. Then water level in the basin was measured. Since it was too low, about 16 liters of water were added. After that Control-0-Measurement was conducted, according to the kit's instructions. Then the water heater and water pump were switched on. Water level and quality were measured regularly. CO_2 level was measured by environmental sensors nearby the hydroponics. The experiment consisted of testing the water and CO_2 parameters in the hydroponic system basin, observing the system's operation and modifying/repairing it in case of damage. The measurements of the water composition and quality were carried out using the JBL Pro Aqua Test kit.The observations made and lessons learned can help improve the system in the future. Water quality and composition were initially measured every 24 hours. From day 3, the frequency of testing decreased (every 48h). The measurements consisted in adding, specified in instruction to JBL Pro Aqua Kit, an amount of individual indicators detecting the presence of specific compounds/ions, to the water from the basin. From day 4, CO_2 measurements began and were repeated every 24 hours to the end of the mission.The experiment used a CO_2 fertilizer, made of yeast (7g), sugar (50g) and water (about 3l). As a result of the alcoholic fermentation process, CO_2 was formed, which was transported from the cylinder to the hydroponics by means of a discharge pipe. The volume of CO_2 was measured for 10 minutes using a beaker immersed in water, taking care not to let air in. Measured volume x 6 = Flow rate in ml/hr. Readings from the environmental sensor near the hydroponics and water level in the basin were also measured. Several technical problems occurred during the experiment. On the second day, there was a problem with water leakage, however, fortunately, it was not serious and was quickly fixed. On the fourth day, the water pump transporting water to the upper levels of the system failed. Unfortunately, the pump could not be repaired and the water was not pumped all day. Instead, a makeshift pumping set was created consisting of two smaller pumps and a water bottle cut in half. The first pump transported the water to the bottle and the second from the bottle to the top of

the hydroponic system. Said set worked until the end of the mission, except for a minor two-hour break at night, when the pump was turned off for fear of flooding the electrical system.

4. Results

The measurement of water quality was quite reproducible. Only nitrate concentrations changed depending on whether the pump was operating or not. This may be due to the filtering properties of the pump or the evaporation of water and thus increasing the concentration of the components present in it. Environmental measurements showed an increase in CO_2 concentration in the hydroponic system from morning to evening. At night there was a drop, probably due to the ventilation of the room and the lack of breathing people. CO_2 flow rate measurements were reproducible with the exception of day 4, where the measurement was probably erroneous.

5. Conclusions

During the experiment, the possibility of observing the hydroponic system available in the habitat was used. The conducted observations allowed to draw several conclusions that may prove useful in the future as the technology develops. For the system to work properly, it must have its own microclimate. Isolation from the environment is important, not only from external conditions, but also from the conditions inside the system. Controlling the amount of gasses on ships/space bases is extremely important and too much CO_2 inside can have a very bad effect on the astronauts. During the experiment, after the installation of the CO_2 fertilizer, everyday CO_2 levels were increasing from morning to evening. It's been visible from day 3. A controlled level of CO_2 may be necessary for proper growth of the plants inside the hydroponics. The pump in the basin is an extremely important part of the hydroponic system. It is important to clean it regularly and check that everything is working properly. Each ship/base should have at least a couple of backup pumps with enough power to run the entire system. A high concentration of nitrates is good for the plants, but when the pump is not working, the water evaporates

quickly. This means that water that is not pumped and full of organic residues becomes a great fertilizer for use for breeding purposes. Appropriate control of the amount of nitrates in the water can have a very beneficial effect on the growth and development of plants.
To ensure the conditions for the growth of C3 and C4 plants, attention should be paid to their requirements. C4 crops, such as millet, corn, and sugarcane, require a higher temperature and drier environment than C3 crops. In addition, they can carry out the dark phase of photosynthesis also at night, which makes them less sensitive to changes in lighting. C3 plants, such as wheat, soybeans, tomatoes, cucumbers, are more demanding on light and temperature. They feel better in cooler temperatures and in good light. The right concentration of CO_2 allows for the proper growth of these plants, and the right growth medium provides all the necessary nutrients. A properly selected and planned method of lighting allows for the proper growth and functioning of both types of plants, as well as the appropriate temperature and humidity inside the system.

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Blood Smears in Isolation

Danniel Osoianu

Introduction / Theory

Studying blood samples can tell you heaps of information about a person's health, including potential diseases and abnormalities in the person's bone marrow. To see individual blood cells, a technique known as blood smearing is used. With this technique, it is possible to separate the blood droplet so it forms a layer where cells are spaced out in a way that you can count and differentiate the cells. This layer is known as the monolayer, and it has a feathered and smudged appearance on the glass slide.

To be able to view these blood cells, a microscope is required to view the cells. These devices can magnify an image up to 1000x. At this high magnification, light gets refracted too much to enter the lens, so immersion oil is used between the slide and the objective lens [1]. Stains are also used in microscopy to better see the cells, as under the white light, some cells such as white cells are transparent, and cannot be seen without a stain. Common stains used in hematology are Romanowsky stains, such as the May-Grunwald Giemsa or the Wright-Giemsa stain [2].

The purpose of studying blood cell microscopy in the context of space is to further research the prevention of disease and abnormalities associated with red blood cells in an isolated environment.

Hypothesis

"Time spent in isolation affects blood cells"

It is true that in space, astronauts in space have a fewer count of red blood cells. In a study performed by NASA and the University of Ottawa Faculty of Medicine, they discovered that the red blood cells in the astronauts are destroyed more than 54% more than on Earth [3]. This was shown by precisely measuring molecules of

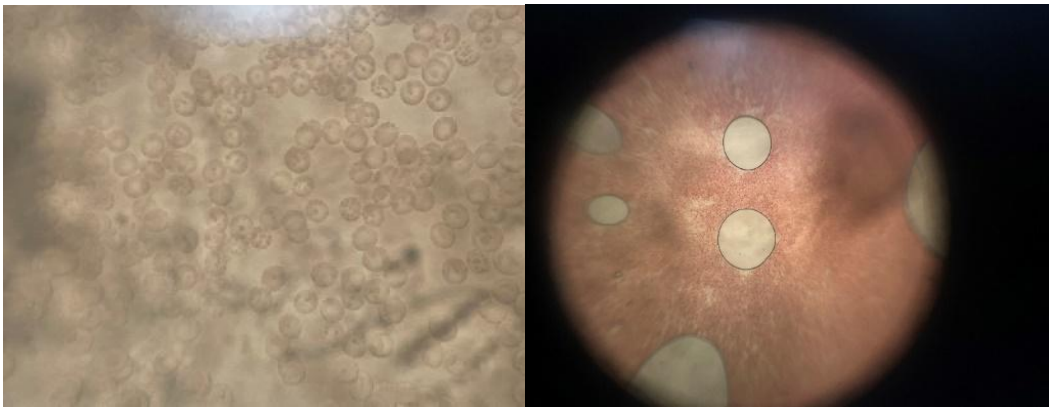
carbon monoxide in their breath, as one destroyed red blood cell produces one molecule of carbon monoxide.

Materials and Methods

To perform this study, a glass slide, microscope, lancing device and lancets were used. The procedure was as follows. The lancing device was prepared with a lancet and activated at the finger tip of the participant. The blood was squeezed out until a drop formed and was caught by a glass slide. The edge of another glass slide was then pressed against the blood drop as if to split the droplet in half, and then slid across the bottom glass slide in a rapid motion. This technique is known as blood smearing. The bottom slide was then placed onto the stage of the microscope. Starting at the lowest objective lens, in this case 4x, the monolayer of the blood smear was examined. When the focus was set, the objective lenses were switched for higher magnification lenses. This occurred until the highest power lens was reached, which in this case was 40x. Note that the eyepiece lens gives 10x magnification, so the minimum total magnification was 40x, and the maximum total magnification was 400x. Pictures and results were taken at 400x magnification.

Results/Discussion

The four participants in this study were Sean, Ava, Nicolas and Wojtek, and the period measure was over 5 days (except for Wojtek due to time restrictions). The images below the participants name on the left are arranged from Day 1 to Day 5. The images on the right are zoomed in on specific locations indicated.



From these pictures, it is clear to see multiple variations of the shape of red blood cells, also known as poikilocytes. For example, dacrocytes, or teardrop shaped blood cells, can be seen in Nicolas's Day 2 blood smear. This type of poikilocyte is commonly found in diseases including the bone marrow fibrosis, and rarely could be found in specific anaemias. However, they are not seen in any of the other blood smears tested. In Sean's Day 2 sample, poikilocytes known as echinocytes can be found. These cells are characterized by their many small, evenly spaced thorny projections. They are harmless, and usually revert to their original state. They can be caused by an incorrect blood smear procedure.

The image quality is not as clear as hoped for, as the lenses were quite dirty and any attempts to clean the lens were to no avail. Thus, many of the images may have artifacts or patterns that are not found on the sample, merely only appearing on the lenses. Also, a stain was not used for this experiment as there were none available at the time. The blood cells would have been easier to view if a stain was used, and other cells such as white blood cells and platelets would also have been visible.

Conclusion

The experiment of studying blood using blood smearing and microscopy was quick and takes almost no energy from the experimenter or participant. However, this has the possibility of producing a large amount of waste through used lancets and used glass slides. A microscope is also required, and these are usually heavy and very delicate equipment, and could take up unnecessary space and mass to operate in a space station for example.

Furthermore, the experiment did not give quantitative measurements such as a complete blood count (CBC) or complete metabolic and lipid panel might give. However, it can be used as a way to see poikilocytes of red blood cells and to determine if a disease is beginning to infect/has already infected the participant although for long-distance space missions, it could be cumbersome due to the reasons listed above, and there are more efficient and accurate methods of achieving the same goal.

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Cognitive Decision-Making Patterns in Isolation

Ava Hutchison

1. Introduction

This work was inspired by a wealth of research in the cognitive sciences concerning astronaut decision-making and cognition, especially as long-term and deep-space missions steadily creep towards technological realization. That being said, the longer humans stay in the space environment, the more likely they are to encounter emergency situations during which following procedure and making critical decisions are essential to survival. Understanding dominant information search patterns and how these evolve under conditions of stress and isolation are key to preparing mission manuals. This has implications for individual

astronaut information search patterns relevant to manual and instruction organization for optimal future crew information retention (especially when under heightened physical stress), and observable influence of isolation on cognitive effort.

2. Aims & Goals

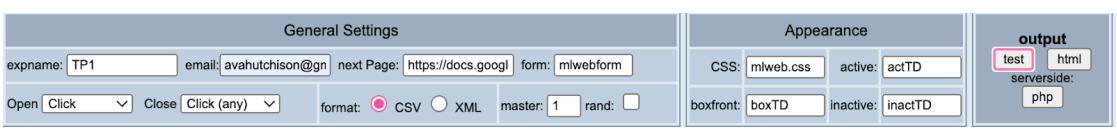
The goal of this study is to evaluate how cognitive decision-making behavior is influenced by isolation and a state of physical activity over the course of the mission.

3. Methodology

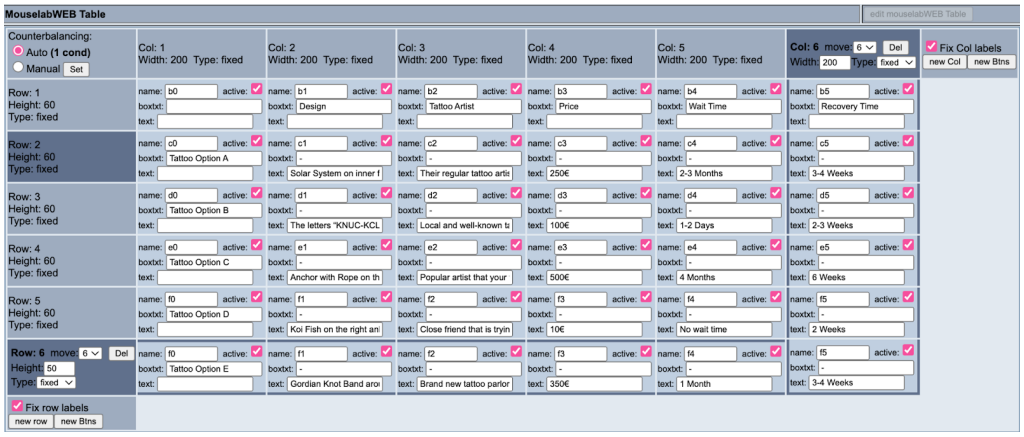
Everyday, all four crew members will undergo designed decision-making tasks presented on a computer with a mouse-tracing interface (Mouselab Web Designer 1.00) that will require members to search for and find descriptive information by clicking on information cells on a 5-alternative x 5-attribute matrix, after which they make a decision amongst the alternatives. Two subjects will be tested after waking and two after exercising, and each pair will alternate these time frames everyday (or at least after exercising periods). The dependent variables in testing these tasks are search engagement (e.g. the level of cognitive effort measured by information search time and amount of information sampled) and search pattern (calculated based on alternative-based or attribute-based search on the Payne Index). This data will allow us to evaluate whether decision before and after physical activity is more systematic/comparative OR more efficient, and more importantly how these types of decision-making patterns might change over the course of isolation. The protocol is as follows :

Day 0

1. *Fill out Mouselab Web Designer 1.00 with the general settings below :*



2. Add the MouselabWEB Table options pictured below, with the text corresponding to the pre-planned questions.



3. Add the post-HTML code : <P>[Insert question between the alternate options.]</P>
4. Click “test” in the upper right corner and make the new page fit to full screen.
5. Set the computer to screen record, and propose the question to the subject, instructing them to hit the “Show Data” button when finished.
6. Copy the text in the box that appears in the box below the “Show Data” button.
7. End screen recording and save to files.
8. Paste data into raw data spreadsheet, and watch recording while recording the following data :

- Circumstances (pre- or post-exercise)
- Time Of Response
- # Of Boxes Sampled
- # Of Att-Att Transitions
- # Of Alt-Alt Transitions

9. Reset MouselabWEB table for next Table Set.

Day 1 :

1. Propose Table Set 1 (TS1) to Sean and Nic before exercise, taking heart rate (bpm) before beginning: Sean - Between 0.0-4.0; Nic - Between 0.0-6.0
2. Follow steps 7-10 from Day 0.
3. Propose TS1 after exercise to Danniel and Wojciech, taking heart rate (bpm) before beginning: Danniel - Between 10.0-15.0; Wojciech - 15.0-Bedtime
4. Follow steps 7-10 from Day 0.

Day 2 :

1. Propose TS2 to Sean and Nic before exercise, taking heart rate (bpm) before beginning: Sean - Between 0.0-4.0; Nic - Between 0.0-6.0
2. Follow steps 7-10 from Day 0.
3. Propose TS2 after exercise to Danniel and Wojciech, taking heart rate (bpm) before beginning.
4. Follow steps 7-10 from Day 0.

Day 3 :
Repeat Day 1 Protocol using TS3.
Day 4 :
Repeat Day 2 Protocol using TS4.
Day 5 :
Repeat Day 1 Protocol using TS5.
Day 6-7 :
Evaluate data tables and written observations.

4. Results

Subject 1

Day	*Heart Rate*	*Decision-Making Time (s)*	*# of Boxes Sampled*	*# of Att-Att Transitions*	*# of Alt-Alt Transitions*	*# of Alt-Att Transitions*
Day 1	84	140	62	27	27	8
Day 2	70	102	53	46	0	10
Day 3	130	128	34	28	0	6
Day 4	135	65	30	24	0	5
Day 5	68	68	31	26	0	5
Day 6	140	88	43	29	6	7

Subject 2

Day	*Heart Rate*	*Decision-Making Time (s)*	*# of Boxes Sampled*	*# of Att-Att Transitions*	*# of Alt-Alt Transitions*	*# of Alt-Att Transitions*
Day 1	61	130	62	27	30	11
Day 2	65	160	56	20	29	8
Day 3	110	120	47	29	7	11
Day 4	98	136	54	36	8	7
Day 5	70	256	93	63	15	18
Day 6	-	-	-	-	-	-

Subject 3

Day	*Heart Rate*	*Decision-Making Time (s)*	*# of Boxes Sampled*	*# of Att-Att Transitions*	*# of Alt-Alt Transitions*	*# of Alt-Att Transitions*
Day 1	110	90	41	6	17	3
Day 2	86	94	26	0	21	4
Day 3	86	65	30	4	19	5
Day 4	93	44	27	3	20	4
Day 5	114	65	25	20	0	5
Day 6	-	78	29	2	21	6

Subject 4

Day	*Heart Rate (bpm)*	*Decision -Making Time (s)*	*# of Boxes Sampled*	*# of Att-Att Transitions*	*# of Alt-Alt Transitions*	*# of Alt-Att Transitions*
Day 1	83	53	5	0	4	0
Day 2	77	67	7	2	4	0
Day 3	127	43	7	1	5	1
Day 4	80	39	10	4	5	0
Day 5	123	93	19	4	12	2
Day 6	-	-	-	-	-	-

5. Discussion

(The results and discussion section will basically explain the results, show also where difficulties were, what you can interpret from the data, etc.). Due to situational circumstances during the simulation, there was a disruption to the planned schedule detailed in the methodology section. Instead of alternating the timing of data collection for Subjects 1 and 2 with Subjects 3 and 4, the schedule had to be reversed to collect pre-exercise data for Subjects 1 and 2 on Days 1 and 2, and post-exercise data on Days 3 and 4. That being said this caused minimal disruption to the data itself, and was relatively easy to rectify the issue.

From this collected data we can ascertain some key takeaways from the EMMPOL15 simulation about the cognitive behaviors of its participants :

- There is not a clear correlation between higher heart rate/ physical activity and lower search engagement across all of the participants. For Subject 2, it is clear that at a lower state of activity they dedicated more effort and time to searching for information before making a decision, however for Subjects 1 and 3 this is not the case.

- Isolation possibly has a weak but negative impact on search engagement. This would of course be confirmed by testing subjects over much longer periods of isolation, however excluding some outliers, Subjects 1, 2, and 3 all experienced a slight general decrease in both the number of boxes viewed and the amount of decision-making time. Subject 4 was the only participant to experience a continuous increase in both number of boxes sampled and decision-making time.
- It is possible that the subject matter of the decision has a strong influence on the degree of search engagement employed by the decision-makers. For example for Test Set 1 [see Annex Table A], both Subjects 1 and 2 did not have tattoos and Subjects 3 and 4 did, which possibly influenced the fact that Subjects 1 and 2 spent more time making their decision and sampled more boxes, whereas Subjects 3 and 4 exhibited attribute - prioritizing behavior and sampled fewer boxes. This is supported by the survey information that demonstrates that Subjects 1 and 2 felt that the information was less familiar and relevant to them, compared to Subjects 3 and 4 who orally confirmed that they didn't feel the need to sample information they deemed less important to their decision.

Key search patterns observed :

- Some participants, most notably Subject 4, identify the most important attribute (to them), evaluate all of the alternatives within this attribute, and then review the other attributes of their preferred alternative before making their decision. This means they sample fewer boxes and are generally more efficient in their decision-making, although not necessarily quicker.
- Some participants, most notably Subject 1 and 2, work systematically beginning with evaluating all attributes of a single alternative before moving to the next alternative (or vice-versa, from alternatives to attributes), before reviewing all attributes of their preferred alternative and selecting their choice. This implies a longer decision-making process, but a more thorough evaluation of the question. It is possible however that over the course of a longer isolation period, stress might influence subjects with the tendency towards this

type of search pattern to modify their behavior to be more efficient and thus decrease their effort/search engagement.

- The degree of influence that the subject matter has on a participant's information search pattern depends on individual characteristics. Subject 1 has a very rigid and systematic search pattern with an average of 30 Attribute-Attribute transitions and 5,5 Alternative-Alternative transitions, meaning they engaged in almost exclusively single-alternative focus (meaning they evaluate all attributes of a single alternative before moving onto the next alternative option), and regardless of the subject matter, they adhered to their cognitive system. This is the opposite of Subject 3, who – for separate test sets – engaged in 0 Alternative-Alternative transitions and 0 Attribute-Attribute transitions, depending on how they chose to interpret the information matrix.

6. Conclusion

The conclusion wraps up the document, summarizes the main results, and gives an outlook on what more work could be done, what could be improved, etc.

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8. Annex

Test Set 1

Your friend wants to get a tattoo and is having trouble picking between five artworks each with their own unique design, tattoo artist, price, location on the body, and recovery time.

	Design	Artist	Price	Wait Time	Recovery Time
Tattoo Option A	Solar System on inner forearm (linework, 6 cm)	Their regular tattoo artist.	250 €	2-3 Months	3-4 Weeks
Tattoo Option B	The letters “KNUC -KCLES” on the knuckles (linework, 1,5 cm)	Local and well-known tattoo shop with an online rating of 7/10.	100 €	1-2 Days	2-3 Weeks
Tattoo Option C	Anchor with Rope on the back left calf (colorful, 10 cm)	Popular artist that your friend follows on social media and is visiting your city.	500 €	4 Months.	5-6 Weeks
Tattoo Option D	Koi Fish on the right ankle (colorful, 2 cm)	Close friend that is trying to learn how to tattoo.	10 €	No wait time.	2 Weeks
Tattoo Option E	Gordian Knot Band around the upper left arm (linework, 2 cm width)	Brand new tattoo parlor that you’ve heard good things about.	350 €	1 Month	3-4 Weeks

Test Set 2

You are looking to get a dog from the local animal shelter, and there are five eligible rescue dogs named Bernard, Agata, Brent, Meatball, and Princess Diana described below :

	Breed of Dog	Age	Health Status	Personality	Grooming Requirements
Bernard	Small Shih-Tzu with long brown and white fur.	12 years old (out of a 16 year lifespan)	Developing arthritis, and is unable to run or walk for an extended period of time.	Rambunctious and people-loving, but tends to bark a lot.	High commitment
Agata	Medium-size Dalmatian with a short spotted coat.	5 years old (out of a 13 year lifespan)	Needs to be treated for fleas.	Alpha dog that is great with people but can be aggressive towards other dogs.	Low commitment

Brent	Large Newfoundland with lots of black fur.	2 years old (out of a 10 year lifespan)	Has separation anxiety, and regularly needs to be checked for tumours.	Likes to cuddle with people and eat shoes.	High commitment
Meatball	Small grey French Bulldog with a short coat.	<1 year old (out of a 14 year lifespan)	In need of pet vaccinations but otherwise healthy.	Loves running in parks and chewing on toys and anything else that is around.	Low commitment
Princess Diana	Medium-size Border Collie with long brown fur.	4 years old (out of a 17 year lifespan)	Needs to have a teeth cleaning and possible teeth removal.	Afraid of men and other dogs, but likes long walks and a calm environment..	Medium Commitment

Test Set 3

Your university has accepted your application for study abroad ! Where do you want to go ?

	University Reputation	Location	Nightlife	Workload	X-Factor
University of Horvord	Fairly good but not the best in its country but it has a wide range of modules.	Outside of a beach city that becomes a tourist destination in the summer.	Bustling social organisations and associations that are very well-known.	Light	Bonus scholarship of 10,000 Euro
TU Batur	One of the top scientific education institutions in the world, with very famous professors.	In a medium-sized city with lots of parks but very gloomy weather.	Not much of a nightlife, although there are many ways to engage in group research at the university.	Heavy	A great place to make connections for your future career.
South Lyref University	Most famous for its hugely successful sports teams and programs.	Small town just around the university, but otherwise lots of rural farmland.	Huge party atmosphere, lots of student organisations and sports fan culture.	Light	They offer clown classes.
MacDavidson College	Very small and tight-knit, but also politically and socially engaged.	In a small forested rural town with lots of beautiful mountains and geographical features.	Many philanthropic organisations and social clubs, hiking and other outdoor activities are very popular.	Medium	You have to take horse-riding lessons.

University of Rälmoc	The best school in a very small country, but with a large diverse international student body.	In a very northern city with lots of modern architecture, but winters can be very cold.	Not much university social life, but fantastic nightlife and the city has many attractions and activities.	Medium	Many countries are close by, so it is very easy and cheap to travel.

Test Set 4

You are hosting a fancy dinner party for all of your friends and family. What do you put on the menu ?

	Cocktail	Entree	Main Course	Side Dish	Dessert
Menu A	Old Fashioned	Waldorf Salad	Roasted chicken	Ciabatta bread roll	Vanilla ice cream with fudge
Menu B	Margarita	Mussels in butter sauce	Sushi rolls	Edamame beans	Tiramisu
Menu C	Whisky sour	Mushroom soup	Sausages and Mashed Potatoes	Cooked beets	Oatmeal cookies
Menu D	Screwdriver	Caprese salad	Shrimp and tomato risotto	Roasted asparagus	Apple strudel
Menu E	Mojito	Egg rolls with vegetable filling	Assemble-your-own tacos	Green Beans	Lemon sorbet

Test Set 5A

You need to take one additional course to obtain your final credits before graduation. Which class do you take ?

	Course Title	Difficulty	Workload	Class Environment	Professor
Course A	Puppetry	Medium	2 hr/week	Lots of theatre, comedy, and art students that love to chat.	The puppeteer that played Elmo on Sesame Street for 20 years.
Course B	The Science of Superheroes	Medium	4 hr/week	Humanities and film students who throw lots of cinema nights.	World-famous sociologist of propaganda that has a secret superpower himself.

Course C	Taxidermy	Hard	6hr/week	Many medical and agriculture students who love animals (dead and alive).	An American guy named Dan from the Appalachian Mountains who has 3 teeth.
Course D	Underwater basket weaving	Easy	2 hr/week	Only about 4-5 students at a time, who wake up to weave in the ocean at dawn 1 day out of the week.	Very old and spiritual lady from the Samoan islands who has weaved an entire boat.
Course E	Street Fighting Mathematics	Very hard	3 hr/week	Lots of nerds who want to learn how to throw a punch.	“Nutty professor” stereotype, likes to make his students fight as the final exam.

9. Test Set 5B

Congratulations ! You are a reality television show contestant on a programme looking to find you a significant other, please evaluate the contestants below and decide which date you would most like to go on.

	Personality	Date Location	Profession	Interests	Red Flag
Alicia	Introverted, very witty and sophisticated	Dinner at Italian restaurant	Veterinarian	Wine tasting and photography	Litters frequently
Nikita	Confident, easy-going, and honest	Modern art museum	Software developer	Yoga and crossword puzzles	Won’t stop talking about their mother
Yasmin	Ambitious, spontaneous, and extravagant	Jazz concert	Real estate agent	TV shows and playing drums	Hates all animals
Jia	Extremely funny, neat, and patient	Ice skating	High school teacher	Travelling and tattooing	Smells absolutely terrible
Isabelle	Artistic, active, and sweet	Food tasting festival	Firefighter	Working out, dogs, and vinyl collecting	Is constantly texting or on her phone

10. Test Set 6

You and a random group of people survive a plane crash that leaves you stranded on a deserted island with many dangerous animals and very limited supplies. Who do you make an alliance with ?

	Age	Profession	Skills	Weaknesses	Personality

Michael	17	Student	Boy scout, used to go hunting and foraging with his Dad	Has asthma and can be a bit naive and annoying	Joker, very optimistic and funny, but can miss some social queues
Joo Mi	33	Military Officer	Her leadership skills and combat acumen	She speaks very little English	She is not very social, but is very strict about fairness among the group
Andrea	48	General Surgeon	Her medical knowledge and physical fitness	Fatal allergy to nuts and bees	Very serious and quiet, is not a fan of nature but likes to sing
Roberto	36	Tour Guide	His familiarity with the region and other islands similar to the one you are on	Has a prosthetic leg, and is very afraid of animals	Very dramatic, and has frequent mood swings
Fatima	52	Carpenter	Engineering and construction knowledge	Has weak joints and muscles, and is a very picky eater	Amazing conversationalist, and always has a good story.

Blink Rate Sensor

Nicolas Barker

Introduction

Blink rate and sclera redness - the properties that this sensor will measure - are both good indicators of stress, fatigue, focus, and irritation. Especially in combination with other biometric data such as heart rate, blood pressure, skin conductance, and body temperature, a quite accurate estimate of a person's mental state can be formed with this data, allowing us to more objectively evaluate subjects and form conclusions.

Aims and Goals

The purpose of this experiment is to develop an affordable blink rate sensor that could in the future be used to estimate the condition of both analog and real astronauts. The aim of developing this throughout an analog astronaut mission is to explore what is required for such a device to be practically applicable.

Specifications

- Record blinks (typical minimum duration of >100ms)
- Record sclera color @ 1 sample/min
- Low power: survive at least 24 hrs on one charge
- Cost effective (<100$)
- Comfortable to wear for extended periods of time
- Does not obstruct vision significantly

Deliverables

- Camera and software that can record 100ms event → FPS > 20
- Rapid image classification via eye openness or EAR (Eye Aspect Ratio)
- Physical camera and computer head mounting

Materials

- Raspberry Pi Zero W
- 128 GB microSD card
- Micro USB cable
- >60Wh UPS or power bank
- 180º wide angle CSI camera module
- 3D printed camera mount
- Magnifying glasses
- 1.44” Raspberry pi screen module

Results

Mechanical Construction

The main purpose of the mechanical part of this device is to position the camera in front of the eye. Just containing the eye is however not the only requirement for the input images. Images should have limited distortion, and also ideally contain a significant amount of face area around the eye as well. This is because the model used to determine the face shape (which is introduced in the next section), tries to fit a full facial mesh to the face, and without enough context it will not succeed. A wide angle camera is desirable to reduce the distance the camera must be from the face, however too wide angle at too close of a distance will cause severe distortion, and the software will once again fail. This device consisted of a cheap pair of magnifying glasses (Fig. 1 left) and a custom 3D printed camera mount (Fig. 1 right) that clicks into the lens holder of the glasses.

Figure 1. (Left) Generic magnifying glasses. (Right) Nicolas testing the setup.

Openness Classification

In order to determine the openness of an eye, the first step is to extract the eye landmarks from the image. The landmarks can be seen below in Fig. 2 left. as the green numbered dots that surround the eyelid. The specific AI trained model used is Google's MediaPipe IrisLandmark model which is based on [1] which builds on the BlazeFace model, allowing for sub-millisecond landmark extraction given a 64x64 px image of an eye (Fig. 2 right).

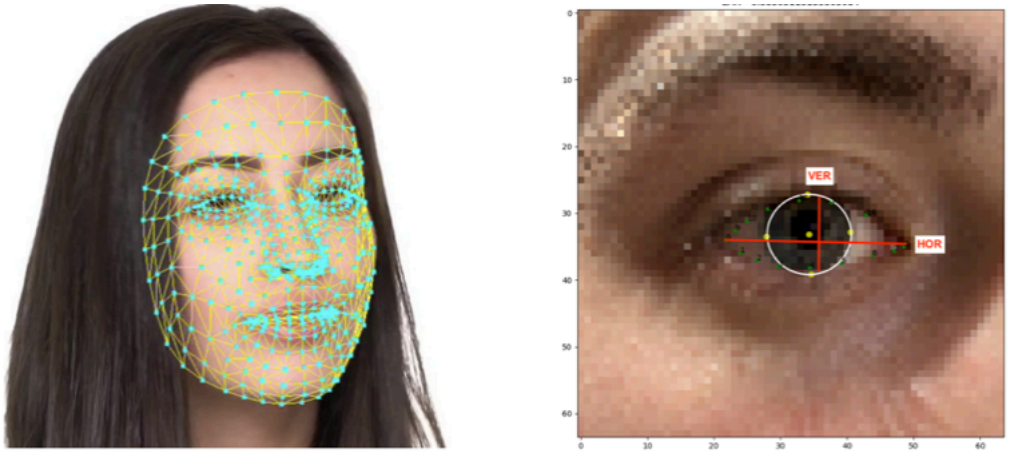


Figure 2. Left: Face mesh fitting example. Right: Output of EAR eye openness classifier on downscaled 64x64 px image. Here the EAR = 0.383.

From these spatial points the Eye Aspect Ratio (EAR) can be calculated as the vertical size *VER* divided by the horizontal size *HOR*. EAR = VERHOR.

Next by plotting the EAR over time, blinks can be detected by extracting the troughs in the resulting waveform, as seen in *Figure 4*. First however, the bias is removed from the signal, as the EAR value changes depending on which direction the eye is pointed.

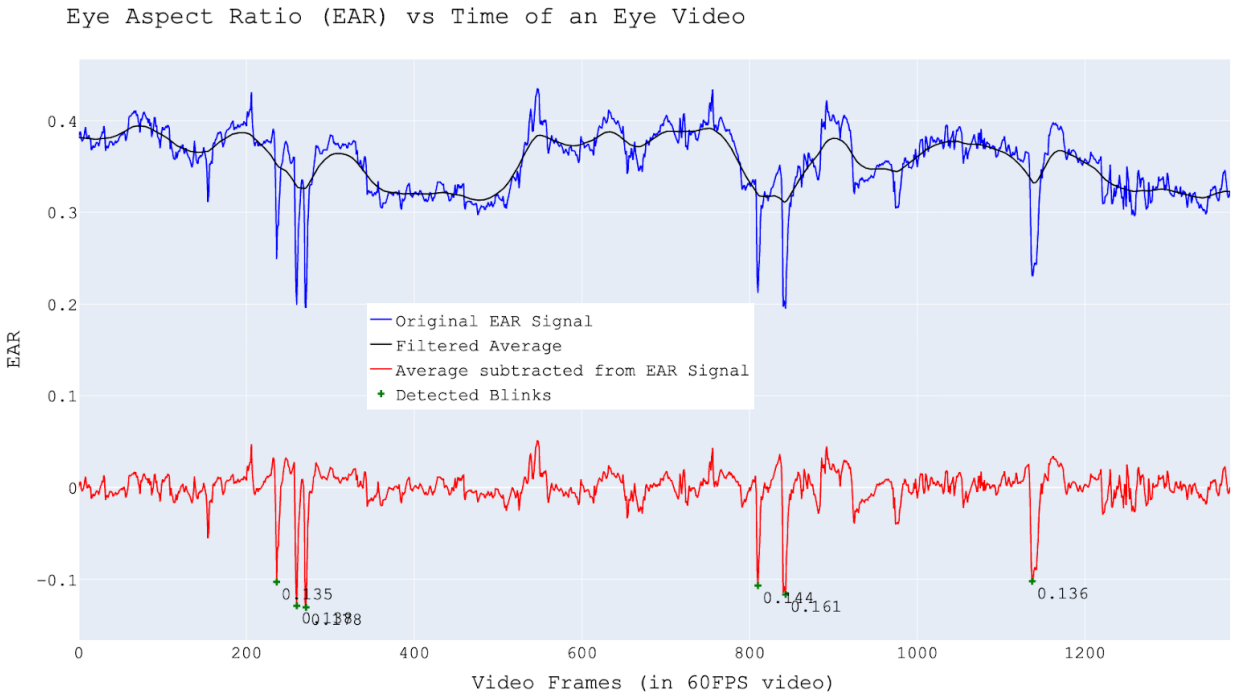


Figure 4. EAR data filtering and detection of blinks with their respective peak prominences

Conclusion

To conclude, the aim of successfully detecting blink rates automatically was achieved. The one main problem is that despite software optimizations, the processing speed of the Raspberry Pi micro computer used is simply not enough to execute the required calculations in real time. The solution proposed instead saves the recorded eye data to a video file for later processing, but ideally only the actual blinks and their respective timestamps would be saved in order to reduce data storage requirements. Various solutions to this already exist, and unfortunately the simplest one is to just wait. The Raspberry Pi 2W was recently released with four times as many CPU cores as the original Zero, showing up to 10x

the benchmark scores on similar image processing applications, however due to the global chip shortage, it is currently unavailable or uneconomical to buy. This application would benefit from the parallelization provided by multiple cores, as new frames could be recorded while the previous frames are being processed.

Discussion

IR Lighting

The original plan was to use a camera that can see in the IR range and also shine IR light on the eye to give more consistent lighting conditions and to function in low light conditions. An IR camera was indeed used, however the IR light I intended to use was too bright, as it caused irritation to my eye even though I could not see the light coming from it. Together with the medical officer we investigated the matter and indeed IR light can be very dangerous to the eye if it is too bright. Because of this the light was removed, but in the future safer IR lights will be added to regain this functionality.

Sclera Redness

The Sclera redness measurement was not implemented due to time constraints, but it would not be much work to add. For this the camera would be set to take much higher resolution images once per minute, the resolution 64 x 64 px was chosen because this is the input dimension of the IrisLandmark model used, while in reality the camera supports up to 5MP images. Next using the landmarks around the eyelid and iris as shown in Fig. 3, the sclera region can be extracted from the original image. Subsequently a comparison of the total magnitude in the red color channel can be made between images, giving a robust indication of redness over time.

Extension: Gaze Estimation

A possible simple extension to this setup would be gaze estimation. By adding a forward facing camera in addition to the existing eye camera, one can estimate where the user is looking. This would be very interesting for social interaction or emergency situation experiments, as the gaze indicated very clearly what or who the user is currently thinking about. Together with facial recognition on the forward facing camera, a log file can be created

including the time stamps when the user looked at the identified person visible in the front camera, which could be very valuable data for social interaction experiments.

Extension: IR Reflectance Method

A simpler method to measure eye openness could be by measuring the reflectance of the surface above your eyeball. The eye sclera is quite reflective, whereas the skin of an eyelid is not so much, depending of course on skin color and texture. If possible to implement robustly, this method would be desirable as it would require much less power, could be placed closer to the eye, and would mitigate the privacy concerns of being filmed constantly. However, initial testing with this method showed it having less potential of being functional due to a low signal to noise ratio observed in a preliminary trial. Multiple sensors would also be required, because it is hard to get one spot on the eye that is not covered by simply looking in a different direction and not blinking. Despite this, with more refinement the author believes that this is a far better tool for the measurement of blink rate, however it would come at the cost of the sclera redness measurements.

References

[1] Kartynnik, Yury, et al. "Real-time facial surface geometry from monocular video on mobile GPUs." arXiv preprint arXiv:1907.06724 (2019). https://doi.org/10.48550/arXiv.1907.0672.

Urine Filtration with Regolith Simulants

Wojciech Guziewicz

Introduction

Future lunar and martian habitats will have to withstand a lot of difficulties in order to sustain human lives in the hostile conditions outside of our planet. It is unavoidable that most of the systems and building parts of those astronaut shelters will have to be built and brought from the Earth, but at the same time it is crucial to use as much as possible of resources available on the Moon and Mars. In-situ resource utilization is one of the biggest and most important fields of research when it comes to sending people back to the Moon and then to Mars to stay for longer periods of time. The most abundant resources on both of these celestial bodies are regolith and rocks. Regolith is a layer of loose, weathered rock on the surface and therefore it is the most important material for the ongoing concept of in-situ resource management. In my experiment conducted during the EMMPOL 15 analogue mission I wanted to see if the simple filtration of urine through a regolith simulant can change any of its physicochemical parameters, therefore affecting further process of its filtration and recovery, possibly making it easier.

Aims and goals

The experiment is conducted to evaluate if martian or lunar regolith could be used to filter urine and wastewater produced by astronauts as a pre-processing step for further purification and recovery of drinkable water.

Equipment and materials used

- 250 ml glass Erlenmeyer flask
- 200 ml G4 glass vacuum filter
- Self-made 3D printed flask adapter
- Oil vacuum pump

- 100 g MMS-1 martian regolith simulant
- 50 g grainy basalt sand
- 50 g basalt rocks
- Sealing tape
- Water testing strips

Experiment Set-up

The adapter was put into the Erlenmeyer flask neck and sealed up with the tape. Then on top of it the vacuum filter was connected. 100 g of MMS-1 martian regolith simulant was poured into the filter as a bottom layer. On top of that 50 g of grainy basalt sand was poured, making a second layer. The top layer were basalt rocks around 1,5 cm in size. Vacuum connector from the filter was connected to the pipe from the oil vacuum pump.

Procedure

The filter was first rinsed with 500 ml of distilled water to get rid of any impurities and small particles. Urine of four analogue astronauts was gathered for the experiment. Each sample was examined for pH, NO_3, alkalinity, Cl_2,, and blood traces before and after the filtration. Blood traces and pH was examined using CLINITEK Status®+ Analyzer and SIEMENS Multistix® 10 SG strips for Urinalysis, while rest of the parameters was measured with PRO JBL Aquatest® water test strips. Both test strips were immersed in a fresh urine sample or post-filtrated sample. Then the urine testing strip was placed in the analytical device and the water testing strip was compared after 60 s with a color comparative scale. Each filtration was conducted with 100 ml of urine under the pressure difference of 700 mbar. After every filtration the filter was rinsed with 200 ml distilled water and ran dry under vacuum.

Results and discussion

Table 1 shows measured parameters before and post filtration. Also there are visible color differences for analogue astronaut 1 and 2 samples in the Figure 1. In three out of four samples there is a change of pH and in one of those samples there is also an increase of alkalinity. The trace of blood from sample 1 was also filtered during the process. Colors of both samples in the picture 1 and 2 changed from amber/straw yellow to pale yellow.

Table 1. Parameters of pre- and post-filtered urine of four analog astronauts.

	Astronaut 1		**Astronaut 2**		**Astronaut 3**		**Astronaut 4**	
	Pre-filtration	Post-filtration	Pre-filtration	Post-filtration	Pre-filtration	Post-filtration	Pre-filtration	Post-filtration
pH	5.5	6.5	6.5	7.0	7.0	7.0	7.5	7.0
NO_3 [ppm]	25	25	0	0	0	0	0	0
alk. [ppm]	>268	>357	>357	>357	>357	>357	>357	>357
Cl_2 [ppm]	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
blood	trace	negative	negative	negative	negative	negative	negative	negative

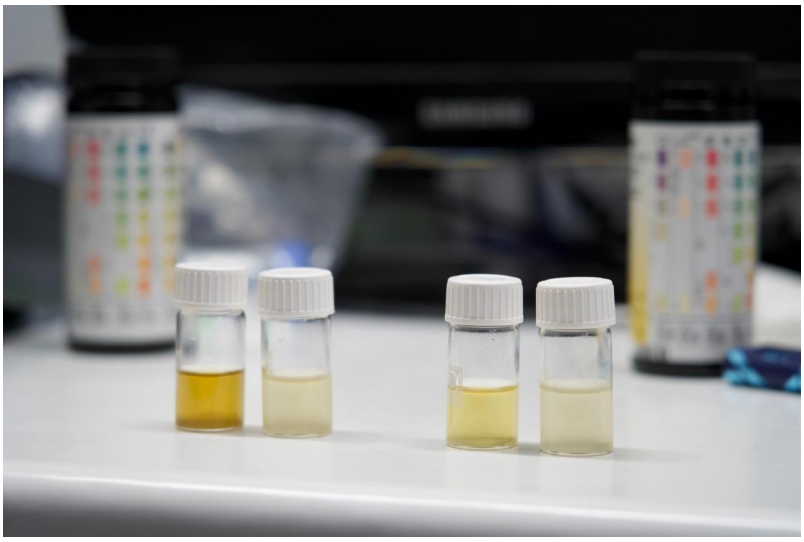


Figure 1. Pre- and post- filtration urine for astronaut 1 (left) and astronaut 2 (right).

Conclusion

These results indicate that lunar or martian regolith filters could possibly filtrate some of acidic (uric acid, other organic acids) or basic (urea, ammonia) compounds of urine, as well as bile pigments in it. These changes could allow alteration of urine recovery processes, possibly making them easier and more effective given in-situ resource utilization approach. However, the conducted experiment does not clearly indicate effectiveness of regolith-based filters and the research should be continued with more accurate analysis methods and more faithful regolith simulants given its structure and chemical composition.

Expedition *58*, Joanna Stępień, Poland

Biostrat Mission
10.03.2023 - 17.03.2023

Day 1

I woke up early. At the beginning of the day I felt very nervous and unsure. We cannot find some needed equipment and our measurement for circadian and bioimpedance goes very slowly. So it takes us more time than it should. After breakfast I become more relaxed and optimistic. Firstly, when I get to know what kind of experiment I had to do, I become very nervous. I was scared that It could be too difficult for me. But I started to look for information on the internet and I think that I made progress. I designed elements according to the pdf, downloaded Z-SUITE and properly formatted my project. I was so euphoric when I saw that I made it. After workout I feel tired but positive. Then I got my period, so I started to be stressed and frustrated. But after lunch I calmed down and felt cheerful again. Next I took a short nap (maybe 15 minutes). But after these I become sleepy and irritated. After a nap I started again looking for information about the 3D project. Today I also learned that cockroaches can hiss. I was shocked. I was so tired so I almost fell asleep before the space dragon procedure. But my friends made sure I was with them before we started drawing. I was so tired but I had fun sitting with the rest of the crew on the floor and drawing. I was so happy when I could go to bed and start to sleep. I read about a 3d project and watched a tutorial on youtube. I made project of necessary element for my experiment. I convert it into properly format. I downloaded Z-SUITE and I started collect information about Zortex M200. Now I have to get to know how to connect with 3d printer and start it. At the gym I did strength training, stretching and I jogged. After training and eating I take a nap. I did urine analysis. For breakfast (02:00) I ate one tortilla, 3 chicken sausages, half of tomatoes and a little salad and drank one cup of tea (500 kcal). For lunch (07:00) I ate 3 pulpets

with sauce, basmati rice and salad and I drank one cup of kakao (750 kcal). After lunch I ate 3 cube of chocolate, one piece of Ptasie mleczko and I drank a can of coconut water. For dinner I ate tortilla with tuna, butter, salad, tomatoes and paprika (350 kcal)

Day 2

I woke up a little irritated. Noises disturbed me a little at night, but I found earplugs. I feel really sleepy and exhausted. Later I started working on my experiment. I realized that I made a few mistakes, when I tried to convert my project into .zcodes format. But today I fixed it. I also switched on the 3D printer and started printing. I have a problem with setting, but Kristian helped me. When Zortex started working, I became really stressed but also enthusiastic. I was scared that something may not succeed. But it turned out that I correctly did my task. I was happy and proud of myself. It was my first serious project associated with design and 3D printers. Today I helped Bartek a little with cockroaches. I don't like them too much, I am scared that they may bite me. During meals friends from the crew help me to choose an appreciative photo for presentation. I finished my task in the morning so I could go for a short nap after lunch. I have been craving sweets all day!!! I can't stand it, but I try not to eat too much biscuit, because of my weight. I made some corrections to my work yesterday.I watched tutorials from YouTube on how to change filaments in a 3D printer. I set appropriate parameters on Zortax and I printed elements for microPura. I also found a knife and got rid of the support. At the gym I did a heart time procedure, but running 5 minutes at a speed 12 km/h was too much for me, so I only ran 2.5 minutes. I also made today photos for ophthalmoscopy. After lunch and gym I took a nap. For breakfast (02:00) I ate one tortilla with cheese, butter, eggs, salad, tomatoes and paprika and I drank 1 cup of tea(about 360 kcal). For lunch (07:00) I ate 3 piece of Breaded chicken with basmati rice and salad and I drank one cup of kakao (720 kcal). After lunch I ate 1 cube of chocolate (about 50 kcal), 2 Belvita cookies (about 140 kcal), 1 milka cookie and musli bar. For dinner I ate a tortilla with tuna, butter, salad, tomatoes and paprika (350 kcal). For lunch I ate a tortilla with cherry tomatoes, cheese and salad (about 260 kcal).

Day 3

In the morning I was very well rested. I have a lot of energy. I felt a little frustrated when I couldn't find a caliper. I also was shocked when my friend from the crew started to look for it with me. I didn't ask them about it, they just wanted to help me. It was really nice. Later I started a new experiment. I looked for information about audio signal processing and I installed and got familiar with Audacity. I felt very motivated and enthusiastic. At the gym I did a Heart Time experiment. Next I and the rest of the crew made lunch. It was very tasty and I felt really happy after eating. But after a workout and meal I become very tired. I took a nap, but for me it was too short. Later my friends and I danced together. Julka showed us what we should do. Firstly I was a little irritated, because I woke up a while ago. I wanted to start as far as possible and Julia explained very long but I know that she should do it. I think that it was very funny and I want to do it again, despite the fact that I don't like such kind of dance and music. During lunch I told the crew that I didn't understand the Fourier transform well. After this Jitt sent me a link to the film at youtube where the guy explained it. It was nice. Today flew by very quickly. I started a course on the Coursera about signal processing. I installed and got familiar with the Audacity application. I also installed a new python library in the visual studio. I am gonna use it to transform audio signals. I also learned a little more about the mathematical and theoretical part of signals. At the gym I did a heart time test, exercise with weights and stretching. Today I also took photos for the ophthalmoscopy procedure. For breakfast (02:00) I ate one tortilla with peanut butter, strawberry jam and bananas and I drank 1 cup of tea (about 500 kcal). For lunch (08:00) I ate 1,5 Breaded chicken with bulgur groats and salad with tomatoes and paper (about 500 kcal). I drank one cup of tea . After lunch I ate 2 cube of chocolate (100 kcal) . For dinner (11:00) I ate a tortilla with fish, salad, tomatoes and pickle (500 kcal). After dinner I ate 3 Belvita cookies and drank 1 cup of tea (200 kcal).

Day 4

When I woke up today, I felt quite good. I got up even a few minutes before everyone. Later I very quickly started to feel tired. I think it is because I didn't have a REM phase during my sleep. I

couldn't concentrate on my thoughts and focus on my work. I noticed that I was more irritated and nervous all day. I and the crew figured out that we had mice in the habitat. It ate our tomato. I felt disguised and angry. I am afraid of the disease it can have. But we cannot do much about these. After taking a nap I was really moody (because I wanted to sleep more) but we quickly started to dance, so my humor improved. Me and Margot created a short choreography. Everyone liked it. Even if I don't like such kinds of music and dance, I had fun. I realized that I really like dancing with the crew. It gave me so much joy. It was also very nice to see how happy Julia was. She was so delighted that we were interested in her hobby. To me during our lesson she is more euphoric than the rest of the time. I think that I can dance every day just to see her like this. Today I was a little about Bartek. He seemed to be more sad and nervous than before. I know that it is because of the pump. Some of the crew members try to help him. I didn't know much about these, so I didn't want to disturb them. Today's time slows even faster than yesterday. Today Margot told me that I have a sweet voice. It was so kind. I was so happy when I heard this. I also was a little disappointed that I didn't get more information about microPura. I wanted to print something. During taking photos for ophthalmoscopy me and Julia started joking and crying with laughter. I was very proud of myself because I found the librosa library in python and it is very useful if you want to modulate voice audio. I watched a tutorial from Youtube about Fourier transformation. I get to know more about the librosa library, IPython and pitch shifting. I also figured out how to display audio signals. I spent so much time writing code in python and trying to understand it. I have been surfing the different sites looking for the best methods to solve my problems and resolve doubts. I had so much fun. I like doing it and I feel so satisfied. At the gym I did the same things as yesterday (a heart time test, exercise with weights and stretching). I didn't like doing a heart time test. After the sprint i was so exhausted that I didn't have energy to workout more intense things that i liked. I took photos for the ophthalmoscopy procedure. I did urine analysis. I drank one cup of tea. For breakfast (02:00) I ate one tortilla with scrambled eggs, cherry tomato cheese and salad(about 250 kcal). For lunch (08:00) I ate pasta with chickpeas, Breaded chicken and tomato sauce. I drank

one cup of chocolate. After lunch I ate 20 g of chocolate(100 kcal). For dinner I ate a tortilla with peanut butter with jam.

Day 5

Today I woke up and felt better than yesterday. I was more rested. Everyone was in a good mood. Unfortunately we made a mistake today, so members of our crew became really sad and depressed . I tried to cheer them up a little. Everyone makes mistakes, so we shouldn't care so much about them (especially when no one gets hurt and there are no losses). Their moods improved a little. Next everyone got back to their work. I got to know more about signal processing, but I faced problems with my programming environment. I tried to solve them but I failed. Because of this I become very nervous and snappy. I wanted to eat all the time (especially sweet things). When I had lunch with my crew, I forgot about my problems and started to laugh and be happy. When I came back to work, I was a little more laid back. But I couldn't make it work until debriefing. MCC and the crew tried to help me. I felt uplifted. Then Jitt fixed my problems!!! I was so happy and cheerful! It was an amazing feeling. I am very grateful to him. I like it that everyone in our crew tries to help each other when they see that something is wrong. Later we started dancing again. I am starting to get used to it. When I got to know that today we can watch a movie together I was very glad. I want to spend more time speaking with members of the crew. I was a bit anxious about my experiment. Today I wanted to print more elements and learn more about microPura. But it failed. Today I was more irritated with the noise of my group. I was scared that because of my bad mood today I might be unkind to someone. I said sorry to Julia (I thought that I was unpleasant to her when she asked me what I wanted to eat for lunch), but she said that I wasn't mean to her. I was relieved. Today I haven't done much of my work. I tried to fix Visual Studio all day. But I was so proud of myself at the gym. I managed to run 5 minutes at the speed of 10 km/h. But it was so much that I didn't have energy to lift weights later, so I only did some stretching. I also printed a second element for the microPura experiment. I took photos for the ophthalmoscopy procedure. During it I always speak a lot with Margot (she takes photos of me). I drank one cup of tea. For breakfast (2:00) I ate one tortilla with 1 sausage, cherry

tomatoes, hummus and salad. For lunch (08:00) I ate bulgur with chicken, 1.5 salad and dried tomatoes. I drank one cup of chocolate. After lunch I ate 20 g of chocolate (100 kcal). For dinner I ate instant noodles.

Day 6

Today flew very quickly for me. I had a lot of things to do and no time. I was happy because I received a project from MCC. I could finally start printing more things for my experiment. Unfortunately, I didn't have a lot of time. All day I was very stressed and scared. I was frightened that I wouldn't make it. I was so stressed that I couldn't eat anything. My crew was very worried about me. They asked all the time if I am Ok. They want to give me something to eat. When they looked after me I felt really nice. It is such an enjoyable feeling that people want you to feel better. All day I tried so hard to meet up the expectation. Unfortunately, because of lack of time and bad organization, I wouldn’t get important information from MCC, so my work didn't turn out perfect. I don't think it is very bad. I put a lot of effort into making it look great. Crew tried to persuade me that I should be proud of myself. During my stay at the habitat I made a big progress. Today I did an experiment report, normal report, role report, urine analysis. I took photos for ophthalmoscopy. I calibrated the 3D printer, changed filament and printed a few elements for microPura housing. At the gym I do stretching. For breakfast I drank a cup of cacao and ate a tortilla with eggs and salads. During the day I have a lot of snacks like chocolate, jelly or cookies. I ate a lot of sweet things. I was so stressed that I only ate one pulpeta with rice for lunch and drank coconut water.

Expedition 58, Julia Zioło, Poland

Biostrat Mission
10.03.2023 - 17.03.2023

Role Report

What is expected from a Communication Officer:

- constant contact with MCC,
- communicating with MCC during briefings and debriefings
- sharing important information with MCC, for example updates on the water usage, important information, updates and changes, or other matters.
- the Communication Officer is (except for special occasions) the only crew member that communicates with MCC
- constantly keep an eye on the Signal chat whether an important message is coming in
- regularly (at least every 30 minutes) update MCC on ongoing and finished crew activities,
- transferring open questions/requests from the crew to MCC and transferring back MCC's replies,
- inform the crew about MCC announcements and requests and sends the reply back to MCC, and
- calls in the daily morning and evening briefing.

My experience:

As a Communication Officer of the mission I kept contact with MCC, sharing important information and transferring questions of the crew members. I tried my best while keeping contact with MCC and I think that in general I did my duty well. Nevertheless, there were some mistakes I made, among others: I did not hear MCC calling me before an emergency, I did not always transfer open questions from the crew (beside briefings), did not inform about crew activities every 30 minutes. However, keeping in mind that I was not sure about taking this role on myself, if I would be able to

meet the challenge, I am proud of myself and I notice how much I did learn.

Day 1

I was feeling good the whole day, really. The day passed faster than I thought, I learned a lot and adapted well, I think. I am feeling the outside, I assume that the weather was nice, because I had a lot of stable energy, and was feeling good both physically and mentally. I really liked all my tasks, I feel like I did a good job. I don't feel like this is a big challenge for now, because all the tasks are "performances" which is much easier for me than studying for an exam at a university, for example. I guess that living in the habitat will be getting more uncomfortable with time, I will be missing the outside world more. But still, I know it is just a week. And I've survived many difficult times, when I could count only on myself and my intelligence/instinct (Germany for example, I went there to work with horses, had to learn super fast and had to just give a good performance. And somehow using my body while working, not just the brain, gives me a lot of peace. If I make a mistake, a horse could kill me, injure themself, etc. I have had to think a lot, but it's been something new everyday, I've been using my instinct and the way I feel about the world. I hope you know what I mean, by comparing it to living in a habitat. And I really like this "survival mode". I feel like I'm in a forest as well. Like an animal. I need to have a plan, but everyday is different. Excuse my explanations, I know it may sound weird… In the very beginning of the day everything was chaotic, I was feeling a bit stressed because of it, that we couldn't solve so many problems. But once we succeeded and started the breakfast I felt relieved and started to feel the environment of the habitat, how everything needs to be done, where is what, etc. Yesterday I organized shelves and a fridge, which makes me satisfied every time I look at it. Later I started my gym session, a bit late but I wasn't stressed about it. I started learning choreography to NCT Dream - "Beatbox", because on March 29th I will go to their concert with my friends and I really would like to know the dance by this time. After the gym I feel like the time flew so fast, I did everything. I enjoyed counting calories and filling all the sheets, I don't know why. Also, I hope it is what you wanted from me, but this wasn't my only motivation. Lunch

was nice, the crew is getting familiar and comfortable with each other really fast, I think. I like them and working/living with them, but I don't think they will know more about me than my family, like MCC have said it would feel like. Basically no one knows anything about my inside and I feel like this is something unexplainable, so I don't shorten the distance. Like I am in a bubble. Very close with people, I can see and hear them perfectly, I live among them. But there's this border of a bubble. It doesn't make me sad nor I think this is something bad, I just think this is a neurodivergent way of living. During the debriefing I felt really angry. Not even stressed, just like when I was working in Germany and they told me "in Germany we don't pay for extra hours". Just like ready to murder someone, like this is a danger. Felt like a cat facing an intruder in their territory. The cat can't just give up, feels stressed but won't just accept the attack. Don't take it personally though, I just try to explain the feeling. When I sleep less than 6 hours my rhythm is already messed up and more importantly I just don't feel like myself. I can't perform. I am not the type of a student, who will stay up until 4 AM because of a colloquium. I prefer to fail it looking straight to my professor's eyes. If I sleep for less than 6 hours for 4 days, I need to rest a lot, I am annoying, annoyed, angry, feeling like everyone is attacking me. I just hate people then, usually I stop responding to anyone. This is not healthy, but I can't sort it out in this time of my life. When there is a crisis, I don't look for help and for social interactions, I prefer to isolate myself, to be connected only with myself and nature. Then I come back to myself. So that is why I felt so much in danger, 3 hours of sleep is something really really bad. The rest of the debriefing was nice, now I am enjoying writing the report, getting better as a communication officer, researching for my experiment. We took a group picture, had a lot of fun with this task. I feel comfortable, very calm and satisfied. I think I am ready for tomorrow. Now I feel tired and a bit sleepy. The crew is really nice and I hope we will get more comfortable and befriend even more. Experiment: I've started searching for literature and discovering different ways that my experiment can take. Hopefully tomorrow I will get the full grasp on the topic. I really enjoy reading about this, but it is a lot of knowledge to absorb, also I need to think how to connect it with the music I listen to.
Gym: Learning dance choreography for NCT Dream - "Beatbox". I am still a total beginner. I lack the basics, the confidence and

technique of movements, but have a good sense of rhythm and movement itself, so I know I will succeed, sooner or later. The gym session was satisfying and fun. I learned Jeno's part of a prechorus/chorus (not sure if it is already a chorus), tried footwork of Mark's part, but it's difficult.
Activities: counting a food intake, doing a group photo (a lot of fun), eating with the crew, researching for my experiment, helping other members, sorting out the environment I've filled all the food intake data, counted the calories, noted everything.

Day 2

Had a very interesting dream. I wrote about it in a sleep report; I don't think I ever had to explain my dreams to someone so much (or maybe I don't have to? I will keep reporting them anyway, maybe they give some information and data, I'm curious and want to know after the mission), so it was a bit difficult. Also, my dreams are always colorful, even the nightmares, then they just have a different palette and vibe. I find the question "do you remember any colors" really interesting. Today's dream was almost an "indie filter" palette, so happy and bright colors. Anyway, I woke up feeling good, but chilled at the same time, so I assume the weather was like this - nice, but refreshing and calm. The whole day I was feeling really good, tired only because of a short sleep, was able to do many things. I had a problem with the chimp test, just couldn't think with patterns, which I use for this task. It was too quickly after waking up I guess. The whole day was very satisfying. We ate breakfast before the briefing, which made me really happy. I didn't have any problems with keeping up with reports, which also made me feel secured. I noticed the potential leakage and I am proud of myself and crew members, how we handled this. Then I started my gym session which was great. I made some progress through the night, like my body put together all the information about moves. I did Jeno's part easily, started working on executing each movement in a proper way. Started Haechan's part, which I found easy, then started breaking down Mark's part. It took me a lot of time, my leg started hurting a bit, but I got it! I know the footwork now. I did all 3 parts a few times and was feeling incredibly proud of myself. I think that it is something good for astronauts/mission

members, to do a workout that has some end and that you can perform later even better and better, with music and joy. Not only running on a treadmill. But this is my opinion of course. Didn't do a heart experiment, forgot about it. After the gym session I did some research for my project and I find it super interesting. I don't even know where to start, I had so many tabs opened, that my safari app crashed. I made a OneNote file where I put all the links, and I written down what I want to research. When I look at this file I feel inspired and more comfortable with the task. Because I can see all my ideas and thoughts and directions I want to explore. I hope that tomorrow I will learn even more and be able to actually start something. I know that I should mostly follow scientific research, but for now I find the basics of music structure, frequencies, etc. on youtube and blogs more approachable. They also give me more inspiration and show new directions I should check. I am excited for this project and I will try my best. Then I started feeling sick, had problems with sinuses, had 37.2 degrees, were feeling unwell physically, but still energetic. Actually, I started feeling a bit sick even before gym, so I drank water with vitamins, which helped me for a while, as well as the gym session. I think I was feeling sick because of the short sleep+period+cold room. I had, and still have, dry itchy lips, which is a sign of sickness for me. So even though I feel good right now, I am really happy that I will have 8 hours of sleep. Maybe this will solve the problem, I hope. But I am really surprised on how well I feel in general considering that today is the first day of my period. I feel 100 times better than usually, I am confused but content. Maybe habitat is a good environment. Then I did Hof experiment, which made me very sleepy. Got a result of 48 seconds of holden breath, which shocked me, because my breathing isn't the best. Probably I have an asthma inducted by a cold air. While swimming, I can't hold my breath properly. And now 48 seconds, I am curious about tomorrow's result. Then I took a 20 minute nap and dreamed of habitat and MCC. I was talking with you (because I guess an MCC is reading this) about k-pop groups and why you should consider giving them a closer look as a people, who research human interactions in a set group. And actually I agree with my dream a lot. I don't know how much you know about kpop, but it is an interesting phenomena. Groups are usually 4-9 members, who train really hard before debuting together. They share the same passion, same work, same home,

they need to become a true family, even more, if they want to succeed. They usually have leaders, “mom” of the group, the oldest person who supports younger members. Sounds familiar? For example, my faves - Enhypen. 23 contestants from one company went to a closed area (like a kpop-habitat), to fight for a chance to debut. You can watch the whole survival program on the reality show “I-LAND” (available on viki rakuten). TLDR: They were cut from the outside world, in a place perfect for training. Had “MCC”, their coaches, who were evaluating them regularly. The system of survival was designed really well, because how well they were working as a team counted the most. In the end, 7 boys debuted, one of them at the age of 14, coming from Japan. In late 2022 he saw his family for the first time after moving out to Seoul after 3 years (so long because of Covid). He is basically like an astronaut in space, living, working with his crew, no coming back. They have a huge potential and I consider their story and how they develop and adapt to the idol’s life a good source of information for you. Kpop groups show a lot of backstage and their interactions and there is a lot to learn from them, that can be useful for your social interactions research, believe me. You can see which groups succeed, which not, and why not. And the music genre and quality they choose isn’t the reason, almost always it is a team problem. I would love to tell you more and help you with this, if you consider it interesting. Anyway, Joanna woke me up and I was so shocked that I actually was sleeping, because the dream felt so real, I thought I was actually talking with MCC. Later I prepared dinner, had a great time with the crew and started writing this essay. The crew is really great, they are people with passion and they are intelligent, come up with solutions quickly, are friendly and not judging. A great crew, I hope we show it. I feel comfortable with them, I like the fact that I am here with them exactly.

Day 3

The day started badly, because I was feeling sick, had problems with waking up, was just feeling like there is a tiny hamster inside my head, playing cymbals loudly. I took vitamins, gave myself time to come back to myself and eventually started feeling good. I really appreciate how crew members cared for me the whole day, asking

if I'm ok and if I need anything. Got a little stressed from a message, that I need to do a kpop workout, felt like crew members may not like it or I won't be able to lead the group, show them the moves properly. Then I started my gym session, felt a bit dizzy during the 12 km/h sprint and got annoyed with the heart experiment in general, especially because I couldn't practice for the dance workout project. That is also why later I was so long in my gym outfit, I wanted to practice it quickly after gym session, but meanwhile did some research. Sorry, I will wear my flight suit more, I hope you're not too annoyed as MCC. This made me stressed, that some MCC were annoyed, a bit attacked. Which made me curious why this is my first reaction and feeling. I do it in everyday life as well, I can't really stand any reprimand calmly, I tend to feel attacked (which is 99% times not the intention of an "attacker"). My sister told me lately about it, I need to think about it :) Anyway, I will wear my flight suit.
Learned "Fighting" by BSS in a really short time, like 10 minutes, which made me really proud. Practiced "Beatbox" as well and was super proud, I can do it pretty good at 75% speed. I will make it perfect before a concert, for sure. I am happy that I can practice dancing here. If I would start after the mission, I might be too late to learn it on time.
All meals today were so good, I really like the food here and time spent with the crew during meals. After, there was a dance workout, I elaborated on it in the "Dance workout project" file. I am really happy with the results and excited to do more research on this.
In the evening I completed missing food intake data for everyone, talked a bit with Jit about what MCC had sent me and about synesthesia. In the evening I was feeling really good, no headache, no sickness-feeling, I was even too energetic. I did tests, Hof experiment and went to sleep. From today's (Day 4) point of view, I see that I was very distracted the whole day, and was losing things all the time (mug, phone, data, etc.).
The time during the whole day was flying, I sat for 20 minutes and boom- 2 hours passed. So the day passed fast, but also felt really long, because so many things were happening.
I wouldn't like to be an astronaut, but I like time spent here and I'm appreciating this possibility more and more. It's more fun than I

thought it would be. I like the whole crew a lot, they are gentle, warm people, also very passionate and professional.

Day 4

- Good sleep, feeling full of energy
- Remembering the dream
- Feeling peaceful with the crew the whole day
- Feeling a bit anxious about experiments
- Dance in the kitchen
- Doing research
- Going a bit unsure about my skills and synesthesia in general, but this happens every time I research this, still feel excited to try get some results
- Dance workout
- So many things happened, so little time
- Fixing the pomp
- Talking a lot with the crew
- Talking with Jit about experiment and research
- Eating dinner late but it was very peaceful

Day 5

I had a difficult dream, which left me feeling pointless, out of control, washed out of feelings, as stated in the sleep report. I often have a feeling of questioning reality after something like this. The reality feels off, like I changed universes or something. I felt it for around 3 hours, I was completely washed out of emotions. And I mean it, if there would be a meteorite falling on habitat, another pandemic, me breaking my leg - I couldn't care less. I kind of isolated myself. When I do it, I feel like I have two minds. One is emotional, normal, intelligent. The other one is just a facade facing reality, while the other mind can rest. Also when I have a worse time in general, outside the habitat, the second mind is sane, happy, synesthetic, alive. The other one is just for functioning. It is checking ground by asking provoking questions, so I can see if I can feel safe. 99% of the time people fail these tests. Facade is not really reacting, the second brain is stable and knows that the

question was not important, it was just a test. And recovers on, alone. Synesthesia helps a lot then. Also, synthetically, the second brain is up on the left side, while the facade is around but below. So that is how I felt today for these 3 hours, evacuated to a safe space that shows up only when I need it. So I hope it is not schizophrenia. Sounds like a frozen response to me. Anyway, that is why during the briefing I couldn't care less, I was isolated. I will do my best during the day anyway. So sorry for not feeling bad for our mistake, I just couldn't, the dream has broken me for a few hours. Also, today I couldn't tell the time of the day nor the weather. This also made me upset. For 4 days I felt weather (maybe my guesses were wrong, but at least I felt something) and time (could tell if outside is before noon, afternoon, early evening or night), today I feel the same the whole day. After breakfast after breakfast we made our PR photos and time spent with crew brought me peace and happiness and eventually brought me back to life. This is a very, very good crew, honestly. I like all of them and I appreciate so much their attitude, supportiveness, how they care. 10/10. Later I had a gym session and I hate heart exercise. I shorten it, because running on a treadmill makes me really dizzy and I just can't do this for 5 minutes. Later I did dance workout, but since "Beatbox" became too spacious on 100% speed, I chose other choreos I know. I repeated many times, mostly chorus+post-chorus of ENHYPEN "ParadoXXX Invasion" and chorus+post chorus of ATEEZ "ROCKY", but also did ITZY "Dalla Dalla" and LE SSERAFIM "ANTIFRAGILE". I enjoyed a lot, also because these choreos are spacious only to sides, not sides+front like "Beatbox". Later I started research on synesthesia and elaborated on this. Listened to ATEEZ "Cyberpunk" for 40 minutes, even now I'm listening and trying to understand more. I wonder what will be my ATEEZ statistics this year, they are already on #1 place on stats. Later there was lunch, a really nice one. Later research and elaborating again. I felt washed out of feelings again, but the dance workout helped me and gave me a lot of excitement and happiness. Even the crew members say that I visibly become so excited for the dancing. We did it sooo good, we need to practice only a bit more to make our formation perfect. Later synesthesia again, reporting. And now a kimchi instant soup. I talked about traveling to Korea with Jit and Margot and I miss Korea so much. And I love my crew. It was so nice of Jit, that during dinner he gave

me his spoon, so I didn't have to use the "wrong" one. I promised to write about it in the report. (I don't like touching metal and can't stand some cutlery, it is just painful to my mind. But that sounds like an autistic trait)

Day 6

There was an emergency, I died, had fun with another dead body, probably because of tiredness. Later there was a problem with hydroponics. After this we went to sleep. I woke up super dizzy, 25 breaths per minute, 100/48. Jit did a great job and he was so lovely and kind to me, took good care of me, he and Margot prepared me. Later we had a briefing, breakfast. I went to my gym session, trained as stated in the sport measurement sheet. Was super proud of myself. Then I started working on reports, presentation, and worked really hard with the rest of the crew. Then there was dinner. Then we started working a bit more, goofing around, singing, and cleaning. Love the crew, the best one ever.

Expedition 58, Margot Winters, Belgium

Biostrat Mission
10.03.2023 - 17.03.2023

Day 1

General feelings: slept well, felt comfortable, ready for the day. Thoughts on the bad dream I had had, which faded away during the day.

Thoughts: The habitat so far is quite comfortable. Though I won't show any sign of hubris (like Agata hanging her golden chain on the stratospheric balloon …): it is yet day 1. The crew is doing well,

everybody is getting adjusted quite quick. Food is better than expected, my crafted patch not so much. I look forward to the week. You are giving us 3 hours of sleep? Perhaps only 1 tomorrow? Quietly looking forward to see the effects on the crew, on myself. In that sense, make it as extreme as wanted, as long as we can rest well on the 19th before going back to lectures. I have an assignment due Tuesday 21 ;)

Things I did : Prepared food, tidied, got frustrated by the chimp test app :) prepared and sent an internship application email, which I knew I could not stall until 18 March.

Day 2

Waking up after only a few hours of sleep was of course noticeable, but I believe I had the right mindset which made me feel energetic nonetheless. I was quite happy when working, grateful, and was inspired by how well the crew got along with their challenges. Sports made me feel at ease. I look forward to laying in bed, though feel not too tired.

Things I did : I was able to start quite some work today for the Biostrat mission, the report for my experiment seems to turn out well! Keeping up with measurements was easier as on the first day, since we found all together a good rhythm for it. I was quite happy when working. During sports I tried the Heart test procedure, it was challenging and I only made 4 minutes into the 12km/h run. Hopefully better tomorrow.

Day 3

Waking up I felt positive, then fulfilled when realizing the morning measurements and tasks all start going so quickly! Briefly felt apprehensive that today there might be a crew emergency, but these feelings went away quickly. Amused to have contributed much to lunch and dinner preparation and clean-up. Felt at ease during the day when working on my preparation report for the

mission. And joyful when doing the K-pop dancing group activity, what a nice idea of Julia! Writing the report I feel a bit worried about time, since I yet have to do sports soon and my Hof experiment before sleep.

Things I did: My report evolved quickly and steadily today: rewriting old parts, adding new parts from the papers I read, optimizing the structure. Soon I will be able to show the result and ask feedback to the seed company Bejo Zaden and AATC.
Gym: still has to happen. I will continue this report after the gym session (perhaps tomorrow).
Activities: Dancing K-pop with the group, preparing and cleaning for lunch, dinner. Some good questions were asked during the day to each other, which at least from my side made our connection grow. I appreciate this team more and more every day.

Day 4

Waking up I felt tired. We had a lot of sleep but the timing of waking up was wrong (deep sleep). Felt a bit too much at ease sometimes, there may be more challenges. Felt connection during the crew dancing. Felt proud during and after gym.

Things I did: send experiment preparation report to the seed company I will work with, they will review it and give feedback tomorrow. Was in contact with Agata about the payload needs. Did dance with the crew! Played guitar for the crew. Helped Bartek with searching for pump. Did heart rate tests in gym. Hof test 2m30!!!

Day 5

Waking up I felt sleepy, due to having woken up several times during the night. Then a feeling of regret once MCC explained the crew woke up 2h late. Happy feelings came back during breakfast with crew. Grateful and elated during and after making the crew pictures as I felt proud of our story and what we have achieved here, each in our own way. I can already see myself showing and telling all about the habitat when home. During lunch we felt inventive as we created a new meal! Of course it included wraps.

Felt euphoric during work because there was good progress which made me think about future plans and dreams. Focused during gym.

Things I did: got feedback on my report from the seeds company. Implemented this feedback. Sent revised document to Agata. Asked also questions to Agata. Made crew position pictures of myself, Jit and Joanna. The pump works! Sent 2nd round application details to EMM for another analog mission. Dances with the crew. Gym heart rate test and more sports afterwards.

Day 6

Saddened by the loss of my two fellow crew members, happy and comfortable whilst writing report and fulfilled when hearing the news about SGAC (see below). Worried about my rejected ESA internship (see below). Happy to make presentations again, it had been a while, outreach is something I truly enjoy.

Things I did: urine sampling, rewriting report with Sebastian's useful feedback, making a well considered presentation and slides to accompany it, getting accepted to become member in a project group of the Space Generation Advisory Council (SGAC), where I will work on the gap in knowledge of female studies for human spaceflight, by becoming contact person between medical institutes such as Medes and analog habitats. My conference paper for the Biostrat research was well received even though I missed the deadline, so fingers crossed. My internship at ESA got rejected… Feeling a bit lost in this, but luckily preparing the presentation provided good distraction.

FOR IMMEDIATE RELEASE

TRAGEDY STRIKES DURING METEOR SHOWER ON LUNAR HABITAT: TWO ASTRONAUTS LOSE THEIR LIVES

Lunar Habitat, 16 March 2023 - In the early morning of March 16, 2023, tragedy struck the Biostrat astronaut crew as they experienced a catastrophic event during a meteor shower. Julia

Zioło and Joanna Stępieńwere both impacted by meteors and tragically passed away. Another crew member, Margot Winters, suffered severe injuries to her leg but survived the event. The meteor shower hit the lunar habitat around 21:00, causing the alarm siren to fail and the communication with Earth's mission control center was briefly disrupted. Two members of the crew, Julia Zioło and Joanna Stępień, were tragically killed.

Margot Winters, another crew member, suffered severe injuries to her leg but managed to survive the ordeal. The remaining crew members worked tirelessly to repair the damage to the habitat and ensure that the oxygen support systems were functioning, albeit at a reduced capacity.

In the aftermath of the meteor shower, the majority of the crew's food supply was found to be contaminated by solar radiation and had to be discarded, leaving the remaining crew members with limited provisions. They stored Joanna's body in the freezer and removed Julia's body from the habitat. The cause of the malfunction of the alarm siren and communication with Earth's mission control center is still being investigated. While initial reports suggest that the malfunction was an unforeseen event, sources close to the investigation have hinted that the astronauts may have been negligent by turning off their alarms. Further updates will be provided as they become available.

"We are deeply saddened by the loss of our colleagues, Julia and Joanna," said Agata Kołodziejczyk, spokesperson of the Biostrat mission. "Our thoughts and prayers are with their families and loved ones. We will continue to support the remaining crew members and work tirelessly to ensure their safety and well-being."

The Biostrat analog astronaut program is committed to advancing scientific research and exploration in space. The program has been instrumental in developing new technologies and methodologies that have enabled astronauts to conduct cutting-edge research in harsh and remote environments. Despite this tragedy, the program remains dedicated to pushing the boundaries of human exploration and discovery.

The Effect of Sound and Vibration on Plant Growth

Seán Molony
EMMPOL 15

Introduction
This investigation raises the question of if sound and vibration can positively affect the growth of plants. Research has been done on the effects of sound on specific plants such as *Gerbera Jamesonii* and *Actinidia chinensis* [1][2], but this experiment will document the effects of music played in close proximity to Garden cress (*Lepidium Sativum*) and Radish Sprouts (*Raphanus Sativus*). This experiment was carried out over seven days and measured the length of both the root and shoot system, the percentage of seeds that germinate as well as commentating on the general health of the plant based on appearance.

Hypothesis
The current hypothesis of this experiment is that the sound waves emitted from the speaker will stimulate the plant cells being subjected to the music and induce a faster metabolic rate within the plant, causing an accelerated growth compared to one that is kept in a similar environment without the music.

Materials used
30cm LED strip
12 petri dishes
Agar powder
Large glass container
2 Bluetooth speakers
Plant mister
Garden Cress seeds
Radish sprout seeds
Sound intensity measuring device

Methods/Procedure

Agar was first produced using the agar powder and hot water, a shallow layer of which was then poured into each of the petri dishes and left to cool until the process of gelation begins. Once sufficiently cooled, the garden cress seeds and radish sprout seeds were placed in the dishes, six dishes each and left to germinate. After one day, three of the watercress and three of the radish sprout dishes were taken to a secluded area where they were placed under the glass container alongside the bluetooth speaker where it would play classical music constantly. The specific music that the plants were subjected to was not important for this experiment, but the sound intensity was kept at an average 81.7 dB compared to the plants subjected to “silence” intensity of 38.2 dB. A lower result would have been preferable, but lower intensities were not possible in the conditions where the experiment was conducted. All twelve of the plants were lightly watered twice a day using the mister. Progress was documented throughout the experiment. On the final day, the dishes were all collected where the number of seeds per dish were counted and the shoot and root system of three random plants from each dish were measured and recorded.

Results

Radish Sprouts-no music-average intensity = 38.2 dB

Dish Label	Seeds in Plate	Description	Germination Percentage	Root system Length (cm)	Shoot System Length (cm)	Total Length (cm)
RS 1	79	Some healthy stalks, 39 ungerminated seeds	50.6%	1.6	2.8	4.4
				1.1	2.7	3.8
				1.2	2.9	4.1

RS 2	62	Some plants with long roots, 19 ungerminated seeds	69.4%	3.3	2.2	5.5
				3.5	2.4	5.9
				1.8	2.5	4.3
RS 3	71	Some thick stalks with long roots, 22 ungerminated	69%	5.2	3.6	8.8
				2.6	2.5	5.1
				3.1	2.6	5.7

Table 1. Radish Sprouts without music results.

Radish Sprouts-music-Average Intensity = 81.7 dB

Dish Label	Seeds in plate	Description	Germination percentage	Root system Length (cm)	Shoot System Length (cm)	Total Length (cm)
RS 1	64	Most plants grew healthily, 12 ungerminated seeds	81.25%	6.2	3.1	9.3
				3.6	4.1	7.7
				2.9	3.5	6.4
RS 2	70	Tall stems, 13 ungerminated seeds	81.4%	3.8	5	8.8
				3.6	4.8	8.4
				3.9	4	7.9
RS 3	74	Some stems didn't reach full maturity, 14 ungerminated seeds	81.1%	3.1	2.4	5.5
				2.9	3.7	6.6
				2.7	4.2	6.9

Table 2. Radish Sprouts with music results.

Garden Cress-No-Music-Average Intensity = 38.2 dB

Dish Label	Description	Root system Length (cm)	Shoot System Length (cm)	Total Length (cm)
LS 1	Slightly darkened stems/leaves	2	1.6	3.6
		0.5	1.3	1.8
		1	1.9	2.9
LS 2	Agar is beginning to shrivel, dryer look	1.3	0.4	1.7
		1.7	1.8	3.5
		1.8	2	3.8
LS 3	Dark leaves, seeds still on many plants	1.5	2.1	3.6
		1.6	1.9	3.5
		2.2	2.4	4.6

Table 3. Garden Cress without music results.

Radish Sprouts-music-Average Intensity = 81.7 dB

Dish Label	Description	Root system Length (cm)	Shoot System Length (cm)	Total Length (cm)
LS 1	Pale stems	1.8	2	2
		1.4	1.9	3.3
		1.7	1.8	3.5
LS 2	A lot of plants floating on agar, roots not burrowing under	0.6	1.3	1.9
		0.8	1.5	2.3
		1	1.1	2.2
LS 3	Small Stems	1.4	1	2.5
		1.2	1.1	2.3
		1.1	0.9	2

Table 4. Garden Cress with music results.

Discussion

As seen from the tables, there is a net increase in the total length of both species planted for most of the samples. There were difficulties setting up the experiment as the work space in which this investigation did not have ideal spaces for growing plants. The hydroponics system was used for the non-music plants, but the music plants had to be placed in an isolated area to avoid the music they were subjected to affecting the non-music plants. An attempt was made to ensure that the conditions were the same for all samples, but temperature and light intensity may have varied.

Conclusion

From the data collected in this experiment, it would suggest that music had a positive effect on the plant growth, however, the conditions were not ideal and with a sample size so small, results are not completely conclusive. Repeating this experiment may be beneficial, with more resources, a larger sample size and maybe different species, a more thorough investigation may be carried out.

References

[1] Xiujuan W, Bochu W, Yi J, Danqun H, Chuanren D. RETRACTED: Effect of sound stimulation on cell cycle of chrysanthemum (Gerbera jamesonii). *Colloids and Surfaces B: Biointerfaces*. 2003;29(2-3):103-107. doi:https://doi.org/10.1016/s0927-7765(02)00153-4.

[2] Xiaocheng Y, Bochu W, Chuanren D. Effects of sound stimulation on energy metabolism of Actinidia chinensis callus. *Colloids and Surfaces B: Biointerfaces*. 2003;30(1-2):67-72. doi:https://doi.org/10.1016/s0927-7765(03)00027-4.

Expedition 59, Alice Managau, France

EMMPOL 17
29/04/2023- 06/05/2023

Day 1

I woke up in a good mood because I though a slept very well, better than expected. Then I was directly in a energized mood and I have a lot of energy to give to my experiments. Even if I woke up 2 times during night, it don't really affect my sleep because I fell asleep as soon. After that came all of the experimental tests such as urine analysis, blood samples, and I found it quite interesting and fun to do. The only thing I could say it's that it is quite long. Then I started to work on my experiments. I was on my two devices and I go from one to another. I don't really go on with piezoelectric sensors on the electrical aspect because I don't had the time but I finish construct the attach on the ankle. During that time I had my sport hour where I do some cycling and running/ walking. Then, during Mae sport hour, I collect some data with my dynamo device.

For the piezoelectric sensors, all of the device was built except the attachment for the astronaut's ankle. That’s why, thanks to Valentin who 3D printed the support, I could construct all the attachments by sewing some parts. Then, I spent a long time on the dynamo electric circuit in order to make it work. The most difficult part is making the software work but David helped me to do so. Once it was done I could test it and I saw some results. I was really happy to make it work so fast. At the gym, I do a lot of treadmill because I feel more active. But I also tried cycling but it's more chill. I ran at 7 kph. After sport I “showered” with some baby wipes.

Today's breakfast was quite good and simple: bread with butter. For lunch, the meal was really good. It was red pepper with rice and some seasoning: I really enjoyed it. The dinner was much

weirder: tortilla with some cream cheese. I don't particularly enjoyed it.

Day 2

I woke up really really tired but it went better through the day. I actually don’t feel as if I slept 5 hours. That’s a good point because the day was really long. I don’t wake up during the night so it was one straight: very pleasant even if the waking up step was really difficult. I felt very tired the first hour of the day but it fastly disappeared. After that we did all of our experiments and tests. It was shorter than yesterday because there was no urine test and other stuff. Otherwise, I tried the blood analysis, even though I'm very scared of needles. Turned out that I did not have enough blood to analyze. Today, I collected a lot of data for the dynamo device, but I'll collect more tomorrow, from other people. The piezoelectricity is more sensitive because I have no way to know if it works or not, except to wear it for a long time and see if the battery charges.

For the piezoelectric sensors, I tried to get data but I'm not sure yet if it worked. I wanted to try it at the gym but the ankle attachment broke so tomorrow I'll have to do another one. I spent a long time on the dynamo electric circuit so that i could collect a lot of data. I tried to collect as much as I could, but I did just collect Mae’s ones. I have the data but i haven’t analyzed it for now. I was really happy to make it work so fast. At the gym, I do a lot of treadmill because I feel more active, and because we had to do an experiment. I was quite frustrated because I couldn't reach 200 bpm for the experiment.

Day 3

When I woke up I was kind of good because I slept well and a lot (more than 6 hours) and was in a good mood until my tummy began to hurt (period) for almost 2 hours until I took medicine. After that I work a little on my experiment and then do sports. I collected some data and we ate. Next we had some fun and had to retake a lot of photos that weren’t good enough. That was frustrating because we could not work on our experiments. Next, I could work

on my experiments and do some research about the data I obtained. It was very interesting, I liked it a lot. At the gym we had to do another experiment that was very difficult. We have to run at 12km/h but I can not reach it. It was too difficult because I could not breathe. However, I outperformed and I even reached the 200 bpm that I could not have yesterday. After that I was off and tired a lot. In the experiment, I did a lot of research on the data I obtained, and I found it very interesting to interpret some data I got myself.

Day 4

I woke up really tired even if I slept well. Either way, I was motivated to do experiments and I wanted to be on time with the schedule. However, there were few interferences. First, I prepared for the conference we attended this afternoon, this morning. Next we were late and didn't have the time to eat, so we had to attend the conference. I don’t know how long it lasts but it was long and we lost time on our experiments. I was quite frustrated. Next when I will finally work on my experiment, the emergency simulation began. I REALLY liked it because it changed the routine of the days and it was concrete. I felt we acted well, especially David. I was surprised with his way of managing the situation. He was cold headed. Either way, I'm very proud that we are one of the best crew at it.

I didn't really work on my experiment today, but I learned other things, such as emergency management, and presented our crew at EuroSpaceProgram. But I had time to go to my gym, and do the Valentine's experiment. I ate Nutella for breakfast, it made me very happy. Next we ate potatoes, tomatoes and eggs. At dinner we were not very hungry so everyone ate on his side, some leftovers or something that didn't appear on the futures day’s diet.

Day 5

I woke up really tired, even though I slept quite well. I felt kind of tired all day. I had to take a lot of measurements. I took some measurements of the dynamo on the bike. It was quite difficult because we did not have the tools to remove the cover. I can even

take a lot of data. That was difficult but good. Afterwards we had to eat and I did some research in the afternoon. I could not take data because other crew members had sports hours. Afterwards, we all had a nap : it was the best moment of the day. I slept less than 1 hour and I felt way better after that. The evening we just eat, make inventory and clean and do tests. I take measurements, begin to analyze them and sort values.At gym, I did a Heart Time experiment and then I walked because I didn't want to run. I was too tired. Next I had to remove and dismantle the cycling machine to access the wheel.

Day 6

I felt very tired today, however I keep going on my last data on the dynamo experiment. I also spent a lot of time on my report and tests. I like to talk about my result on my experiment report because I can see that what I did worked and I can finally conclude on it after a week of experiments. We spent a good evening with my crew mates, laughing and spending our last hours in the habitat. It was really fun, and I'm excited to finally get out of here, and breathe fresh air. I did a few measurements on my devices and wrote reports and took a lot of surveys. I took measurements that take the voltage produced at different speeds, from 2 to 10 kph. It was important to see the variation of production depending on the speed. Next I took a lot of surveys this afternoon, especially one that took me one hour and a half: was a bit long and delayed me. I fortunately finished my experiment report in the evening.

COMET - Coil Mechanical and Electric Transducer

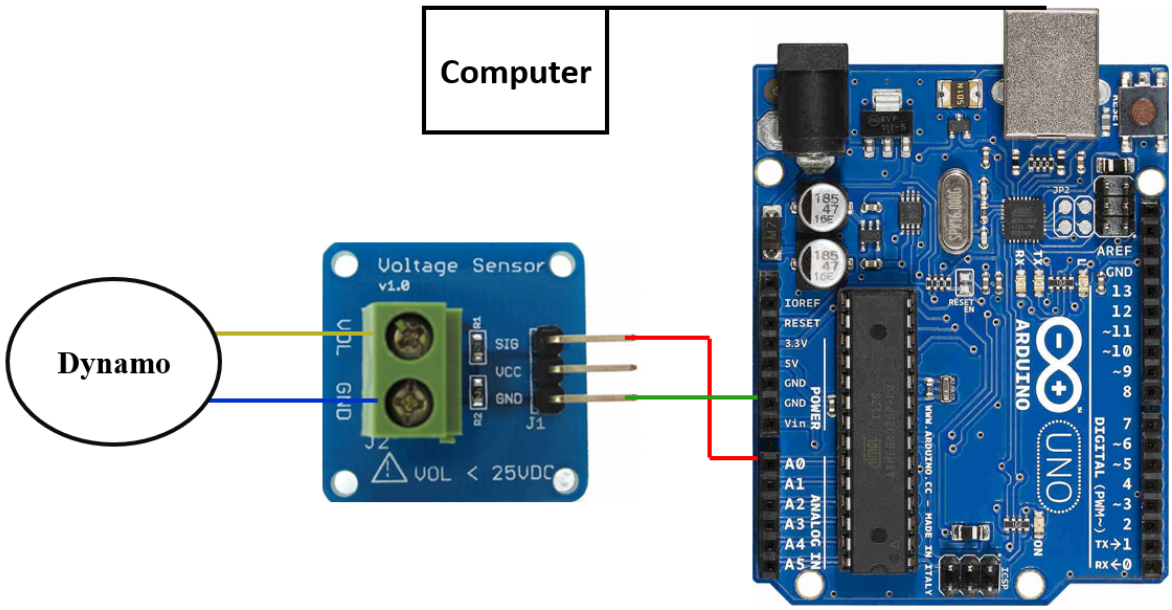
Introduction:
Three of the crew members of this mission were part of a school project at Institut Polytechnique des Sciences Avancées, Toulouse (IPSA) called “Space Spinner”. This project’s aim is to create a rotating space station in order to simulate 1/3 of the earth's gravity. But for what purpose? For example, going to Mars requires 260 days. That's 260 days during which the astronauts will have to live without gravity. To this, we must add the life on Mars and the return trip. With our current advances, it is impossible to send humans to Mars: the trip is too long, and in microgravity, humans lose a lot of bone and muscle mass. This would result in a crew in poor physical condition, not able to do all the experiments, and even EVA. First step is to then think about the energies: how could we produce energies in the habitat. One part of the project is to convert mechanical energies into electrical energies. For that there are two devices. One is a system with a dynamo and the second one is piezoelectric sensors that could convert kinetic energies.

Aims and goals:
The aim of this experiment is to recover every little energy loss in the space station, or in a space habitat. So that we could power a few electric components in the habitat. In that way, the dynamo device would measure and recover the mechanical energy produced during sports hours, given that astronauts have to do 2 hours of sports per day. The piezoelectric devices could recover in a battery the energy produced thanks to the astronaut weight.

Methodology:

1. **Dynamo device**:

- Plug the electric terminal of the dynamo to a multimeter that can record voltage. This voltmeter is the next plug to an Arduino card, so that we can record the voltage produced over a long time period, in order to have a lot of data. We can visualize the following assembly :



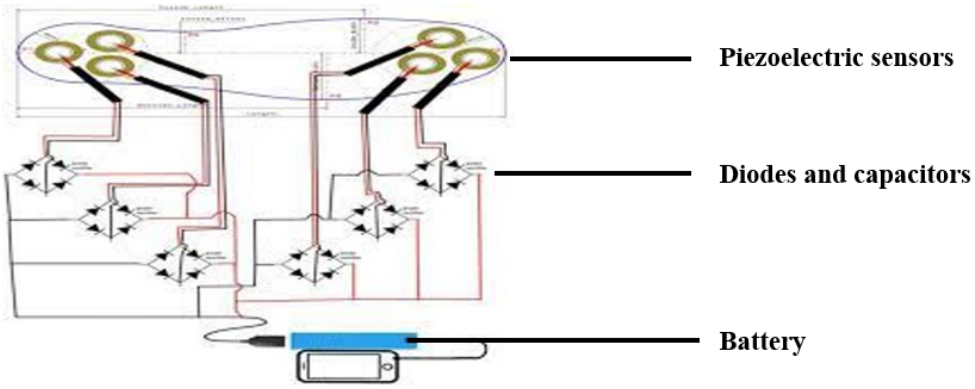
Thanks to that, the voltmeter will be able to record voltage produced, at a baud rate of 9600, thanks to a software called “PLW-DAQ”

- Go next to a sport device, such as a treadmill or elliptical bike and prepare the setup. You need to have access to the wheel of the bicycle or the floor of the treadmill, so that the dynamo could rotate.
- Put the dynamo on the equipment so that the end of the dynamo rotates.
- Launch the software that will record the voltage produced, by clicking on ‘’ Connect”. Make sure you choose a 9600 baud rate and cleaned timer and columns.

WARNING : You need to protect the part of the dynamo that’ll be in contact with the movement with tape so it will not damage itself and the sport equipment.

2. **Piezoelectric sensors :**

- Put sensors in gel soles as in the following picture:



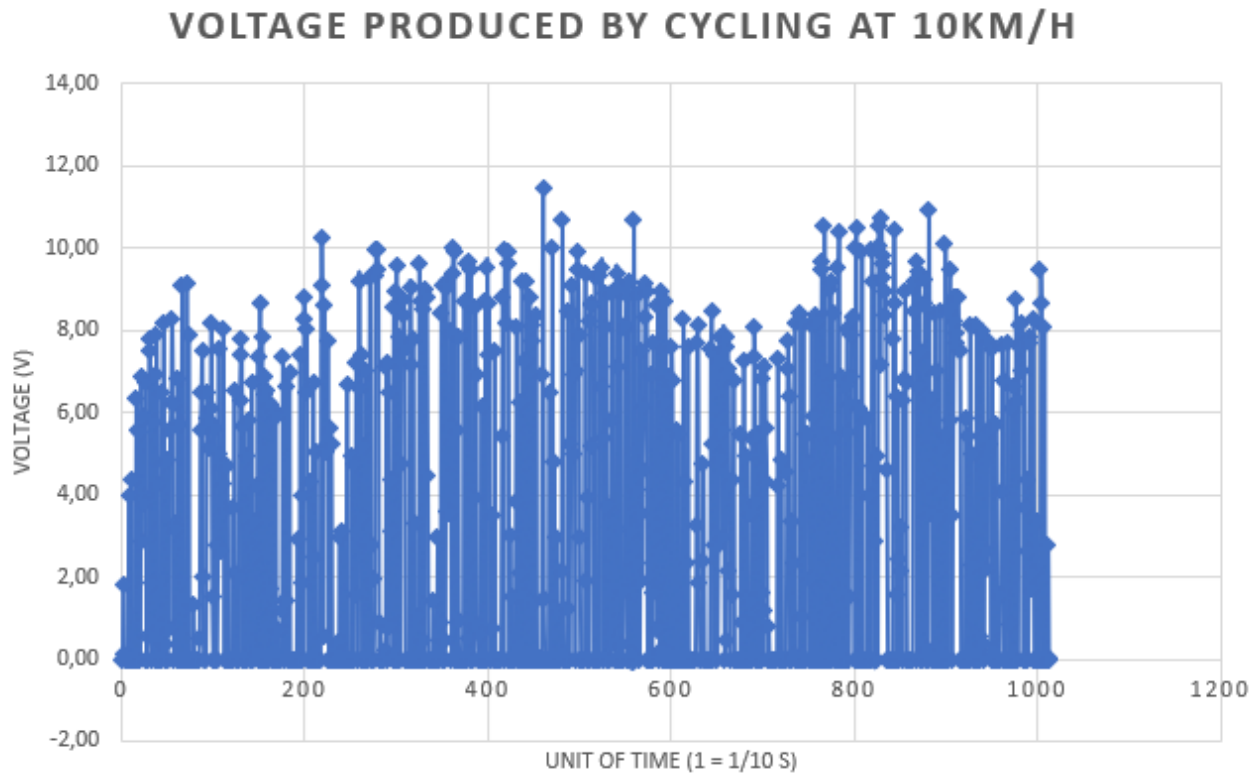
- Put the gel sole in you shoes, attach the battery at your ankle.

Result and discussion:
Unfortunately, the piezoelectric device didn't work properly indeed. There was not enough time to change the installation and to figure out where the problem was. Maybe, the battery was being loaded but it took too much time and I could not get the result.

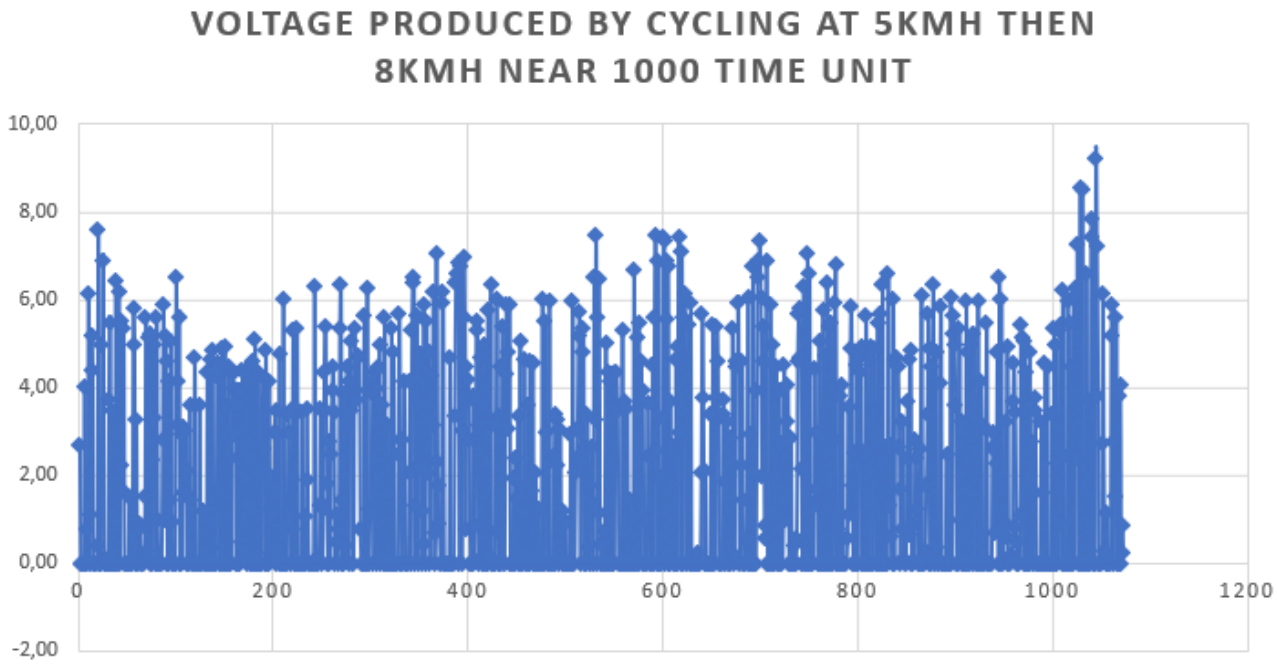
Dynamo device :
I tried this device on both treadmills and elliptical bicycles, as it is the most common sport equipment. It is also one of the only ones that produces rotation movement.

1. Bicycle

First of all, it makes more sense to try the bicycle because the astronaut will produce himself the movement that will induce the rotation of the wheel and so the rotation of the dynamo. For that, the dynamo was put right above the wheel and thanks to movement it produced voltage. For the results, in order to not saturate the dynamo, let's take a speed of 10km/h, and do 10 measurements. The results for this speed are between 1 volt and 12 volts.



This graphic shows how the evolution of the voltage, on an exemple (evolution of the voltage by cycling during approximately 2 minutes). It is not constant and it varies through time because the astronauts do not have constant speed. We can see the effect of speed on the next graphic :

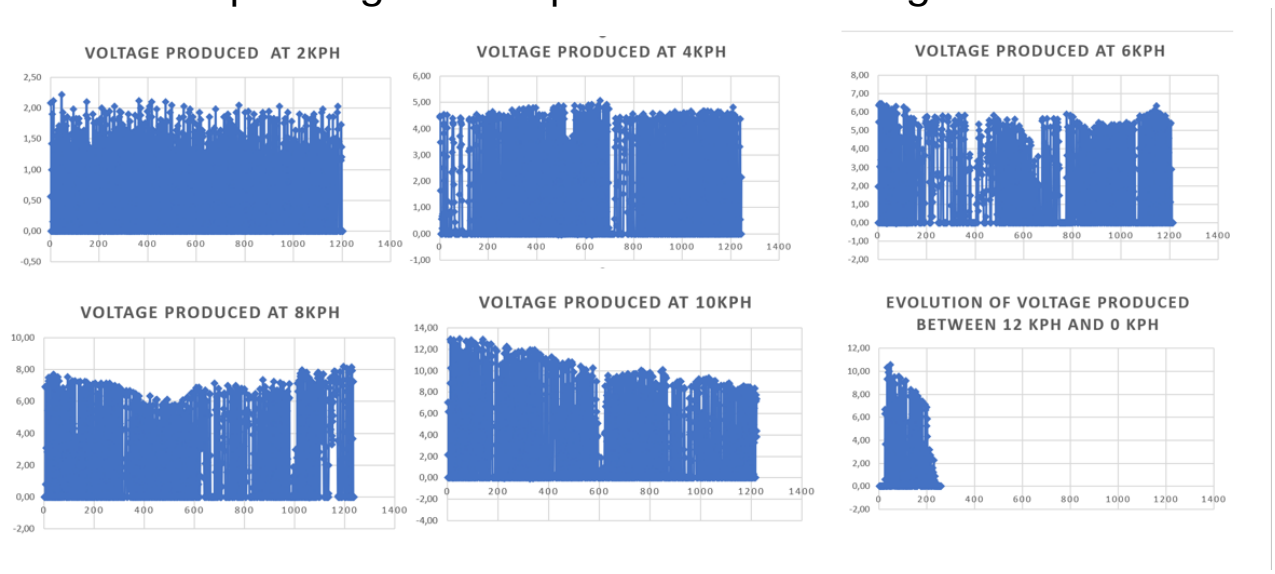


This graphic shows that, at the end, when the speed increased, the voltage produced was higher. It can be concluded that the higher the speed, the more electrical energy the device will produce.

By taking into account all of the data, there is an average of 5.66 V at 10 kph. To conclude on the elliptical bicycle, the voltage produced depends on the speed of cycling, but as astronauts can reach 25 kph on it, if the dynamo is not limited, we may reach 15/20 volts. With this quantity of volts, we could power lights (needs 2/3 volts), speakers, charger or even little engines. That would be very useful on a lunar habitat.

2. Treadmill

As the astronauts are not going to use only the bicycle, it would be wise to also use the treadmill. Even if the treadmill uses energy to work, let's try to not waste all of this energy and recover some.
So, by putting the device on the treadmill, we can see the voltage produced depending on the speed on the next figure.



It seems that, like the bicycle, the voltage produced dependent on the speed. It can be seen clearly on the last diagram. The faster the astronauts run, the more energy they will produce. The treadmill produces more than the bicycle. The average of volt produced is 6.54 V at 10 kph and 4.69 V at 4 kph, according to a lot of data measurements, on several crew members, at different hours of the day. With that voltage, the device could power lamps, radio or fans.

Conclusion:

To conclude, the dynamo device can be very useful to astronauts in a lunar base to produce electrical energies. Thanks to it, they will lose less energy and could power a few supplies while doing sport : they will be able to power light, charge some devices or even power an engine. It is not a lot of energy produced, however,

every progress, even the smallest is worth taking. To avoid the energy stockage, this device could power something the astronaut needs during sport hours, so it's directly connected to it. To conclude on the data, throughout the day the values don't change a lot, it just depends on the speed, so on the physical condition of the astronaut. Let's say that the astronauts are more efficient in the morning because they are not tired anymore. The best hours to do sports would be in the morning, so that they would be able do sports at high speed, and thus produce more voltage and power

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1. Arduino UNO, URL : https://robotechshop.com/shop/arduino/arduino-board/arduino-uno-r3-china/
2. Voltage sensor Arduino, URL : http://buysnip.com/product/voltage-detection-module-voltage-sensor-arduino/
3. https://en.wikipedia.org/wiki/Dynamo

Expedition 59, David Burgun, France

EMMPOL 17
29/04/2023- 06/05/2023

Day 1

After waking up, I didn't really know how I felt because I was confused about my sleep. I slept well but I woke up several times during the night, so it had me confused. Beginning with medical tests was quite funny because I obviously don't do this usually in the morning after waking up. However, I didn't want to be late, so I did things quickly. I hope I didn't stress anyone else. I then started with my experiment on the aquaponic system, and I was super excited to begin. It seems that everything works perfectly, so I'm happy even if I had some issues with collecting data which led to some frustration, but I think I will manage to make it work

tomorrow. I then had to do my workout session and I really enjoyed it because I didn’t run for a long time, so it felt good. I also did some cycling, and it was fun. We then took our pictures in our flight suits, and I was proud of myself. I wished for a long time to be part of an EMMPOL mission and wearing that flight suit really made me proud. Finally, I had a great time with the crew in the evening at dinner. We really hit it off in a great way and it makes the mission event better. For my experiments, I started by trying to link the aquaponics with the hydroponics. I soon realized that I had a problem : the pipe that goes from the pump to the plants to transfer the water isn’t long enough. I therefore couldn't connect the two, but with the help of Valentin, I hope I can get a 3D printed pipe that would complete the length that is missing. I then put the lamps for the plants in a way that it is not interfering with the plants and the sealed space it is located in. I finally wanted to collect data from the temperature of the water, but I had an issue with the programming part, which left me frustrated because it should have worked from the first time.

Day 2

I was obviously tired when we woke up. We only slept approximately 5 hours (even less) but I was surprisingly motivated to start the day. I was focused to continue my experiment but we had to make a new version of our powerpoint presentation because, and I agree on that point, it wasn’t really professional, we could have done better and that’s what we did but for a long time. I didn’t really have the time to work on my experiment and was a bit frustrated, but the frustration quickly vanished when I managed to fix the pipe issue. Valentin succeeded in making the 3D printing machine work, and so he made me 2 pipes that would make the original pipe longer and reach the hydroponics. Later, with Valentin, we had to do our workout session together. I clearly felt that we were two doing sport because it was smelling a lot but I got used to it. Even though we had a long day, I do not feel tired for the moment. I see everybody getting signs of being tired, but I surprisingly don’t feel that way.

For my experiment, as I explained previously, I fixed the pipe issue but I realized I had another one. In fact, the pipe wasn't sitting still and I had to do something about this because otherwise the water wasn't going to spread correctly. Therefore, I attached one cable tie to the top of the hydroponic compartment and created a "rope" or "ladder" with two other cable ties so I could get the pipe through the cable tie without moving. The system was then operational, the only thing that's left to do is to finally program the sensors correctly. Later for my gym session, we had to do the test that Agata told us to do. The beginning was good for me, I got 200 bpm at around 2 km (so 10-11 minutes). I then reduced my speed to 10.5 kph to hit 174 bpm. But from this moment, I couldn't lower my heart rate : I had to reduce my speed to 6.5 kph to get below 160 bpm. For the last part, I had to lower my speed to 3.5 kph in order to get into the range of 141-150. After that, I wasn't able to pass under 141 bpm, and I had to stop so Valentin could do his run, so it wasn't ideal.

Day 3

I woke up a bit tired, even though I slept longer than yesterday, with a sore throat. However, I was excited to start the day because I knew I was going to be focused on the programming part of my experiment. Before doing this, we were asked to retake the individual photos and with a deadline, so I really wanted to finish this early so I could start on my experiment. I may have been annoying for the other members during this period and I hope it didn't affect anyone's mood unconsciously. Once this was finished, I was able to start working, and I was thrilled because I was able to finally collect some data on the experiment. Until the end of the day, I felt relaxed and happy thanks to this. I was able to connect the sensors to my computer and finish the programming of the sensors and collect data. For the workout session, I did the Heart Time experiment which was interesting because I felt I wasn't able to properly realize how much Time was passing by with the STP tests. I finished with 30 min of cycling where I reached 14 km. I also took new individual photos of each member and worked on the powerpoint presentation of EMMPOL 17.

Day 4

When I woke up I felt a bit sleepy but I was in a good mood. I knew that today would somehow be a great day (which was good but not that great). After the usuals medical tests and different reports to write, we took our breakfast in a good mood. I then started my experiments which went great because I was able to recover data simultaneously from the temperature and the turbidity. After that, we participated in one of the EuroSpaceHub conferences for their forum in Ibiza. We were invited to tell our experience as ongoing analog astronauts and I was really hyped by this. The idea to participate in such an event with other analog astronauts and a real astronaut made me really proud. Afterwards, I continued with my gym session and I loved it because I had fun on the cycling machine. Once I had finished and cleaned myself, we were very surprised to have an emergency simulation, which we were clearly not expecting. We started very well and ended pretty good but I didn't feel very proud at the end because I know I could have done much better. However, we apparently did one of the best emergency performance's and we are really happy about that. Even though I've been hard on myself, I felt really calm since then.
For my experiments, I managed to collect data from the temperature and the turbidity of the aquarium simultaneously, in that way, we can verify the correct condition of the temperature and the opacity of the water and quantify it, so I felt quite satisfied. I also talked with Valentin for a potential 3D printing idea for the sensors so that they can be fixed on the aquarium. After that I did my workout session and reached 15km with the cycling machine which was pleasing. The day was followed by an emergency simulation and almost finished there. After that, I calmly did some research to begin comparing my results.

Day 5

I woke up this morning tired because I didn't sleep very well. During the night I felt that the temperature was way too hot and I woke up multiple times, each time thinking I was late for the wake up call, when in fact, it was still very early. However, I was optimistic for the day. Once I started to work on my experiment, I

quickly collected a lot of data of the temperature, the turbidity and the pH of the water, which made me happy, but I was frustrated because I couldn't get any data from the water level, and I couldn't manage to get the data wirelessly with the bluetooth module. After the morning work and after lunch, I went to do my workout session just before the VNP, which was really helpful because I was incredibly focused after that. I then continued to work on my experiment and to collect data but again I didn't succeed for the last two tasks stated above. I'm currently very tired because of my lack of sleep from last night and because I worked really hard on my experiment. For today's experiment, I collected 2 sessions of 40 min for three sensors (Temperature, turbidity and pH), one session in the morning and one in the afternoon. During the part of collecting data, I tried to unite the program of those three sensors into a unique program, but I had an issue with the program of the pH sensor (Baud rate not compatible with the ones from the two other sensors on Arduino). I also did measurements with Valentin for the support of the sensors. The modeling on Catia looked great and I hope to have it by tomorrow. For the gym session, I enjoyed this session, because I almost reached 16km with the cycling machine. However, I almost got a cramp in the calf so I slowed down a bit at the end. I also had my first VPN.

Day 6

I woke up a bit tired but positive for today. MCC accorded us an extra nap time which was definitely helpful because it kept me focused for a long time on the day. Today was especially long as we had to write several reports, some which took quite a long time to answer. The gym session was pleasant as it made a good pause during all of this time in front of a computer. It is currently MT22, mission day starts in less than 2 hours and I am exhausted but happy because I am finally finished. For the whole day, I've been writing all sorts of reports. It started with a report about the emotional intelligence experiment, followed by the official questionnaire for entering the astronaut selection, which was quite long, and then I finished with the report about my experiment which definitely was the longest report. For my workout session, I am really proud because I managed to reach more than 16 km in

the usual 30min with the cycling machine (16.60 km to be specific). However, that is all I did today since I had only reports to do.

Sensor Integration for Conditioning Monitoring in Aquaponics Systems

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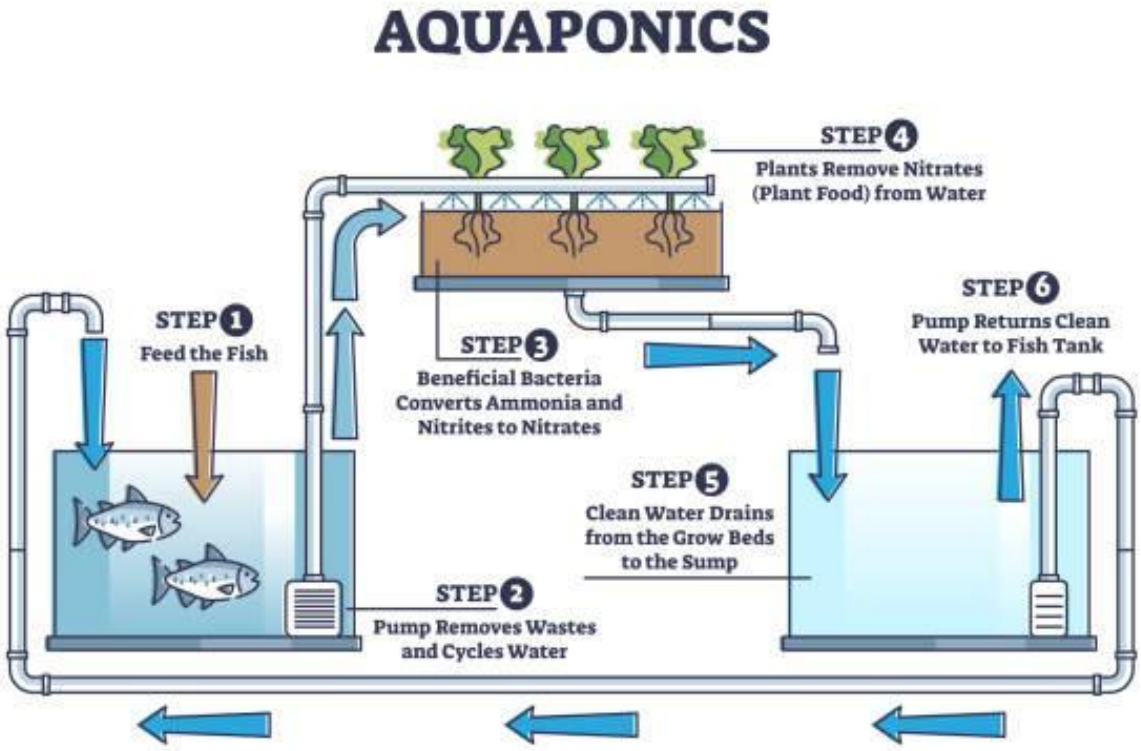
Introduction

The beginning of this experiment started with a project that started two and a half years ago. Called Space Spinner, this student project aims to develop a space station capable of reproducing artificial gravity to erase the effects of microgravity on astronauts. In addition to that, the space station can attach and detach habitable modules that are intended to create a base on the celestial body where they land. These modules, once installed, will have to be energetically independent, hence the interest in recovering a maximum of energy, and this is where the aquaponics experience comes in. The principle of the aquaponics system is the cultivation of fish and plants in a constructed and recirculating ecosystem using natural bacterial cycles to convert fish waste to plant nutrition. This is an environmentally friendly and natural food-growing method that harnesses the best attributes of aquaculture and hydroponics without the need to discard any water or filtrate or add chemical fertilizers. In the long term, this experiment could be used to recover some waste of the fish and create a compost. The heat of the accumulated compost could be used to turn a turbine that would produce electricity. However, to make this happen, we need to be sure that the fish live in clean water. Therefore, the first step is to check the good conditions of the aquarium they live in. The objective of this experiment is to install sensors that would deliver data to the astronaut in charge. Moreover, instead of going back and forth to the experiment site, adding a Bluetooth module

to allow remote data collection would allow the astronaut to save time and check the conditions of the aquarium whenever he wants.

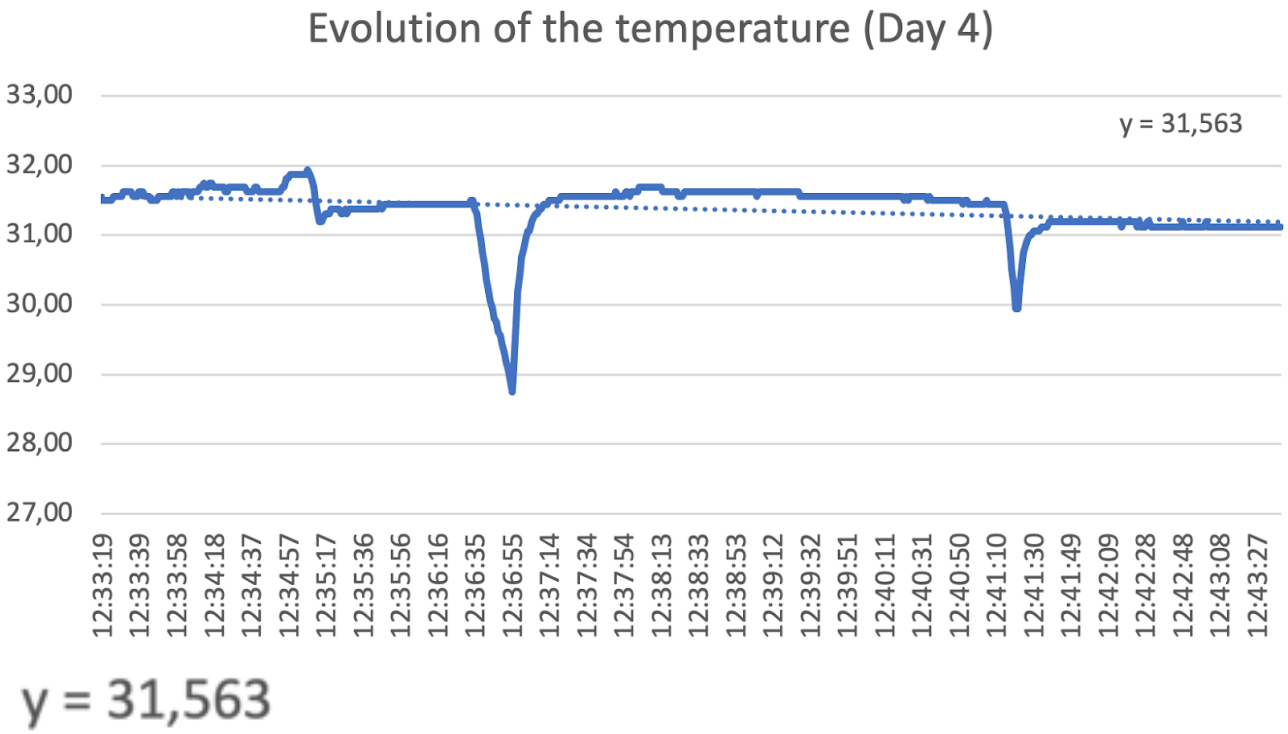
Methodology

A classic aquaponics system works like the following: a pump in an aquarium will transfer the water from the fish tank to another tank where there are bacteria and plants that convert ammonia and nitrites to nitrates that are beneficial for plant growing. The plants, by eating the nitrates, will act as a filter, and at the same time clean the water that will then return to the fish tank.



However, with this configuration, we can't know the condition of the water and that is why this experiment aims to install sensors. For the fish to survive, the water must respect certain conditions: it must have a temperature between 18 and 33 degrees, have a pH range from 6.5 to 8.5, and it should not be too blurry. To measure those conditions, a waterproof temperature sensor, an analog pH sensor, and an analog turbidity sensor will be implemented on this system and collect data to see if they work and if the water is in good condition. All these sensors will be programmed on Arduino.

Result and discussion



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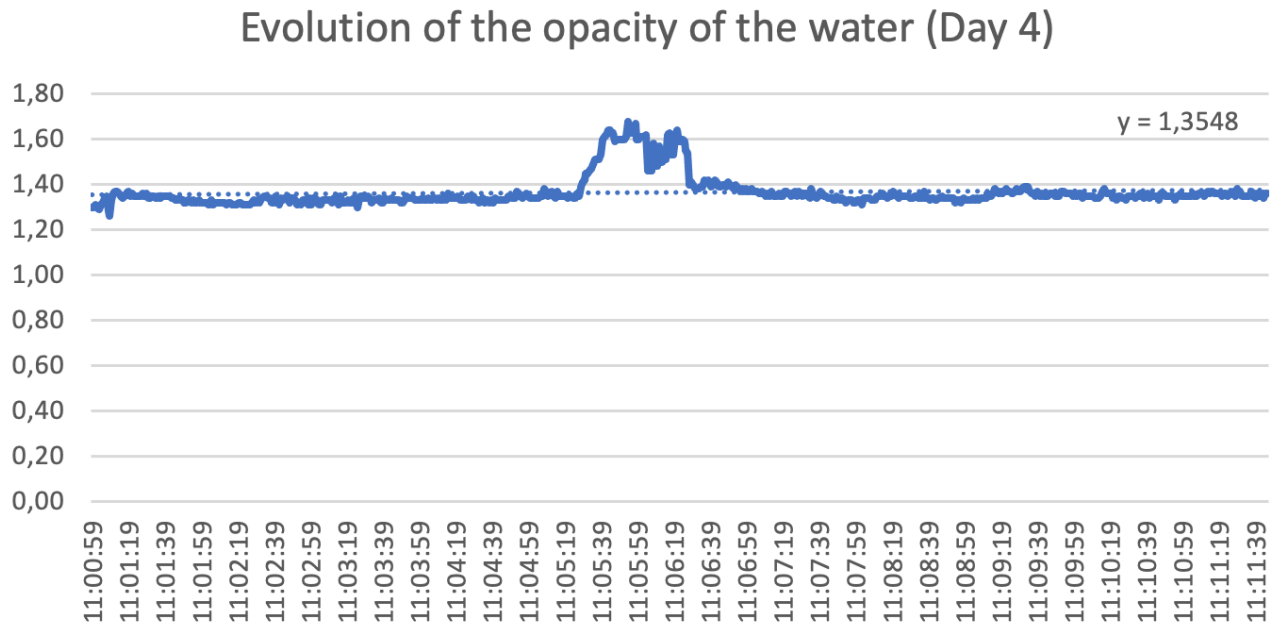
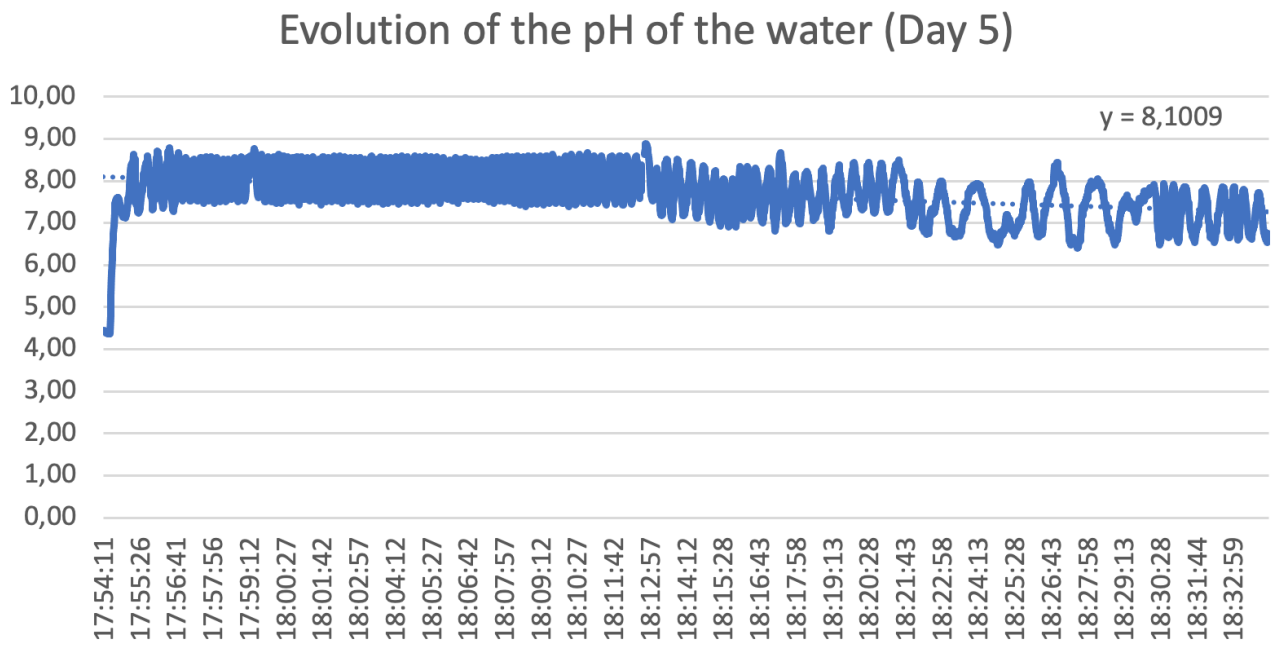
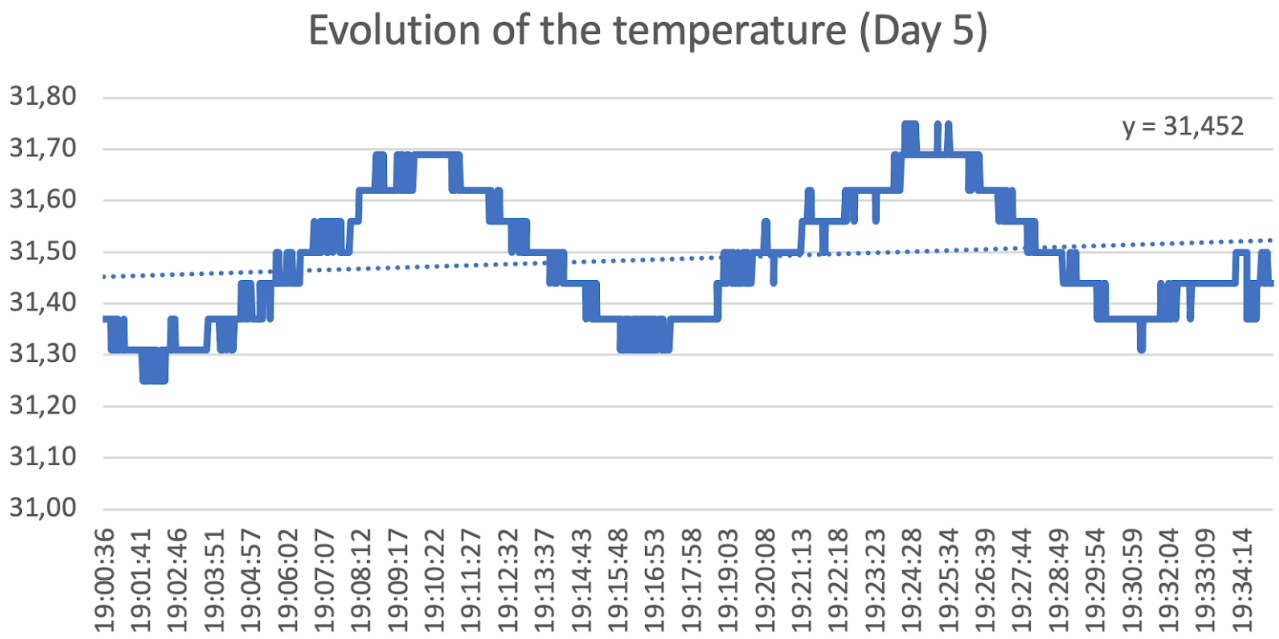
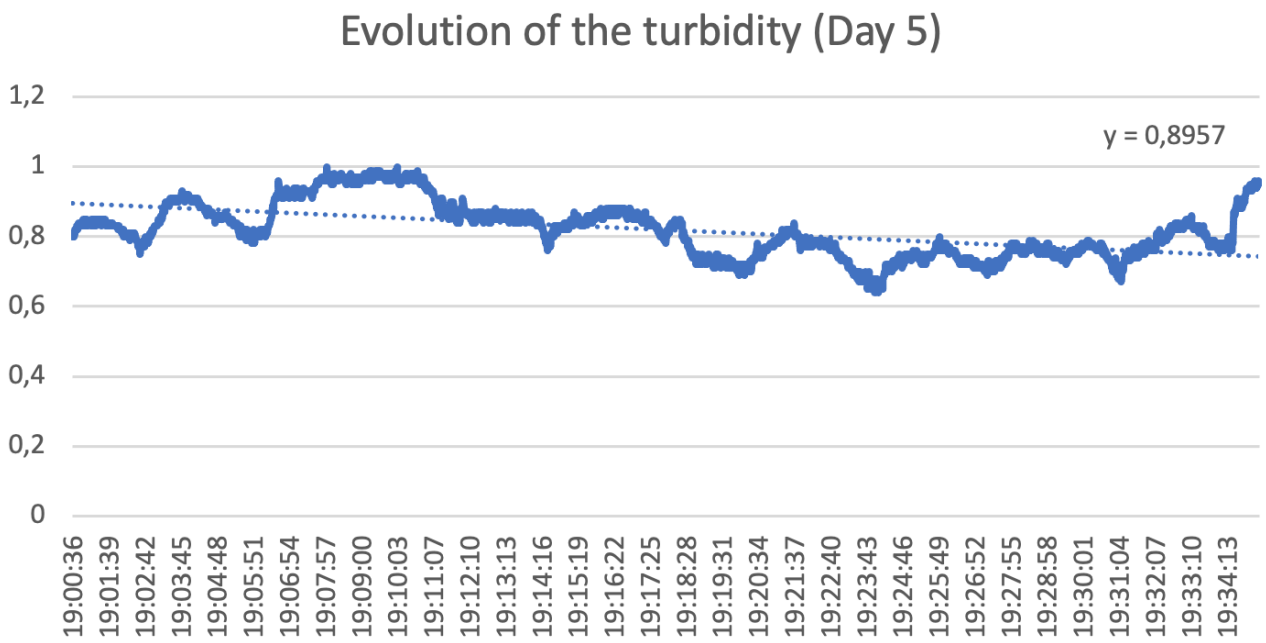


During day 5, the analog pH sensor was ready to collect data after a calibration:



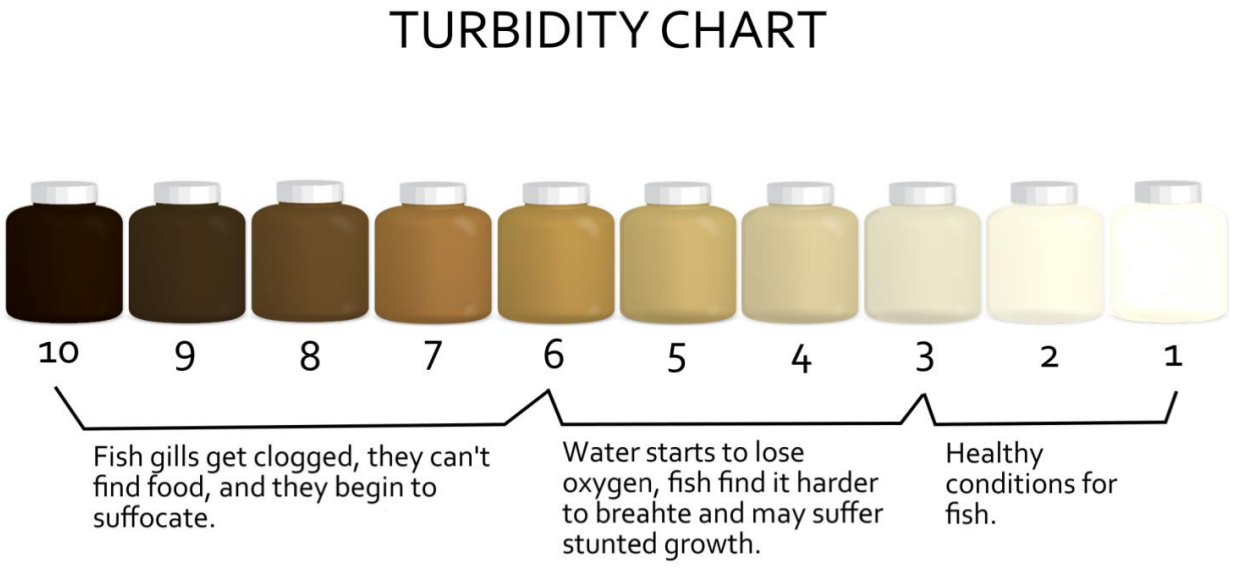
Regarding the temperature and the turbidity of the water, the data collection gave these graphs:





Conclusion

To conclude this experiment, three out of four sensors have successfully shown that they were operational. This means that almost all the sensors are operational and can contribute to the well-being of the aquaponics system. However, there are still two important points that haven't been fully developed for the experiment to be a total success. The water level sensor hasn't been used because of a programming issue that couldn't be solved in the given time, and the Bluetooth module couldn't transfer wireless data because of a similar issue. However, after putting more bacterial treatment on the hydroponics, the reaction of the cleaning of the water has been fast. In one night, the water went from a stage 4 to a stage 3 on the following scale :



Unfortunately, the sensor wasn’t in use when the photo was taken so it could not take measures on the turbidity of the water, but the value that we would have collected would have been higher than the data from day 5.

Expedition 59, Maë Bousseau, France

EMMPOL 17
29/05/2023 - 06/05/2023

Day 1

Since I woke up, I feel a little bit nervous. At first it was because I didn’t know which role I would have and then after becoming the commander, I was a little bit nervous about my responsibility during the emergency simulation. But after I was satisfied because I prepared the different scenarios, and I knew what I had to do during emergency simulations. I was also relieved because I could see that there was a good atmosphere.

Today, I cleaned the food storage, and I wrote all the steps of all different emergency simulation. After that I worked on my experiment. I connected my Peltier module in series, and I also connected my multimeter and checked how much my system produces voltage. Like my Peltier module transforms thermal energy into electrical energy, I tried my device with different temperature differences. I put my device closer to the heater and the air conditioner to increase the temperature difference. After that, I did my workout, and I was happy because I like sports, but I don’t really like doing cardio. But I was still glad because I want to improve my cardio, so it was a good opportunity. But it wasn't a pleasure because it was the first time for me to run on a treadmill

and like it was in a confined zone, with a wall just in front of me, it wasn’t not really pleasant.

Day 2

This morning I was a little bit nervous about the simulation. After I felt better and started to enjoy my day, I was in a really good mood. During the afternoon I worked on my experiment so I was focussed and enthusiastic and proud because my experiment was working. After I did my sport, I was supposed to collect data while I was running but it didn’t work properly because I couldn’t see my speed and my heart beat so I felt really frustrated. And I’m still a little bit frustrated because I had the feeling that some people were infantilizing me (for example they explained to me things that were obvious or talked to me with a superior look because I couldn't understand them because they spoke too fast with an accent I had never heard.

This morning I did the ventilator maintenance with David. So we vacuumed the filter to remove all the dust. After I did the PowerPoint presentation, I worked on my experiment. I put up 5 Peltier modules in series and measured the voltage, I also identified new heat losses.

Day 3

This morning I was kind of worried about the speech that I had to do to my crew but I was motivated at the same time because I knew it was important. Afterwards, I felt satisfied. During the afternoon I was kind of frustrated and upset because MCC asked us to re take the pictures, individuals and group, and it’s a task that takes us time and I wanted to work on my experiment so I was kind of upset about doing something that had already been done. Afterwards, I was happy because yesterday I thought that my experiment didn't work. finally it seems to work. After I worked out I felt drained but serene at the same time and also proud about my performances.

This morning, I wrote my speech and I planned a new schedule. After telling the crew what to clean, I cleaned the bedroom and the

shelter and I ate. We took a lot of photos with the crew and I worked on my experiment. After that, I worked out and I ate dinner.

Day 4

I was sleepy this morning and a little bit nervous because of the presentation that we had to do during the afternoon. Afterwards, I was still nervous because we're late for the meeting and still nervous during the meeting but relieved. After I was still stressed about my experiment I hope I will succeed in collecting enough data before the end of the mission. And after we had our emergency simulation. Surprisingly, I wasn't stressed but really focused and I really enjoyed it. During the evening I was just happy, sleepy and relieved (but still a little bit stressed about my experiment).
First of all,I did all the experiments, tests and measurements that we have to do. After I prepared the presentation that we had to do during the afternoon. After I started to work on my experiment and just before my sports session we had our emergency simulation. After I did my workout and ate dinner. Finally I filled in all the Excel sheets.

Day 5

All day I was motivated to work on my experiment and to collect more data. And during the evening I realized that others measurements would be more interesting for my experiment so I'm a little bit stressed because I don't know if I'll have enough time to finish all my ideas. As usual I did all the tests and measurements this morning. After we prepared breakfast, I worked on my experiment. After lunch I took a little nap and I continued to work on my experiment. I did my workout and ate dinner. I'm taking care of Shraddha because she's sick and I did all the tests for the evening.

Day 6

I was so sleepy this morning it was really hard. Then after I was focused and motivated on my experiment. Afterwards, I was a little

bit stressed because I was late on the schedule and I was worried about my report.
I ate breakfast, after I took a nap. And all day I worked on my experiment. I was late on the schedule so I did my sport after debrief and I ate late.

Thermal Energy Recovery

Maë N'Guyen Bousseau

EMMPOL 17
29/05/2023 - 06/05/2023

Introduction
This experiment is part “Space Spinner” project, a student project from the Institut Polytechnique des Sciences Avancées (IPSA) in Toulouse. Space Spinner is a gravitational space station that reproduces one-third of Earth’s gravity. The objective is to allow longer space missions without the negative impact of microgravity on the human body. Space Spinner can accommodate eight modules that can be detached and land on the Moon or even Mars. These modules are designed in order to optimize energy. This experiment focuses on thermal energy recovery by using heat loss in a Lunar or Martian base.

Aims and goals
The first purpose of this experiment is to collect data to see the feasibility and whether it is worthwhile to pursue more complex research.

Methodology
The experiment is based on the Seebeck effect, according to which a temperature difference induces a current. The Peltier module is a component that illustrates this effect. It transforms thermal energy into electrical energy. This module is composed of

two ceramic tiles, an insulator, and two thermoelectric materials which are bismuth telluride and bismuth selenide. These two thermoelectric materials are, to date and for the moment, the best thermoelectric materials known. In the first step, the goal of this experiment is to identify heat losses in a lunar base and to measure the temperature difference. In a second step, it is to measure the voltage and the current produced by these temperature differences and the Peltier module. A part of this experiment deals with the impact of the number of Peltier modules connected in series on the voltage and current produced. Finally, thirdly, the goal is to turn on a 2V LED with the heat loss that has the largest temperature difference.

Result and discussion

This experiment has been tested in a lunar base in Poland thanks to the Astronaut Analog Training Center (AATC) during the analog mission EMMPOL XVII. The average ambient air temperature is 25°C. The following list is the different heat losses identified in the lunar base:

- heaters, with a temperature of 90°C so the temperature difference of 65°C
- computer, with a temperature of 41°C so the temperature difference of 16
- 3D printer, with a temperature of 41,5°C so the temperature difference of 16,5°C
- astrobiologist's experiment, with a temperature of 95°C so the temperature difference of 70°C
- human body, with a temperature of 37°C so the temperature difference of 12°C
- saucepan (with boiling water), with a temperature of 100°C so the temperature difference of 75°C
- kettle, with a temperature of 87,5°C so the temperature difference of 62,5°C

This list is not exhaustive, there is also the fridge, the microwave, the furnace but those items were not used for practical reasons for this experiment. Due to the length of the mission, the availability of items, and in order to calculate an average, five measurements were made for almost all items. For each item, five different

systems have been tested, for some of them, six different systems. The number of Peltier modules varies for each system from 1 to 5 or even 6 for some items. For measurements with three or more Peltier modules, the experiment was performed with a 3D printing stand to hold the Peltier modules for easy handling.

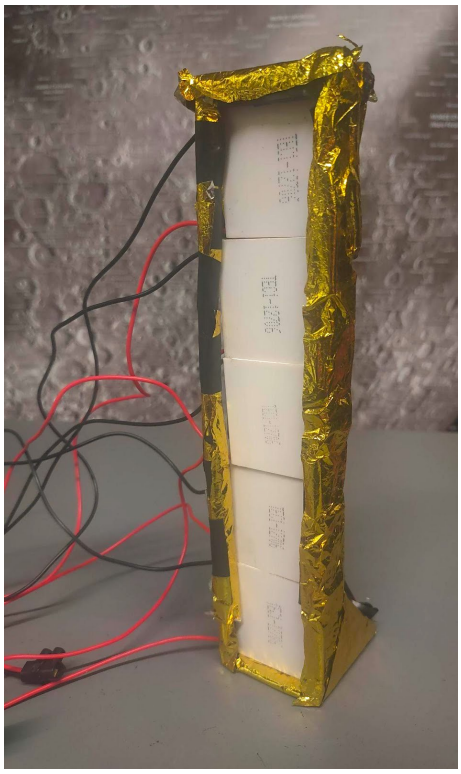


Figure 1. Peltier module support.

For experiments with circular items, Peltier modules were attached to each other with duct tape to fit the round shape of the item.

Here are the data below for each different configuration:

HEATER	average voltage (mV)	average current (mA)
1	338.2	51.48
2	585.8	71.25
3	922.2	64.64
4	1072.4	54.36
5	1276.4	58.06

6	1528.5	61.35

Figure 2. Table with the average of voltage in mV and current in mA produced by a heater depending on the number of Peltier module.

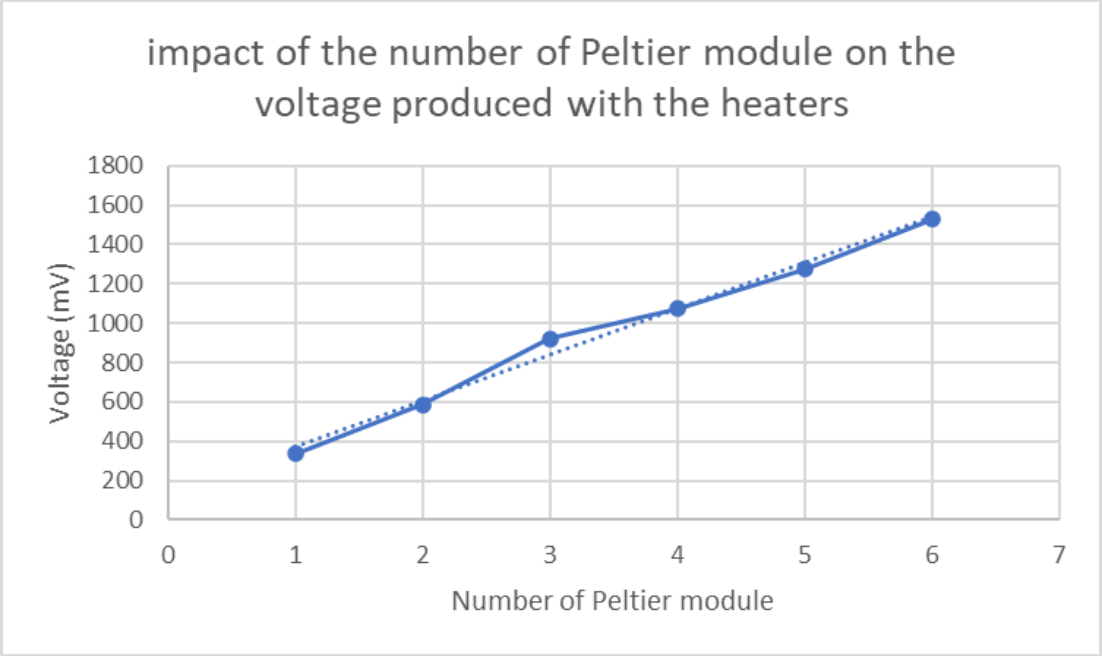


Figure 3. Evolution of the voltage produced by a heater as a function of the number of Peltier module.

This result shows that the function that relates the voltage, produced by a heater, to the Peltier module number is linear.

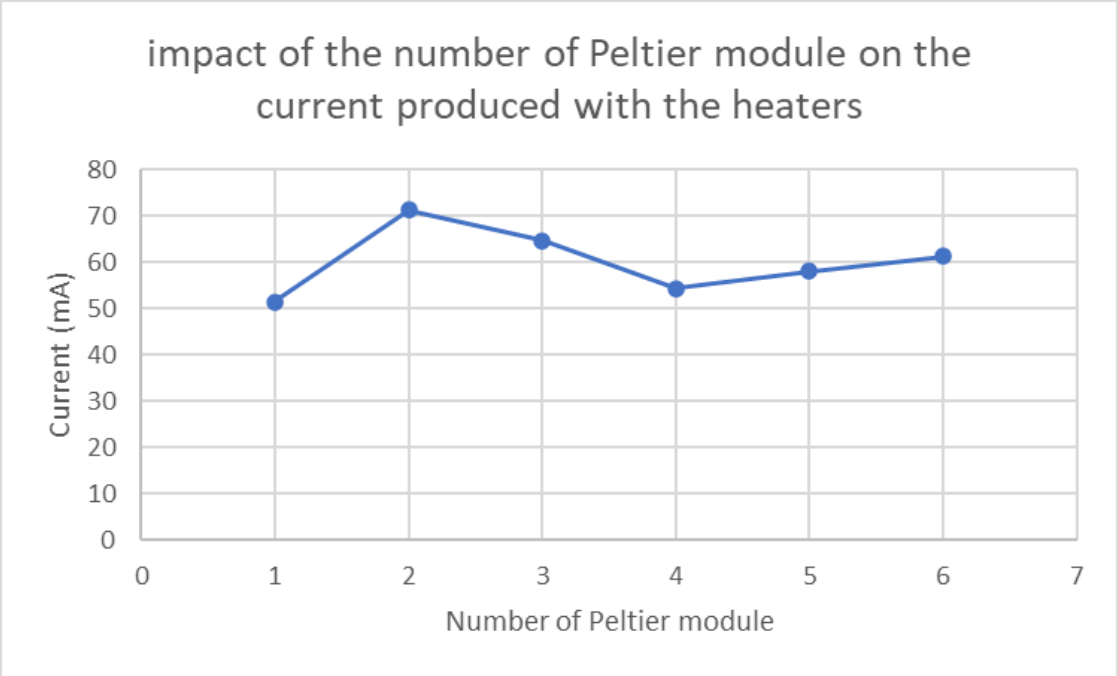


Figure 4: evolution of the current produced by a heater as a function of the number of Peltier module.

This result shows that the current, produced by a heater, is between 50mA and 70mA, no matter how many modules are connected in series.

Computer

Figure 5. Computer in the lunar base.

Computer	Average voltage (mV)	Average current (mA)
1	145.4	30.06
2	179	12.298
3	229.6	15.216
4	338.8	25.16
5	328.8	13.874

Figure 6. Table with the average of voltage in mV and current in mA produced by a computer depending on the number of Peltier module.

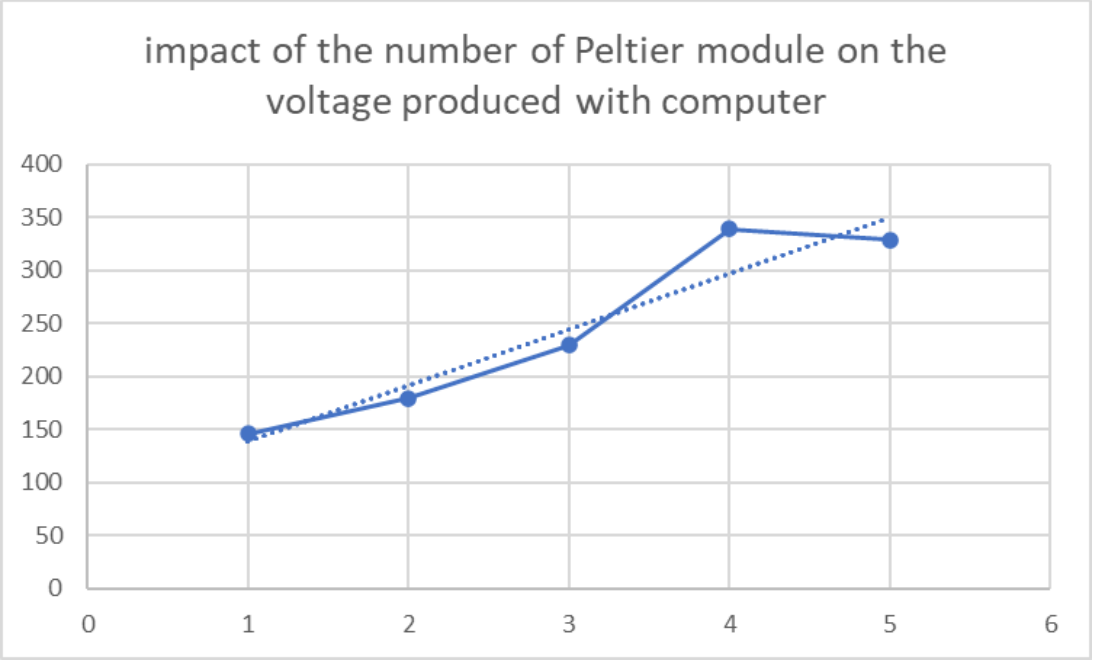


Figure 7. Evolution of the voltage produced by a computer as a function of the number of Peltier module.

This result shows that the function that relates the voltage, produced by a computer, to the Peltier module number is linear.

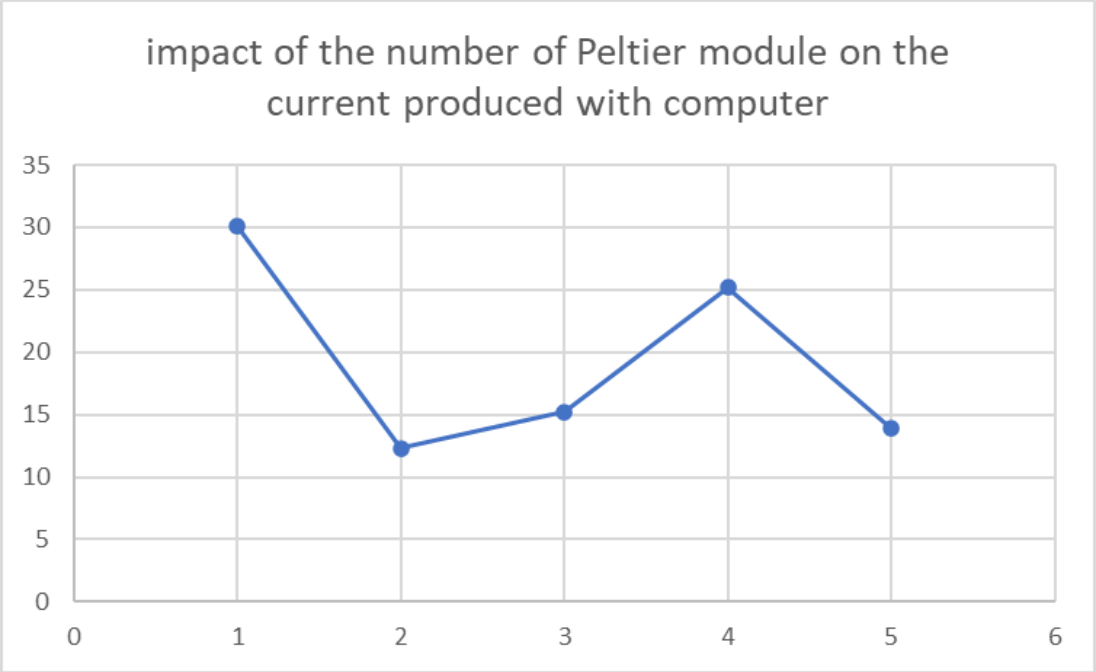


Figure 8. Evolution of the current produced by a computer as a function of the number of Peltier module.

Due to the unavailability of the computer, the measurements with one and four Peltier modules were made one day later than the other measurements and the computer was probably warmer. This result is not treatable.

3D printer

3D PRINTER	average voltage (mV)
1	69
2	317
3	697

Figure 9. Table with the average of voltage in mV produced by a 3D printer depending on the number of Peltier module.

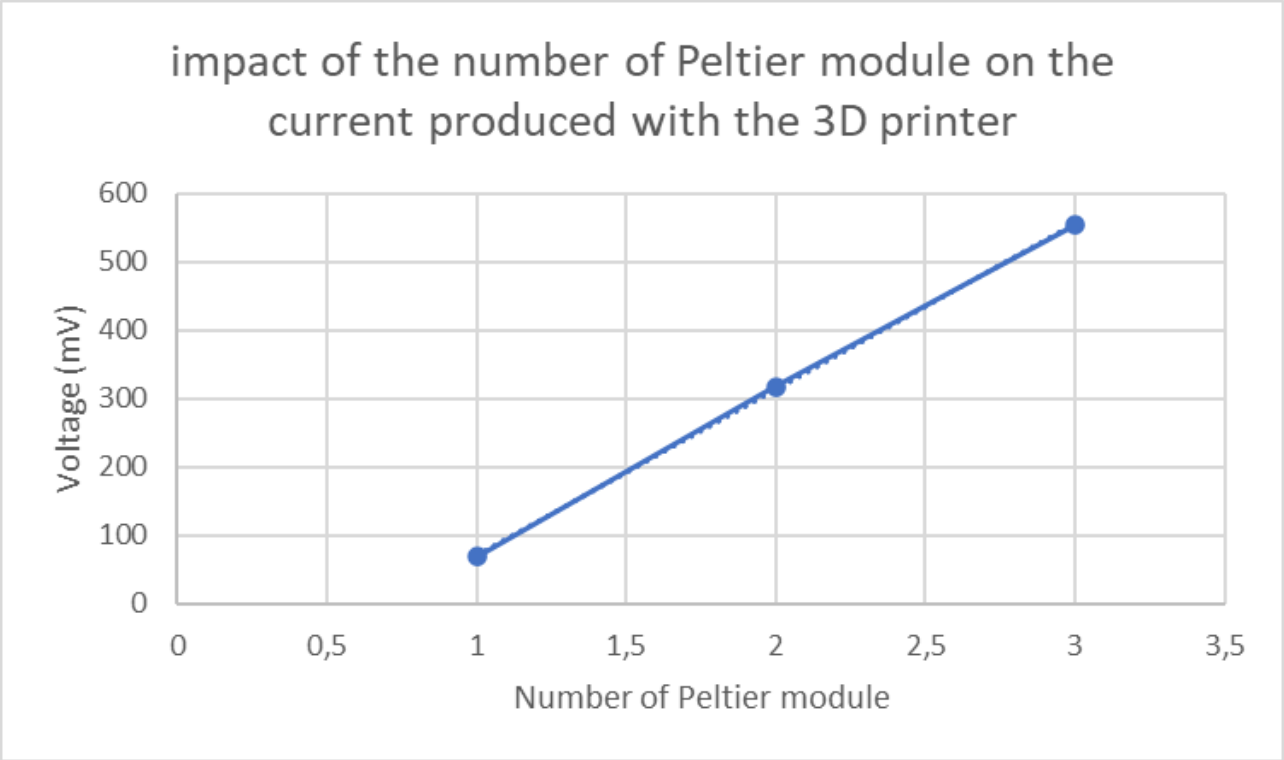


Figure 10. Evolution of the voltage produced by the 3D printer as a function of the number of Peltier module.

This result shows that the function that relates the voltage, produced by the 3D printer, to the Peltier module number is almost perfectly linear. Due to a malfunction of the 3D printer, some data is missing, especially for the current.

Astrobiologist's experiment

ASTROBIOLOGIST'S EXP.	average voltage (mV)
1	80

Figure 11. Sample from astrobiologist's experiment.

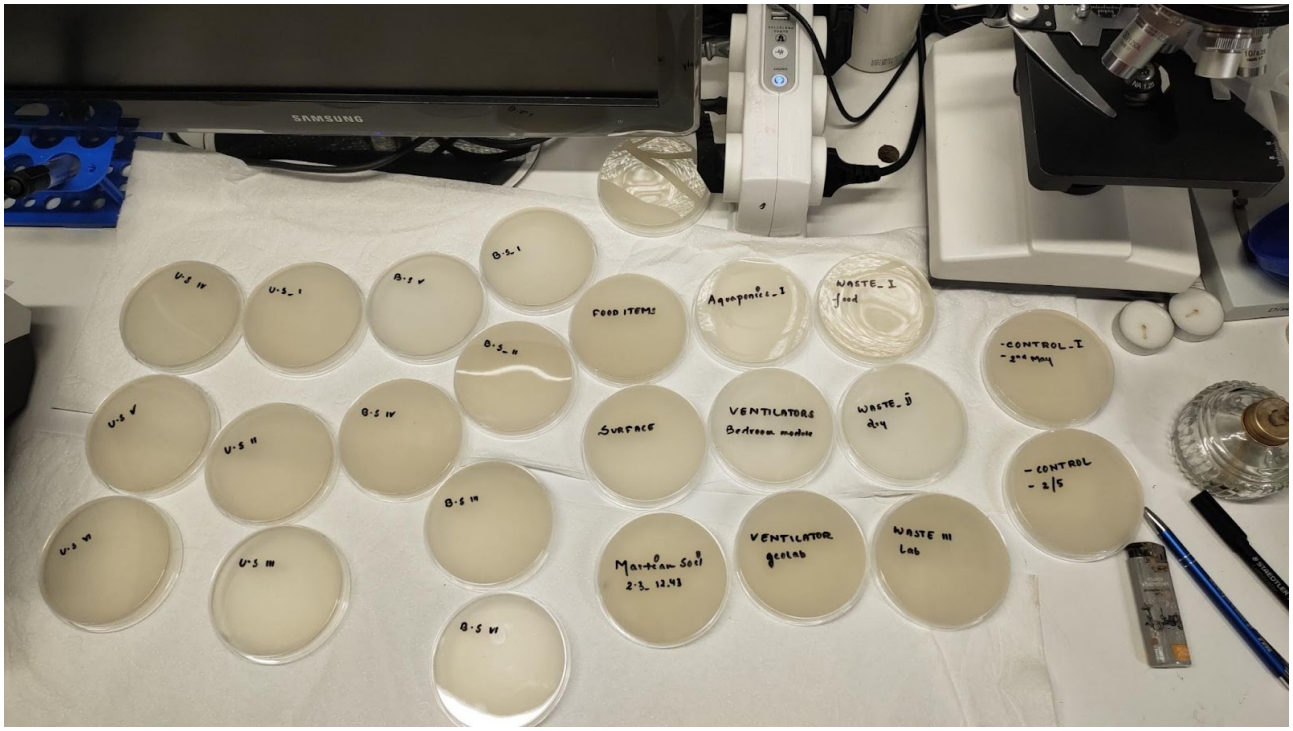


Figure 12. Voltage produced by the hot solution for agar sample with one Peltier module.

To prepare these samples, the astrobiologist has to make a solution composition of 5 % agar from the powdered sample. Further the solution was heated in a microwave till the temp reaches 95 °C which made the agar dissolve fully and make it a

transparent jelly like structure. The astrobiologist's experiment was only able to provide one data through this hot preparation. This data was recorded in order to diversify the item even if the result is untreatable.

Human body during sport session

HUMAN BODY	average voltage (mV)	average current (mA)
1	63	–
6	613	35.3

Figure 12. Table with the average of voltage in mV and current in mA produced by human body depending on the number of Peltier module.

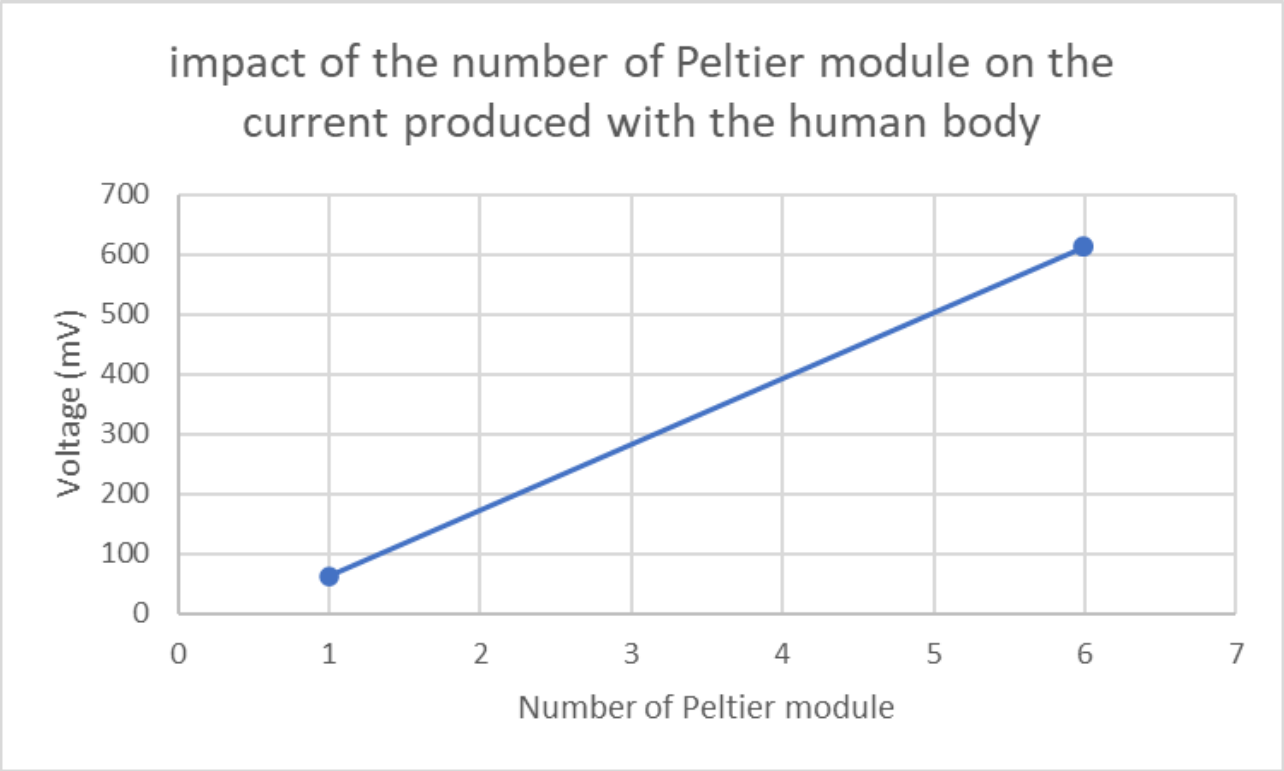


Figure 13. Evolution of the voltage produced by the human body during a sport session as a function of the number of Peltier module.

According to this graph, there is a factor of ten between a system with only one Peltier module and a system with six modules.

Saucepan

The experiment with the saucepan was completely successful. The picture below shows that this configuration produces 12.37 V with only six Peltier modules.

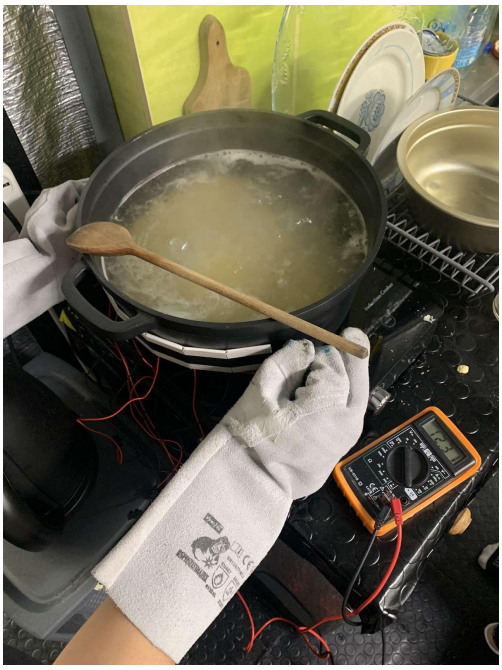


Figure 14. Voltage generation with Seebeck effect and a hot saucepan.

Kettle

This experience with this item was a success. It achieved the third goal of this experiment which is to turn on a 2V LED.

Conclusion

This experiment was ambitious, uncertain but the first results of this experiment are encouraging. Even with low means and little time, there are optimistic results. Now that we know that the data is measurable and powerful enough to power small electrical components (even maybe bigger ones), we can now investigate further. We can optimize the Peltier module itself by searching for new thermoelectric materials or by reducing telluride bismuth into grains in order to increase the efficiency of 40% according to a study conducted by Gang Chen, Mildred Dresselhaus (MIT) and

(Boston College). Or for example, by looking for a way to keep one side of the Peltier module cold to keep the temperature difference and thus generate energy on a longer term. We can also perhaps use concrete applications for this system. For example, a table where you could work with your computer and generate energy at the same time thanks to the heat loss of the computer. We can also think of a kind of partition or wall that could surround a kitchen and thus use the heat losses produced during the preparation of the dishes. This experiment is very promising and deserves to be pushed further. To be continued…

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Structure Study of Bulk Nanograined Thermoelectric Bismuth Antimony Telluride: https://pubs.acs.org/doi/10.1021/nl803235n

Expedition 59, Upasana Mohanty, India

Cosmic Chronicles: Journey of the Lunar Explorers

From gazing at a moon lamp to donning a space suit in a lunar base, my journey as the Vice Commander in Analog Astronaut Training Center, EMMPOL 17, representing INDIA has been nothing short of extraordinary. As a self-proclaimed Selenophile, my

passion for lunar exploration was unparalleled. Little did I know how deeply this mission would ignite my lunar dreams. It all commenced with the spirited onboarding of six enthusiastic crew members into the spacecraft – a vessel pulsating with the thrill of anticipation, excitement, and a touch of unknown anxiety. The commanding voice resonated like a cosmic wizard, enchanting us as the field beneath us began its rhythmic roll," The estimated time to arrive in the lunar orbit will be around 180 minutes. I hope a great journey and adventure and a safe journey back to Earth."

Let me take you through this thrilling adventure!
As the countdown echoed – 10, 9, 8,7,6,4,3,2,1,0, LIFT-OFF!

The Earth's surface retreated into the cosmic rearview mirror, leaving us in the wake of a celestial departure, bidding a temporary adieu to our beloved blue planet.

- **Mission Day 1: Initiating the Cosmic Choreography**

The onset of the 12-day simulation mission marked an enthralling challenge. Days unfolded with a blend of isolation, reflection, and meticulous preparation for the cosmic tasks ahead. The routine metamorphosed into a relentless 20-hour workday, pushing the boundaries of our endurance. Cut off from the terrestrial realm, our lifeline remained the constant contact with the Mission Control Center (MCC), steering us through the cosmic expanse. The awakening on a particular day greeted us with an otherworldly sight – instruments adorned our bodies like avant-garde attire, resembling a peculiar fusion of futuristic Armor and a cutting-edge art installation. It was as if we were transformed into walking experiments, our every move scrutinized. Sooner or later our body's circadian cycle started falling into place, every day starting with the daily report of urine, sleep, pre-meal glucose test, bioimpedance, sports report, moron test , space dragon Romania experiment, and Atlas the HOF experiment. Day by day, time passed. We kept track of everything, from the colors in our dreams to how long we slept. Managing the team, understanding everyone's needs, solving problems, and helping with equipment took up most of my time. I only had a chance to do my experiments when I sacrificed some sleep. Surprisingly, each

morning, I felt more energetic with less sleep. It was like some magical energy was talking to me, and I had to make the most of it. The message was clear: if I didn't act now, I might never get the chance.

- **The Unforgettable Day: A Cosmic Curveball**

A night without sleep, filled with exhaustion and anxiety, reached its peak. However, witnessing the Earth rising through the spaceship window made it all worthwhile. We hastily captured the moment, sending a picture through MCC to Earth, marveling at our beautiful planet. This kick-started the day, disrupting the routine with lunch preparations. Cooking accompanied by music became a cherished part of our daily routine. After a prolonged period, we finally had a satisfying lunch. Amidst this, someone whispered,
-“Dear crew, let's grab a quick nap.”
Subtly, all eyes darted toward the CC camera, and without uttering a word, the crew stealthily made their way to the bedroom module.
Within moments, a commanding voice pierced the air, shaking the serenity, "EMERGENCY, CREW! EMERGENCY, CREW! Asteroid approaching in T-15”.
-“Swiftly head to the rescue module, Up your safety suit, and stay calm."
“Head's up, crew! Two minutes left," warned the voice over the intercom.
"Main switch off and run towards the rescue module," commanded another voice.
Tuckkkkkk! The lights went off, ventilators ceased their hum, and darkness enveloped the space. Emergency lights flickered with an eerie green hue.
-"Crew, let's stay calm and figure out what can be done," suggested one of the crew members. The commander and the electrical officer hurried to fix the defect, while I, along with the medical officer, attended to the rest. We monitored retinal enlargements due to the 3Fs:fight flight, Fright and checked the beat per minute, observing how each crew member reacted to the emergency.
-"Breathe slowly," someone advised. "We're consuming more oxygen than needed."

-"We're getting cold; try to stay close and warm up," another crew member suggested.
-"Someone, please check; she is fainting."
-"Stay awake! You can't fall back now. We need you to stay with us.
“STAY WITH US."
These moments are still etched in my mind to this day. Not immediately, but gradually, things started to come under control. The coordinates of the defects were transmitted, the chip was fixed, switched on, and the ventilator resumed its operation.
We did it, EMPOL 17. We successfully navigated through the last phase of Mission Day 4.
**Mission Day 4 ends **

- **Mission Day 5: Echoes of the Galactic Melodrama**

Regrouping after the tumultuous night, the subsequent day brought a fresh wave of experiences and the lingering echoes of the unforgettable cosmic event. Racing against time to conclude experiments, compile results, and craft the final report, we found ourselves on an unexpected detour – an online telecast to Earth, narrating the quirks and curiosities of our cosmic existence.
A question emerged from Earth that would make even seasoned astronauts chuckle: "How does space smell?" Suddenly, our cosmic exploits took center stage, and as the Earthbound audience awaited our response, we reveled in the absurdity of our spacefaring existence. The light-heartedness of the moment punctuated the gravity of our mission, providing a brief respite before our imminent return to Earth.

- **Mission Day 7: The Cosmic Homecoming**

Finally, the day arrived. Yes, we were coming back to Earth, landing on our home planet. Everything was prepared, everyone was in their places, and there we were, heading towards our, Dear Earth. It felt like Earth was pulling us with its gravity. When we landed, the door opened with a "hussss" sound, and a strong wind blew into our faces. The sunlight was blinding; after days of isolation, we could hardly open our eyes. It was a sunny day, and the darkness over the brightness spread all over our eyes. Taking the first steps

on Earth felt amazing, experiencing gravity, the smell of nature, and breathing oxygen. It made us realize that unless we are deprived of something, we may not fully appreciate everyday things like sunlight, oxygen, and the beauty of nature. The smell of Earth, the warmth of sunlight, and the familiar pull of gravity were overwhelming after days in space. Every step on solid ground felt like a revelation, a celebration of the mundane joys that we had temporarily left behind. But the cosmic curtain hadn't fallen yet. Post-isolation tasks beckoned, introducing us to the challenges of scuba diving and enduring hypothermia tests. The absurdity of these trials, juxtaposed against the vastness of space we had just traversed, reinforced the resilience forged in the crucible of our lunar exploits.

"***As I compare the picture of me gazing at a moon lamp to one of me wearing a space suit in a lunar base, I am reminded of the transformative power of dreams and the limitless possibilities that lie beyond our earthly boundaries. Here's to future adventures and the pursuit of the unknown***!"

Expedition 59, Shraddha Gunjal, India

EMMPOL 17

29/04/2023- 06/05/2023

Day 1

I woke with some headache because I travelled lot of so I was frustrated and very nervous but after the breakfast I feel better and i'm started working on my own experiment with chill mood and I was very excited to do today's training session. After the breakfast I just started working on my own experiment, first I google it what I don't know about the experiment, I found many research paper about that and I wrote some main things about experiment on the paper I did gym only for 30 min because I had a headache while

gym I did all the activities of today's training session, I did chimp test, circadian, STP Test, urine test.

Day 2

I was woke up with lots of energy because I should do my experiment, I was very excited to do that, I have already done with basic information, but for 1st try, I don't get a perfect texture so I was nervous, and tried to make it again it's again failed, I was frustrated, had headache and vomiting, after that listened some music, get motivated and finally, I tried my best, I am happy.
Firstly, I finished my daily activities STP test, sleep report, chimp test food intake, urine, water after the daily activity I started my experiment, I was fail for 2 times in my experiment, because there is problem ratio and heat, after 2 times, third test was successful I was so happy I took the samples for my Petri dishes from each astronaut’s mouth sample and fingerprint.

Day 3

I woke up with sleepy mood, did all the activities like STP test, sleep report, chimp test other too, in all day I felt nervous because lack of communication skill of mine, but tried to make me motivated.
Firstly I woke up and did all the activities of morning session and after that breakfast, I naked up breakfast today after that I taped my Petri dishes, I did moron test and wrote half report my experiment, I did my sport session for 50 mins I took some group photos.

Day 4

I woke up on 7 o'clock in the morning, I literally what is going with me because i know I am taking pictures because I want to capture moments in my life but I am doing my work too I am doing my experiment and helping to other crew also in making food or cleaning then what??? I know I have lack of communication but I

am trying to change myself, I literally feeling nervous for that, In whole world nobody can be perfect. Still no growth finding on my samples, halfway done with reports, I did my daily activities during the emergency situation, I enjoyed it but I already have some health issue so feeling tired now need sleep.

Day 5

I'm woke up with some sleepy mood but after a cup of coffee. Make me better and happy after the breakfast I did my morning session left work today we was very tried so the afternoon nap was so helpful after the nap I feel well, I'm happily going taking care of my cockroaches when I went to my sports I don't know why I'm throwing up after the sports but because of that I'm feeling very tired by the way, day well spent. Today firstly I did my morning session work, taking care of my cockroaches, after that I did my experiment work, working on reports of experiment after the lunch I did cleaning

BIOCONTAMINATION STUDIES IN ISOLATION

Introduction

To analyze the microbial purity of the Habitat Using the petri dishes with agar medium

Aims and goals

To analyze the microbial purity of the Habitat

Methodology

MICROORGANISMS ARE EVERYWHERE

In this session we will observe and isolate some of the microbes that normally inhabit our skin and throat, the air surrounding us, the soil and the surfaces of common objects such as mobile phones, computers, the lab benches, etc... We don't intend to carry out a deep characterization of these environment microbiota so we will observe only a small part of the microbes living in these habitats. Many of the microbes present in the analyzed samples may grow poorly, or not at all, on agar surfaces. Maybe the nutrients are not appropriate or the Oz tension too high. We will observe mainly

strict or facultative aerobes that do not require very specific or complex nutrients, as this is the kind of microbes that grow on nutrient agar (which is not an especially rich medium). Other factors that will be limiting the growth of microbes are pH and osmotic pressure, which could be different in the culture medium than in the natural environment. First, we will isolate the microbes and then we will study their morphology, mobility and Gram staining. In addition, we will also use minimal medium as well as some selective media to see how different media retrieve different portions of the microbial diversity**.**

PREPARATION OF AGAR MEDIUM

- Count a correct proportion of agar with water
- I take 20 g 0f agar for 15 dishes with 400 ml water
- Wash your hands with ethanol constantly,
- all requirements should be very clean
- After measuring the constant proportion mix water with agar
- stir up until agar mixed well
- Turn ON the microwave ,
- Microwave the solution for 4 to 5 mins ,after each 30 mins check the solution and stir it again and again
- Be careful with solution because its very hot , Use the gloves for protection

PREPARATION OF PETRI DISH

Petri dishes are small flat-bottomed containers made of clear glass or plastic. They have two halves - a top and a bottom - which slot into one another. This protects the contents from any unwanted contaminated air, but also allows any gasses produced by the bacteria to escape. Petri dishes must be completely sterilized before they are used for growing bacteria, otherwise, the results of the experiment could be affected. Newly purchased Petri dishes should come pre-sterilized and sealed in plastic packaging.

- fill up every petri dish with agar medium
- Expose those dishes to cool down by covering plates
- Then agar medium will be solidified after 30 to 45 mins

- After the dishes cooled down, collect the mouth sample that is saliva and fingerprints from each analog astronauts
- And for other , dishes will be in each module for three hours
- When all the samples will ready decorate the Petri dishes nicely
- Then put all the Petri dishes in gloves box
- Set the temperature at 25

STAINING

- A smear of the test was created using sterile procedure by pouring a drop of water on the slide and then transferring a little piece of the colony there using a sterile, inoculating loop.

- The inoculating loop caused the cells to spread in a circular manner.

- After allowing the smear to air dry, the smear was heated to fix it

- The smear was stained with crystal violet stain and left alone for a minute

- The slide was cleaned with tap water after Gram's Iodine had been applied to the smear and left alone for a minute.
- 95% ethyl alcohol was used to decolorize the smear
- The slide was air dried after washing with tap water, stained with the counterstain Safranin, and examined under a microscope after one minute of inactivity.

Result and discussion
In this type of experiment, bacteria is transferred directly to the prepared petri plate via direct contact

Conclusion
So, you will see bacterial growth or microorganisms are on the agar in Petri dish with the help of microscope

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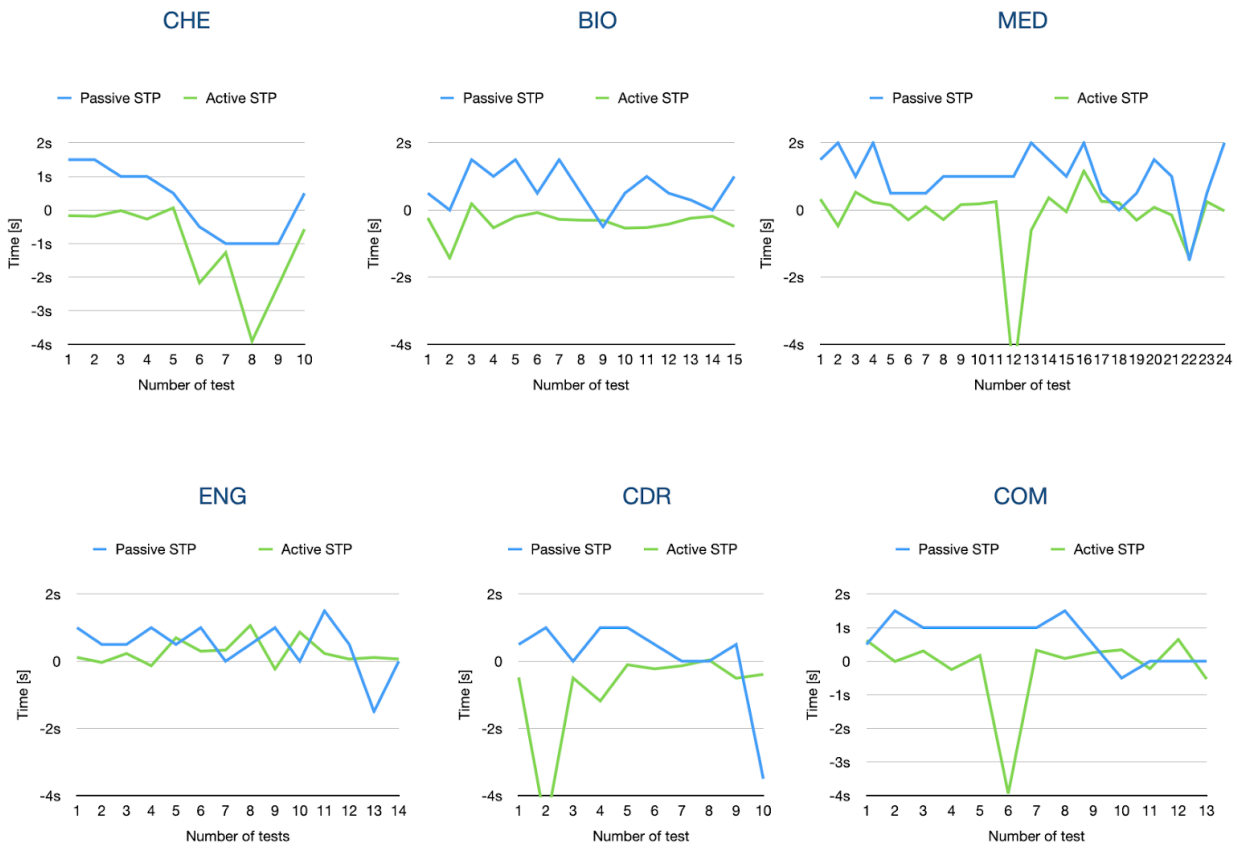
https://www.wikihow.com/Grow-Bacteria-in-a-Petri-Dish

https://www.snexplores.org/blog/eureka-lab/five-second-rule-growing-germs-science

Expedition 60, Cognitive report

MCC, EMMPOL 18

15/05/2023 - 20/05/2023



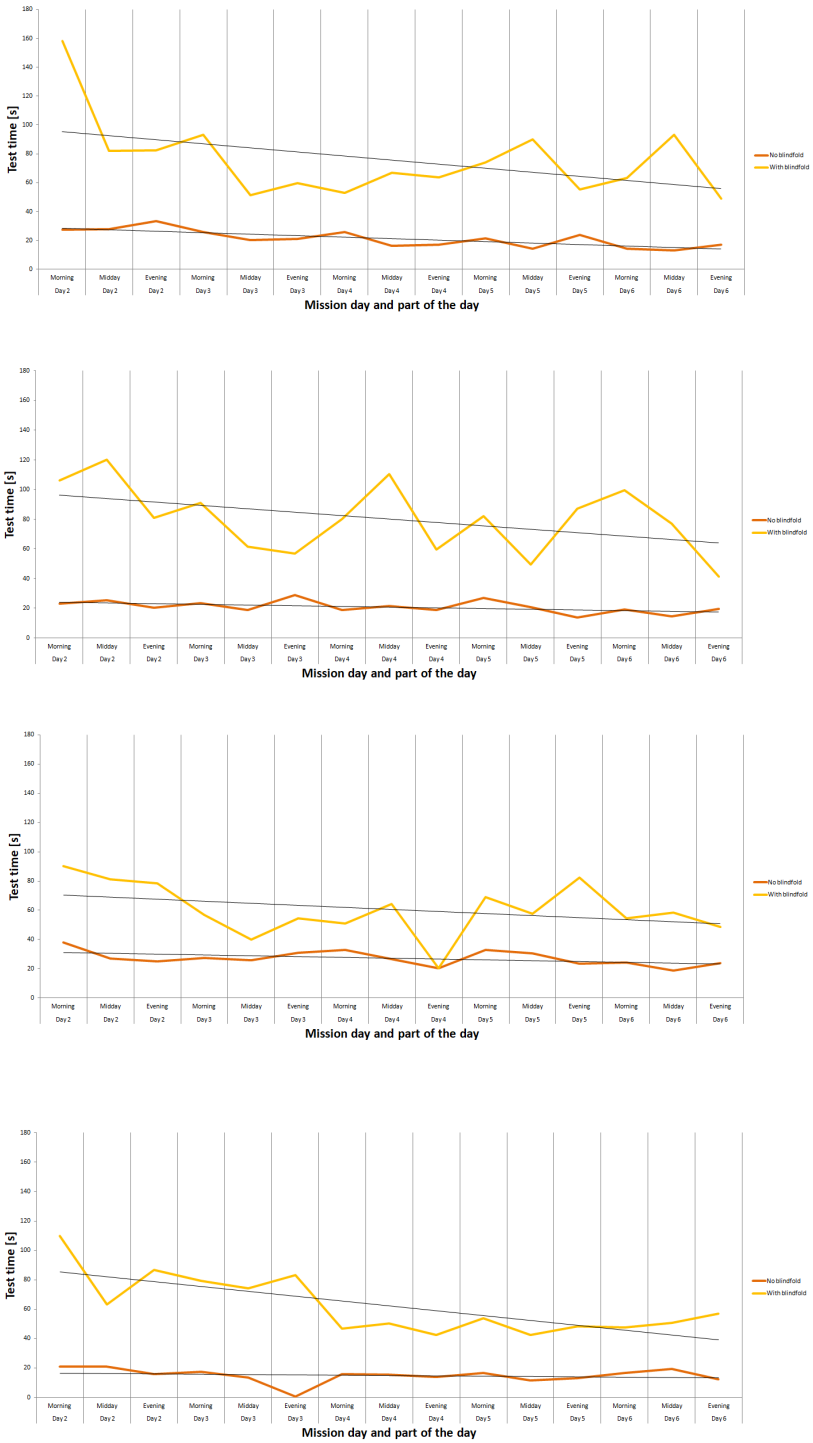
The crew was isolated for 7 full days. During day 1 the crew was adapting to the new situation and new stimuli. The main stimuli affecting cognitive functions were light conditions, CO2 elevated levels, noise, diet, procedures and elevated stress exposure caused by lack of privacy, time regime and low level of communication with MCC.

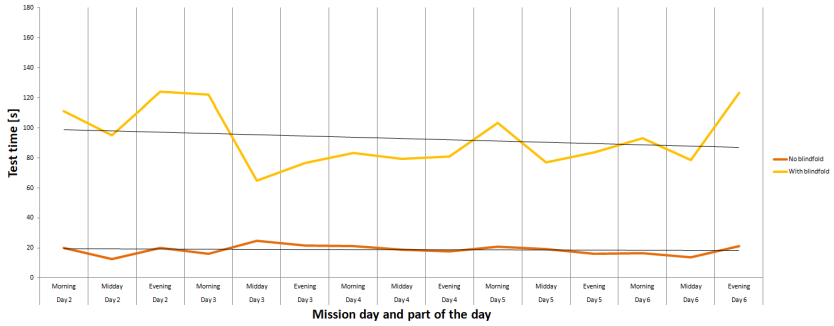
Several methods were used to monitor crew considering cognitive performance:

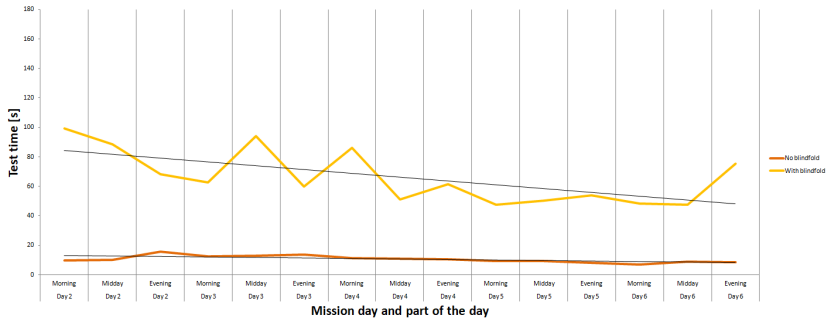
Moron test, measuring the reaction time of inserting 11 dedicated bolts into a square plate equipped with 22 slots. For each round of the test two measurements were taken - reaction time without blindfold and reaction time with blindfold. The following graphs present results for all crew members (figure 1). Black vertical lines

separate each mission day. A trend line is also drawn to indicate increase or decrease.

Figure 1. Linear charts of both Moron Test variant reaction time for every crew member.



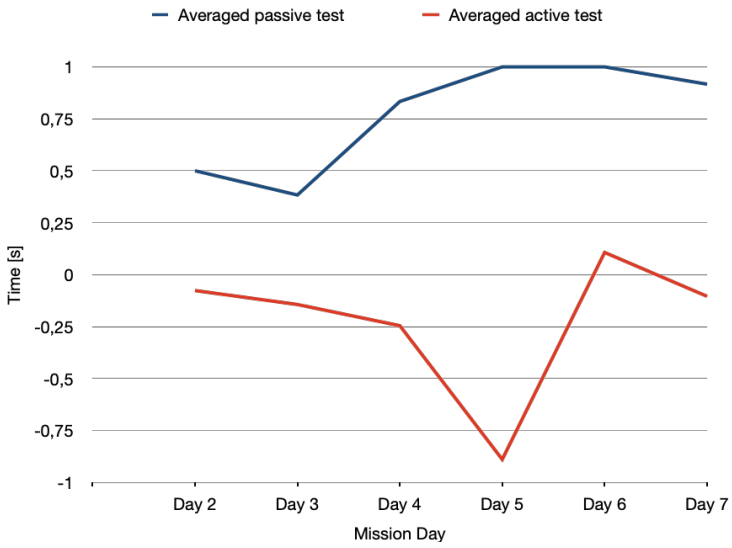




Based on results listed above, it can be seen that for all the crew members a decrease occurred in reaction time while taking the test blindfolded. The highest progress was made by Pierre (almost 10s difference between the first and the last day for the blindfold variant). For Romaric, Tom and Stan, reaction time without the blindfold oscillated the least. For most of the crew members, best times were noted in the evening, and the longest in the morning. The highest oscillations of reaction time values for the blindfold Moron Test can be seen in Diksha, Tina and Romaric's graph. Multiple probable hypotheses can be made about enlisted conclusions, associated with being well-rested in the morning, as well as exhaustion and focusing problems after a tiring day.

Subjective Time Perception Test, measuring passive and active time perception. Passive perception was based on random emission of the visual stimulus for a set time followed by a question how long the emission of the object lasted (visual reaction only). Active perception was based on emission of the object followed by a question for mimicking the same time of exposure by finger (visual - motor reaction). Averaged times of active and passive tests were computed by subtracting seconds guessed from

seconds set (guessed-set). This graph is not complete because of missing data from some analog astronauts however an interesting trend can be observed. In particular: in case of passive test guessed time is longer than set time, so subjective time perception is slower, while in case of active test analog astronauts have a tendency to underestimate the time, so guessed timing is shorter than set time.



Individual screening was unfortunately not possible regarding days of the mission. Some analog astronauts were not performing the test regularly, they skipped several days of the mission. However based on obtained data there is a possibility to visualize results considering the number of performed tests. The minimal number of conducted tests was for Tina and Diksha (10 uses of STP application). The largest amount of conducted tests was for Tom (24 uses). Stan performed the test 15 times, Pierre 14 times and Romaric 13 times. The hypothesis was that analog astronauts will learn how to improve the final result of the test and that the number of conducted tests will correlate with improvement of accuracy. However no such phenomenon has been observed.

Expedition 60, Stanisław Sękara, Poland

EMMPOL 18
15/05/2023 - 20/05/2023

Impact of silver nanoparticles solution on *Pleurotus ostreatus* mycelium growth.

1. Introduction

Fungi serve a significant purpose in matter circulation. It is on account for their ability to decompose complex substances into simple compounds. Strict isolation facilities, such as the ISS or AATC Habitat were forced to develop efficient waste-management solutions, in order to generate as little spare substances as possible. Mentioned process should not be energy-consuming and efficient at the same time. If listed conditions are fulfilled, facility not only should consume fewer amounts of energy, but also become partly self-sustainable. This, on the other hand, generates lower expenditure used to sustain and further develop the facility. Silver particles possess biocidal properties. Preparations containing this metal can be used to control biological parameters of equipment, as well as prevent it's contamination. Fungi-based organic matter decomposing system can not contain any kinds of substances or microorganisms, which have a destructive impact on the fungi. *Pleurotus ostreatus* enriched with silver nano-particles can serve as such system, not prone to destructive substances and microorganisms. Nonetheless, it remains uncertain how the presence of these nano-particles would influence fungi's mycelium. It might not only reduce foreign microorganisms amount and substances' influence, but also inhibit fungi's growth and functionality. The effectiveness of described system can be also dependent on the environment it was prepared in. If the surroundings are not sterile, silver particles' presence can prove insufficient. In habitat, there is a glove box equipped with UV lamp. It remains uncertain if it provides enough sterility.

2. Aims and goals

Examining the impact of silver nanoparticles' on *Pleurotus ostreatus*' mycelium in habitat conditions. Determining, if *Plerotus ostreatus* enriched with silver nanoparticles can serve as efficient matter recirculation system.

3. Methodology

In order to perform the experiment, following items and substances were used:

- *Pleurotus ostreatus* maternal mycelium from gene bank of University of Agriculture in Cracow, which was kindly provided by Faculty of Food Technology, University of Agriculture in Cracow;
- Agar and dextrose growth medium;
- Distilled water;
- Solution of silver nano-particles kindly provided by Faculty of Food Technology, University of Agriculture in Cracow, serving as contamination control (further referred to as: 5/10/25ppmNps, Nps, Ag Nps – silver Nano-particle solution). Concentration: 50ppm;
- Polymer Petri dishes, Parafilm, surgical blade.

3.1. Preparation of growth medium

40g of dextrose, 15g of agar and 10g of tryptones were added to 1000ml of distilled water, then boiled to 121°C until dissolved, and afterwards poured into sterile laboratory flasks with a cap and left to solidify.

3.2. Preparation of silver nano-particles solution.

Chemical reagents were used to prepare the nanocomposites, i.e., sodium alginate (Sigma-Aldrich), glycerine (99.5%, Sigma-Aldrich, Poznan, Poland)—as an excipient (plasticizer), AgNO3 (Aldrich, Poznan, Poland, 99.99%, PubChem CID: 24470), NH3 (Sigma-Aldrich, Poznan, Poland, PubChem CID: 18944693) and D-(+)-xylose (Sigma-Aldrich, Poznan, Poland, BioXtra, PubChem CID: 135191) and deionized water. A 1.5% sodium alginate solution was prepared by gelatinizing 3g of sodium alginate (Sigma-Aldrich) with 197g of deionized water in a magnetic stirrer (Heidolph MR3002). with a connected thermostat (70°C). After completion of the gelatinizing process, 1.5g of glycerine (99.5%, Sigma- Aldrich) was added as a plasticizer. 200mL of the polysaccharide gel was stirred

and 2mL of Tollens solution was added. 1ml of 4% D-(+)-xylose were added to the gel, the temperature was reduced to 55°C and the mixture was stirred for another 10min. The final nano-silver concentration in the gel was 150ppm. Then, dilutions of gel solutions containing silver nano-particles in three concentrations in the volume ratio (1:2), (1:5) and (1:10) were prepared, which allowed to obtain three concentrations of silver nanoparticles: 75ppm, 30ppm and 15ppm. A sterile water solution was determined as a control group [2]. In order to provide viable results [1], 3 types of nano-particle solutions of different concentrations have been prepared: 5ppm, 10ppm and 25ppm. 5ppm solution. 5ppmNps - 4ml of 50ppmNps poured into flask along with 16ml of distilled water, then rapidly mixed for 1min. 10ppmNps - 2ml of 50ppmNps poured into flask along with 18ml of distilled water, then rapidly mixed for 1min. 25ppmNps- 10ml of 50ppmNps poured into flask along with 10ml of distilled water, then rapidly mixed for 1min.

3.3. Preparation of samples

The experimental sets were divided into 2 groups: A and B, and then into 4 subgroups: control with distilled water, 5ppm, 10ppm and 25ppm, 3 repetitions each, creating a total of 12 Petri dishes per main group (A and B). For each group preparation methods did not differ. Firstly, each laboratory tool, dish and workspace was rinsed with 85% ethanol and irradiated with UV light for 10min. Mycelium was not subjected to UV light, with the object of avoiding its unwanted influence on the fungi. Growth medium was warmed up to it's liquid state (approx. 52°C), then it's flask was rinsed with 85% ethanol and introduced into sterile workspace. Growth medium was poured onto Petri dishes and left to solidify for up to 15min. Maternal mycelium of *Pleurotus ostreatus* was cut into rectangular pieces (surface area within range of 20-50mm2) and gently placed on the growth medium, at the centre of Petri dishes. Subsequently, liquid was poured onto Petri dishes; for control group – 2ml of distilled water, for 5ppm group – 2ml of 5ppmNps, for 10ppm group – 2ml of 10ppmNps, for 25ppm group – 2ml of 25ppmNps. Last of all, Petri dishes were wrapped around with Parafilm (on the diameter side) in order to prevent liquids from spilling out and samples from falling apart during measurements and transportation. Each dish was labeled according to main group

and subgroup. Overall amount of samples was 24 Petri dishes. Distinctions occurred within workspace locations:

3.3.1 Group A

Group A was entirely prepared in a sterile autoclave in a laboratory, located at Department of Agriculture, Faculty of Biotechnology and Agriculture, University of Agriculture in Cracow [Figure 1. left], and transported to the habitat in order to gather and process data about mycelium's growth. On account for this process, Group A served as a primary control group of the whole.

3.3.2. Group B

Group B was prepared in a glove box aboard.

3.4. Mycelium growth measurement

A black dot was plotted on lids of every Petri dish, above mycelium estimated center of weight. Photographs of each sample were taken every 24 hours throughout Analog Mission (5 days) using mobile phone camera. An improvised tripod along with flashlight was constructed to enhance photographing quality. A measuring tape was also placed in the vicinity of mycelium in order to establish measurement scale.

3.5. Image analysis and data collection

Images were exported to MatLab Image Viewer software. Using the program,8 lines were drawn from center of black dots to the edge of mycelium. They were later labeled according to compass rose (North, North-East, East, South-East etc.). Software displayed distance between two anchor points as an amount of pixels [figure 2]. Those numbers were then recorded. The process was repeated for all of the samples. Measuring scale was defined as following: 1mm = 45 pixels [Figure 1. right].

3.6. Environmental control dish

Additional dish was prepared in order to determine a presence of microorganisms in AATC Habitat environment. Petri dish containing only solidified growth medium was placed outside the glove box. Growth medium was exposed to habitat's air for 30min. Afterwards, Petri dish was closed, wrapped up with Parafilm around it's diameter and left unaltered for 5 days.

Figure 1. Left: Preparation of samples. Right: Sample processing with MatLab Image Viewer software. Measuring tape along with measurement directions, scale and black dot in the mycelium center of mass can be closely seen in the bottom image.

3.7. Data processing

Initially, scale of numbers was changed from pixel amount to mm according to formula from point 3.4. Analyzed variable was defined as mean of length for all 8 directions for each day of measurement. The process was applied to every subgroup and their repetitions. Subsequently, data was merged together in order to create a global growth rate. An example of group A: a mean of control dish no. 1 mycelium radius growth rate, control dish no. 2 mycelium growth rate and control dish no. 3 mycelium growth rate was calculated and used for growth rate visualization. Similar action was taken for every subgroup.

4. Result and discussion

4.1. Linear graphs

As presented on the line charts [Figure 2], control group maintained it's high-level growth rate in both A and B group as expected. A difference can be spotted between the control group (distilled water) and Nps groups (5pp, 10ppm 25ppm). A decrease can be spotted for 5ppmNps group on the 4th day of experiment. It is highly probable, that differences visible on the charts had been caused by difference of sterility, as well as Habitat conditions later addressed in paragraph 4.4.

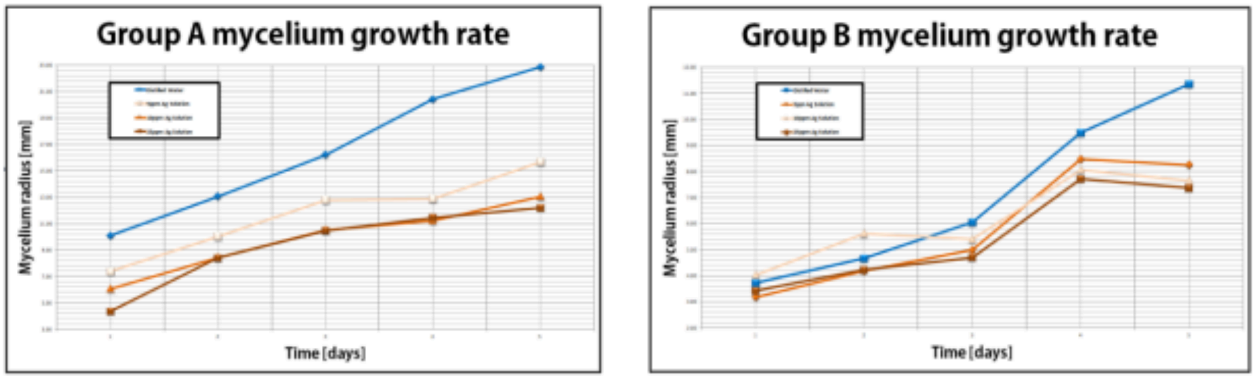


Figure 2. Linear charts illustrating mycelium growth rate of groups A and B during 5-day period of observation and measurement.

4.1.1. Group A

Growth rates of this group have a linear tendency. 10ppmNps and 25ppmNps solutions groups have similar graph on the time span from 2nd to 4th day of experiment. On the 5th day, 25ppnNps group's growth rate has decreased, and control groups' growth rate continued to increase.

4.1.2. Group B

Growth rates of this group have a stronger linear tendency compared to group A. 10ppmNps and 25ppmNps solutions groups have similar graph on the 2nd day of measurements. Afterwards, growth rate of 25ppnNps group increased. A peak can be spotted for 5ppnNps group on the 2nd day, as well as for all Nps groups on the 4th day (Figure 3).

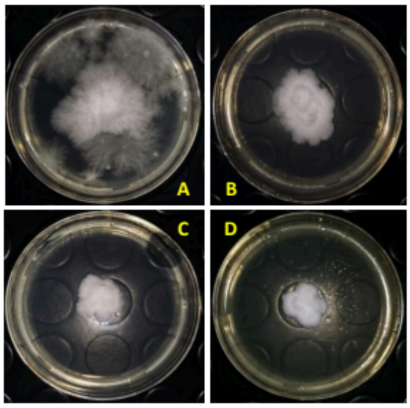


Figure 3. Visual appearance of *Pleurotus ostreatus* mycelium at the end of the experiment. A – control group, B – 5ppmNps, C – 10ppmNps, D – 25ppmNps.

4.2 Statistical analysis

Collected results had been analyzed for both groups on the last day of measurements using R software (Figure 5). Shapiro test of normality came back as insignificant for both of the groups: A (W = 0.852, p value = 0.0390) and B (W = 0.760, p value = 0.0034). Based on this outcome a non-parametric test (Kruskal-Wallis) was conducted. There exists a statistical difference between the growth rate of mycelium in various Ag Nps solution concentration for group A (H(3) = 9.67, p value = 0.0216). There were no statistical differences between mycelium growth rate mycelium in various Ag Nps solution concentration for group B (H(3) = 4.44, p value = 0.218). For group A, post hoc analysis was performed using pairwise Dunn test. Differences in growth rate were significant for 25ppm/control (p value = 0.00464) and for 10ppm/control (p value = 0.0235). No other difference were statistically different. In order to properly understand statistical analysis low amount of samples (12 dishes per group) should be taken into account. Mentioned statistical outcome is also influenced by measurement uncertainty (placement of anchor points in Image Viewer). This parameter estimated value is Statistical analysis war performed in courtesy of Pierre Boulet.

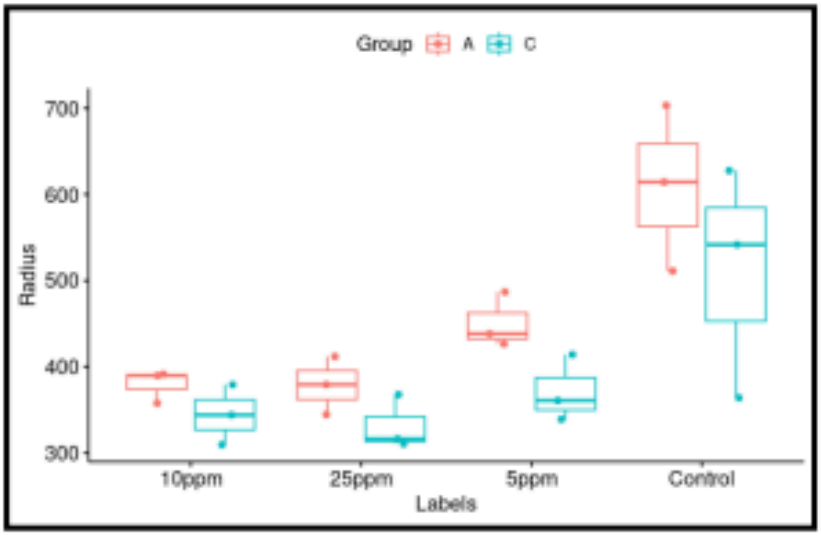


Figure 5. Box plot of gathered data for group A (red) and B (blue).

4.3. Mycelium visual appearance

No sign of degradation can be spotted. Differences in mycelium surface area can be distinguished – it lowers as Nps concentration

increases. Control group has created agglomerates around main mycelium strain. Nps had increased amounts of vertically growing mycelium, rather than plane mycelium. No contamination or deformation was observed in any of the A group dishes. One of the B group dishes showed sign of contamination.

4.4. Environmental control

Cultures of unknown mycelium and bacteria species were found on environmental control dish. Their presence does not pose direct threat to crew members. However, it might affected the mycelium from group C and it's behavior, resulting in an altered growth rate.

4.5. Possible impact of AATC Habitat on experiment results

During participation in Analog Astronaut Mission, researchers were exposed to extreme working conditions. Lack of sunlight, sleep deficiency, constant ventilation noise and tight schedule had influenced a faster and more stressful work pace on crew members. Fast working connected with tiredness and sleepless increases the probability of errors presented on attached images [Figure 6]. Moreover, glove box available at the habitat did not provide germ-free air recirculation and also enough visibility, due to lack of light bulbs. Microorganisms detected by environmental control [Figure 8] might have also inhibited fungi's growth.

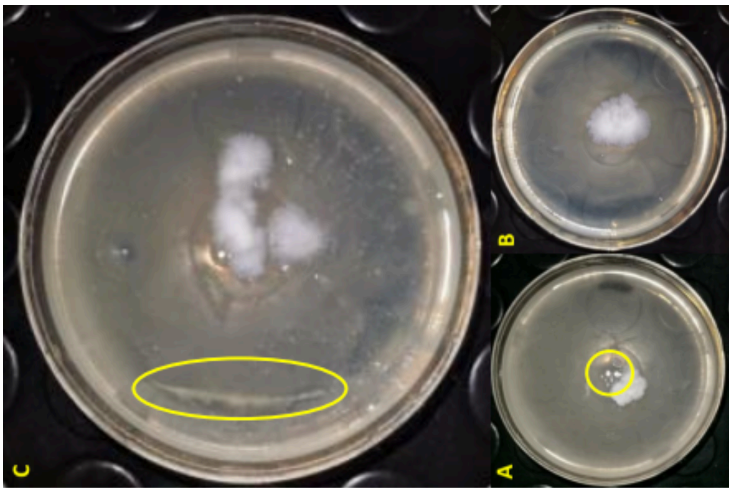


Figure 6. Sample preparation errors of group B prepared in Analog Habitat. A - accumulation of gas bubbles (probable mycelium metabolic disorder caused by growth medium micro-contamination, marked in a yellow circle). B - improper spreading of Ag Nps solution on the Petri Dish, foggy solution can be spotted.

C - accidental damage to growth medium done by the edge of Petri dish lid, resulting in improper spreading of Ag Nps solution (marked in yellow circle).

5. Conclusion

Pleurotus ostreatus mycelium shows culturing potential in Analog Habitat conditions. Application of Ag nano-particles is not toxic to mycelium. It can prevent contamination of *Pleurotus ostreatus* during it's cultivation, provided solutions are placed properly in the dishes with sufficient sterility. According to group A, Ag 10ppmNPs solution stimulates mycelium growth after 4 days of cultivation. Maternal mycelium can be used to cultivate and sustain *Pleurotus ostreatus* as a source for biological material. Once a proper amount is harvested, it can be used as matter recirculating-system mentioned in paragraph number 1. The system may be also more efficient because of Ag Nps, serving as anti contamination substance. Furthermore, a sufficient sterility has to be maintained to prevent sample and system contamination and provide credible results of further research. The glove box present in AATC Analog Moon Habitat does provide sterility. Nevertheless, it is insufficient for proper cultivation and establishing microorganism cultures.

6. References

1. *A. Asanovaa,, V. I. Polonskiya, N. S. Manukovskyb, and S. V. Khizhnyaka, "Fungistatic Activity of Engineered Nanoparticles", Krasnoyarsk State Agrarian University, Krasnoyarsk, 660049 Russia.*
2. *2. Miłosz Rutkowski, Lidia Krzemińska-Fiedorowicz, Gohar Khachatryan, Karol Bulski, Anna Kołton and Karen Khachatryan, "Biodegradable Silver Nanoparticles Gel and Its Impact on Tomato Seed Germination Rate in In Vitro Cultures", Faculty of Biotechnology and Horticulture, University of Agriculture in Krakow, Mickiewicz Ave. 21, 31-120 Krakow, Poland.*

Expedition 61, Krupal Patel, Canada

Second all female analog mission
09/06/2023 - 17/06/2023

The door closes behind you. You hear the turning of a lock. The light in the space around you goes a tad bit darker. Looking around, you see silver walls, cords running across the ceiling, the lab space in front of you, bunk beds through a narrow doorway, and of course, the faces of 5 girls you have known for less than 48 hours yet trust more than most of the people in your life. The only faces you will see for the next 7 days after today. There are cameras in the corners watching your every move. Sensors along the walls letting Mission Control know your atmospheric levels are nominal – at least for now. You feel nervous, slightly anxious, but excited. Seeing your emotions mirrored in the other faces around you, you cannot help but wonder how you got into this position. But you shake your head, because, of course, you know exactly how you got there: this was something you had worked your entire life for. You hear someone say something and with a clap of the hands (most likely your Commander), everyone moves into action: putting away food, collecting inventory. Settling into your new home, isolated from the outside world completely. Welcome to the Habitat.

T-2 days: Landing in Kraków

Landing in Kraków, Poland was a foreign experience for me (pun intended). As a freshly turned 20-year-old engineering student from Edmonton, Canada, I had never solo travelled anywhere before, much less across the Pacific Ocean to a country where I didn't know the language and was unfamiliar with the people and culture. As I made my way out of the airport and to Agata's house, I couldn't help looking around at the architecture as my Uber passed into the city. It was my first time in continental Europe, and it looked like something straight out of a movie. I said as much when I met my first fellow crew member, Ruchira Huchgol, and our Mission Coordinator, Dr. Agata. Ruchira and I were the only two

international crew members, Ruchira flying in from India, so we arrived at Agata's house a day early.

That night, we met up with three of the other girls in the city and decided to walk around, see the sights, and try local street food. Ewa Krężel and Katarzyna Kruk (Kasia) are biomedical engineering students studying at the AGH University of Science and Technology in Krakow, so they became the perfect tour guides. They, along with Urszula Ulanowska (Ula) from Warsaw, introduced Ruchira and I to the wonderful cultures and histories of Krakow and Poland. Looking back now, months later, this night was integral to helping us start meshing like a team.

T-1 day: Team Integration

This day changed the dynamic of our crew before the mission even began. Team Integration was when all the girls, including Natalia Wróbel, Ewa and Kasia's fellow classmate at AGH, had moved into our space on the top floor of Agata's house. Gathered in Agata's living room after our team lunch, we sat in a circle going through

our strengths, weaknesses, how we think, how we perceive the world around us, how we solve problems, etc. All of this would be important later that same day when the crew would sit in that same room deciding the roles, we would all take on during the mission.

As the Sun fell and the rain had cleared for the day, Agata announced it was time for survival training. Changing into workout clothes, leaving our phones and smart watches at Agata's house, as per her orders, we set off jogging after her around Krakow. As Agata led us into a dark forest (like a jungle), she informed us that there would be no talking from there on out. This would, as we would later realize, help us build on our non-verbal communication and teamwork. The ground was muddy, there were protruding roots, and steep slopes, and we learned to watch out for each other throughout the entire climb. After almost getting involved in an altercation with a wild boar, we finally made it to one of the highest points in the city.

All seemed well… until Agata informed us that we would be responsible for finding our way back to the house and she would tail behind us. After getting over the panic of this predicament, we set off back into the jungle guided by only one goal: get out of the jungle and back into the city. Once we were back in the city, we relied on our fuzzy memories, driven by adrenaline, and finally made it back to Agata's house. According to Agata herself, it was one of the fastest times she had recorded. Despite it being well past midnight, after some well-needed showers and bidding Agata goodnight, the girls and I gathered in the living room and discussed our mission roles. Going off on our previous discussions that day, we came to our final decisions. Ruchira would be our Commander; she was the only one with analog experience under her belt. Natalia would be our Communications Officer; she had a knack for concise and clear communication. Kasia was assigned Medical Officer; she was our crew mom and had a passion for medicine. I would be the Crew Engineer; aside from my engineering studies back home, I also had experience in simulated missions from NASA's Space Academy. Ula was chosen to be our Astrobiologist; as the youngest and only non-university engineering student, she had prior experience in biology that we didn't. And finally, Ewa was given the role of Data Officer; her research in her engineering degree gave her the skillset to ensure all our data was well catalogued. Tired, we all finished packing the rest of our stuff and tucked ourselves in for what would be the last "normal" night for over a week.

T-0 days: Mission Prep & Arriving at the Habitat

The morning and early afternoon were filled with final packing and getting over 4 cartloads of groceries for the Habitat. We drove a couple of hours out of the city to our new home for the next 8 days: the AATC Habitat. After dropping off our supplies, and groceries, and going over our daily schedules and safety, Agata had left us to our own devices. The rest of the day was mission prep. We had been told Day 1 would be the most busy and stressful, so we wanted to get on top of everything to ensure the next day went smoothly. We unpacked, assigned bunks, took inventory, assigned meal and maintenance duties, made, and had dinner, and got familiar with the space and each other. After dinner, I sat with my girls at our impromptu dining table in the Mesa Module, sewing the

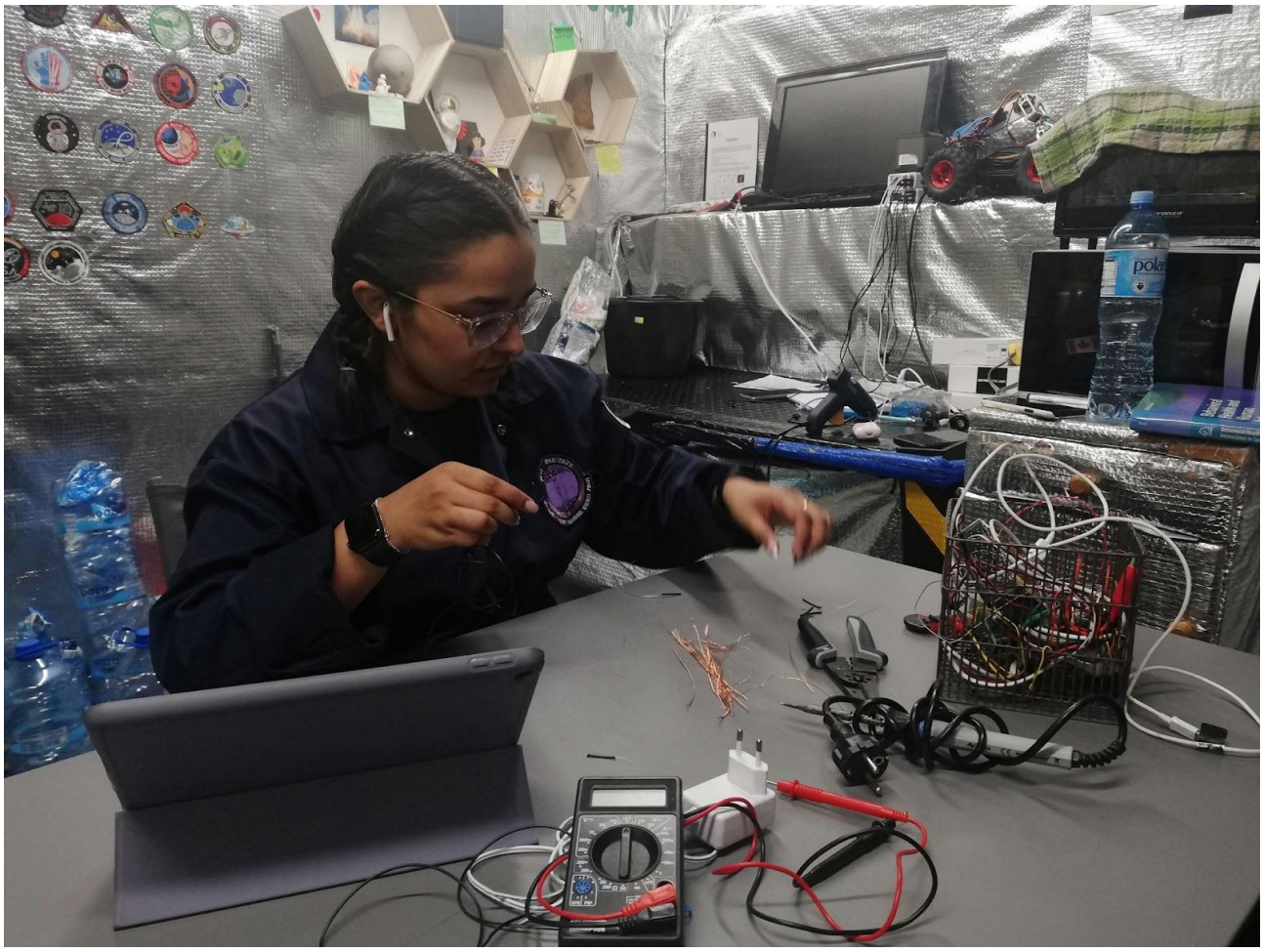
Juno mission patch we had designed together along with a patch of the Canadian flag onto my flight suit. We talked about the expectations set in place for us tomorrow, but also used this time to get to know each other more closely. This would be a recurring theme; we would find ourselves talking candidly about our lives away from the Habitat many times as we worked.

As I tucked myself into my bunk, listening to the faint sounds of the Hab life support system at work and looked up at the wires and cords running along the ceiling, I could feel excitement building in me.

The Mission

We got our wake-up call every morning from our MCC, the Mission Cap Comm, and promptly turned all our clocks to 00:00 on every device. Changing the time to 00:00 every day would be critical for the mission's time perception research portion; we would have no way of telling the time outside the Habitat. As the mission went on, we steadily fell into our scheduled routine. Instead of keeping time

in the conventional way, we counted hours (ie. T1 would be the first hour, T2 would be the second, etc.). Each hour had a set of tasks assigned to each crew member. Some of the tasks included: Hab maintenance, meal prep, experiments, physical fitness training, reports, data collection, and even an hour devoted to spending time with each other. Some tasks we did together and others we split off for.



An interesting phenomenon we noticed throughout the mission was that no matter what we were doing, we ended up clumping together in the same area. Particularly, I found myself sitting with Ewa, Kasia, and Natalia; all of us completing our own separate tasks for our individual research but sharing a space together. Whether it was sitting at the dining table in the Mesa Module or spread out in the Dorm Mod on our beanbags, we found working together comfortable and familiar. This dynamic also ensured that

we became close friends very quickly. This bond was further strengthened when the four of us stayed up late the night of Day 5 of the mission, talking about our families and our personal lives back home. Aside from these interactions, the crew developed several traditions and many inside jokes that kept the team dynamic lighthearted. They were small mundane traditions, such as listening to the High School Musical soundtrack during morning medical checks or sharing cookies during our evening reports, but in that confined space, they made a world of difference. Getting used to the Habitat was another adventure altogether. There are some things you take for granted, small precious things in your everyday life, that you do not notice until they are gone. I found myself missing the feel of the Sun on my skin, the sound of birds singing in the morning, how grass feels under my feet. Being in the Hab also meant constant monitoring through the cameras and microphones set in the corners of every room. It was never quiet in the Hab; there were the constant sounds of our life support systems in the background. Slowly we got accustomed to everything. Slowly the Hab life began to feel normal. Routine was normal for us, and the crew worked like a well-oiled machine. It was the evening of Day 6 that changed all of that.

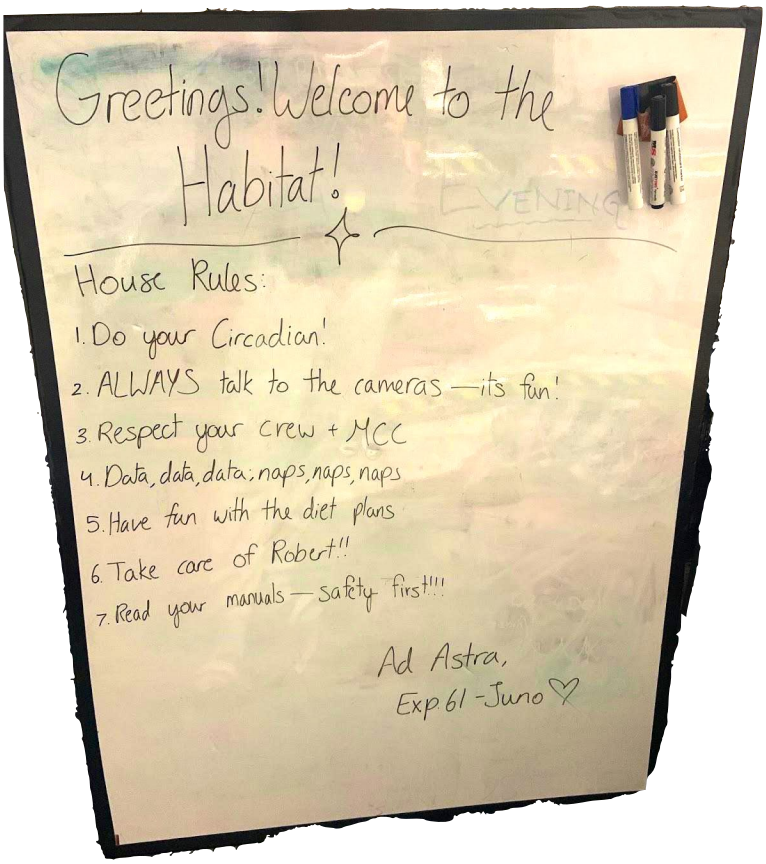
Day 6: Emergency

During pre-training, we were told we would get a simulated emergency. We had a manual with all scenarios and what to do in each. We had prepared our Shelter Mod in advance for the emergency. All week, we waited until before dinner on Day 6, we got notified about an emergency to take place after our meal. Nerves were on high the entire meal and we waited on stand-by as we went about our normal evening activities… until we got the message that set off the chain of events of our emergency. Within a minute of Natalia reading out our message, we stepped into action, gathering what was needed and heading into the Shelter. We began going through the steps of the emergency, receiving instructions from our MCC and carrying out the necessary procedures. During a particular procedure carried out by me and Ruchira (we were the chosen EVA Officers), a fuse was blown. We had later put together the pieces that it was Fuse 3… our emergency and life support fuse. This promptly took out our WiFi, atmospheric sensors, and cameras. Gathering back into the

Shelter, we realized we were all alone. As our Communications Officer, Natalia had contacted our MCC (through her mobile data) but we had no idea how to set everything back up. Kasia, our Medical Officer, was checking our blood oxygen levels and noticed them slowly decreasing, creating a newfound urgency in us all. Our life support system was our top priority and we needed to get our air filtration system up and running ASAP. Luckily, everyone, except Ula, had a degree in or was on a path to getting an engineering degree. We quickly abandoned our old, simulated emergency and started working on our new real emergency. Ewa and Kasia worked on finding another source of electricity: a wire running to the outside of the Hab that was disconnected from the rest of the electricity in the house and powered our lab materials. Natalia and Ruchira were quick to work with the MCC to set up the next steps and reconnect the Wi-Fi. Ula and I were working throughout the Habitat, using blueprints to take note of which wires and fuses were connected to what cameras and sensors. In the end, all of us would come together to understand how we could redirect our electricity to our necessities and what we could leave powered off. Limiting our electrical outputs was necessary to ensure we did not blow another fuse. At this point, it was much later in the night, but we were not sure if our workshopped electrical connections would last. We decided to camp in the Mesa Mod for a while until we were certain and got word from the MCC that we were cleared to head to bed. Spreading out on our beanbags, we talked about the mission so far, about the experience, about our personal lives. Although nerve-wracking in the moment, the girls and I would end up laughing about the whole thing afterwards.

Day 7: Final Day of the Mission

Due to the interesting turn of events the day before, we were given a modified schedule for the final day of the mission, as per our own request to the MCC. While we were given a later start for the day, we knew the consequences of that decision: we had much less time to wrap up the mission and get the Hab ready for egress the next day. The final day consisted of the normal routine with some exceptions: writing up our experiment research papers, finalizing our waste data reports, packing what we could, etc. We were planning on what check-list items could be moved to the next morning to ensure we had our reports done; they were our biggest



priority. We also made sure to get our final pictures in and had some fun with it. The day was spent going down the checklist and reminiscing about the past couple of days.

What Happened After

We left the Hab on a sunny, warm day with a slight breeze. It was the best way to exit the house we had been confined to for the past week and it was evident from the wide smiles on our faces. We packed everything into Agata's van and said our final goodbyes to the Habitat (but not before leaving a message behind).

The rest of the day was spent driving to some phenomenal spots across the mountains where the Habitat was located, trying local food, drinking natural spring water, and debriefing about the last week with Agata. We had said our goodbyes to Ula before heading back to Kraków as she was heading home to Warsaw with her parents who had met us during our lunch debrief. Kasia soon left us as well when we got back into the city, and the rest of us spent the rest of the night spread out in Agata's living room before retiring to our bunks again on the top floor. The next day, we would meet Kasia again for dinner with Agata and our MCC. Afterwards, Natalia

and Ewa said their goodbyes. Luckily, Ruchira and I would meet Ewa again later that night and the next day as we explored more of Krakow.

As my flight left Kraków, I was looking out of the plane window, back at the city that had welcomed me with open arms and the girls who had quickly become some of my closest friends. This mission changed my life's trajectory and made me even more determined to jump into the space sector.

Expedition 61, Ula Ulanowska, Poland

Second all female analog mission
09/06/2023 - 17/06/2023

I hate running. I mean, I literally despise it. Yet, they somehow made me do it. Before the mission, we went to survival training with Dr. Agata. It was fun and scary, but the most important thing was making the bond with the crew. In the evening, Agata told us that we were going for a run, so we assumed that we would run and maybe try to light a fire or something similar (because it was supposed to be a survival exercise). You know, "hard survival stuff" that is very easy and logical in real life. We were very wrong! Oh my God, so wrong. At first she told us to leave everything, even water. We were a bit concerned, but we did it and started our survival training. It started out deceptively easy, a bit of running around town with twists and turns, little houses - a perfect small town at night. Quite pretty. When we ran into the park, I felt that it wouldn't be that easy, especially with Agata in the lead, especially that at first I was a little bit afraid of her. (I mean, she's so open and outgoing, jumping into conversations and carrying them on when the rest of us are too intimidated. But considering her crazy experiments and weird stories, I didn't know what to think. I was supposed to let this woman lock me up in a little space with five other girls.) Then we reached a hill covered in forest, and she stopped us, telling us to be completely silent and hide all sources of light like watches until we reached the top. And she started running. I was confused and a little worried because it was completely dark and it had rained earlier, which made the ground slippery. But I started running. I was the first and it was difficult to see Agata in the dark. I could only see the inside of the hood of her sweatshirt because it was light gray and everything else was black. This bright dot was between the crew getting lost in the forest or reaching the peak, so I tried very hard not to lose sight of it. It wasn't easy because she was so fast! At some point I realized that I was wearing all black and it was difficult to see me, so I took off my hoodie and white T-shirt, tucking it into the back of my pants so that Ewa (who was running behind me) could see something. (She

later told me it was a great idea.) We ran and ran, trying not to get lost, until suddenly we heard the roar of an animal (apparently it was a moose). We stopped immediately, and Ewa and I gathered in a group near Agata, and Krupal, Kasia, Natalia and Ruhira formed another one near the tree, because they were a bit behind us. I was immediately shocked and scared. Then I heard it again and realized that the animals were right next to us! Then I was terrified. I had never run in a dark forest before and been so close to free wild animals. We stood there, not moving at all. Then Agatha roared at them and started running again. How?!? I was so shocked that I just started running again, in complete silence. It was a unique experience. When we reached the Piłsudski Mound (apparently the highest point in Kraków), Agata spoke to us. We were all sweaty, a little tired and of course shocked. The view was amazing, but at what cost? Once everyone had calmed down, she told us that now we had to find our way back without her help. We could talk, so the work was obviously much easier. Thanks mostly to Ewa, we did a great job. Ewa and I led and it went quite well. The most important thing: always go down and in the end we will find our way back to the city. It was going well almost until the end. We came to a fork and weren't sure where to go, so we decided to check each path one by one. As we were walking, I saw something dark in the middle of the path, so I think I screamed and took a few steps back. This shocked me. Then the rest of the girls started screaming and running away because they didn't know what scared me. After a few seconds we all realized we didn't know what we were doing and started laughing, but we decided to change the route anyway. We finally found our way back and did it in record time. There were six of us girls on the mission. Isolated in the habitat, communicating only with MCC (I completely cut off contact with friends and family during the mission). Despite constant tests and measurements every two hours, we managed to have a lot of fun discovering our habits, pushing limits , understanding how our body works and, of course, getting to know each other through fun situations. But when I first entered the habitat, my first impression was that it was much larger than I thought. I mean, we had information about the rooms and the size of the base, but early on I had different ideas. The ceiling was high, you could move around normally and everything was so shiny! It made a good impression on me. Still, I don't know who was at the base earlier, but there was

complete chaos in some places. On day 0 and day 1, we cleaned up the entire habitat, organized food supplies, and took stock of everything in the base. It was a job well done. Moreover, later, when I built my hydroponics, this preparation paid off. And we started the first tests and experiments. Oh, and important things. It was a different time at the base. There was no earthly time. MCC woke us up in the morning and it was hour 00:00. But whether it was 7:00 a.m. or 12:00 p.m. we didn't know. During the mission, I implemented my individual experience - building hydroponics, caring for it during the mission and preparing an automatic hydroponics life support system until the next mission begins. The first two days were a total mess, because I had to go through everything that was left from previous missions, throw away what was unnecessary or completely damaged. Clean out all the boxes, trays and containers because I wanted to reuse as many items as possible. Building hydroponics was not only work but also great fun. At the beginning there was chaos and nothing fit together, but later, when my hydroponics system started to look nice, adding each element or new solution was a really nice feeling. It was an amazing discovery when I realized how and for what I can use sometimes random items from the habitat. For example I used test tubes to connect an aquarium tube with a garden hose. Apparently it was the perfect diameter. I really enjoyed working on hydroponics. I could work for hours and sometimes I was a little unsociable because I was so focused on my work and didn't want to interrupt it. Moreover, I worked better in the second half of the day/evening, when everyone was slowly finishing their research or work, socializing and going to bed. The girls took some very nice photos of me working on it (sitting on the table, on the floor, with my head in the hydroponics, thinking about the problem, etc.). When I was building the hydroponics, I noticed that the girls were a little worried because sometimes the hallway was a complete mess or I would do strange things like burning random pipes and tapes to see how they would react and how I could use them. I'm glad they let me work and I thank them for their trust, patience and respect with my sometimes stupid questions. I completed the project successfully. The complete system worked flawlessly. I wrote an instruction manual for subsequent missions with a QR code linking to it. The instructions also included information on how exactly it was constructed, how it could be opened, what

could be damaged in it (where its weak points were), how to repair it and where hydroponics components could be found in the base. During the mission, we had to test ourselves at specific blood pressure levels, which required running on a treadmill to raise them. Running for the sake of running seemed pointless to me. And what's more, probably because of my anger towards running, despite the monotony, I started hearing strange sounds that reminded me of aliens - they tweeted like birds and moved with the sound of a circular saw. Especially since Robert and Mark (their souls were in the base and were friends with the aliens) seemed quite similar to us in our imaginations, so we assumed that all aliens were like that. I can exercise, I can lift weights, I can repeat various exercises, but I simply hate running. It's rare for 6 complete strangers, from different corners of the world and from different cultures, to work together so well and have so much fun together. Ewa turned out to be an excellent rapper, rapping in both Polish and English, presenting her talent with a rap about "flour Basia" (a brand of flour in Poland). Another time we created a sign for our crew warning others to "watch out, Krupal inside" and not to turn off the bathroom light, which was a regular occurrence, but only when Krupal was inside. It was also nice to resurrect Robert and have his soul return to his body. Ewa and Kasia did a great job making his body. One of the best moments in the habitat was the meals. We all sat together, ate, talked and laughed. Those were the coolest, calming moments. Rest from all the tests, stress (during the mission, in my free time, I studied for a really important math test, and also solved IT homework - the mission was at the end of the school year and I was not at school), work and all. And the food was amazing!!! The other day I had a shift in the kitchen with our commander Ruchira, and she is from India, so the word "spicy" has a completely different definition for her!!! And I don't like spicy food. I prefer, let's say, easy and tasty. So we cooked some grits with fresh peppers. We chopped and cooked and everything was going well until we got to the spices. Then our tastes collided. Ruchira was about to add more pepper when I stepped in to save our tongues! I quickly said that we had already added raw peppers, so why add more, especially the spicy one, which made her laugh a lot. Ultimately, even though she was the boss, we decided to stop at just raw ones. I always found it difficult to work in the morning. I'm useless for the first few hours of it. Now, after the stay

at the base, I was sure that it was not only the light's fault, but also my body's fault (another reason may be an average of 5 hours of sleep a day). After 4-5 hours I work better, but I can work longer. A 24-hour day is not enough for me. Usually, for the first 3 hours I was a bit unsociable (I don't know how the girls coped with me), but during the 16-18 hour I worked normally, I didn't feel tired (at the base they didn't let me work any longer because the rest of the crew was already asleep or about to sleep). The work lasted all day, including an hour of workout. I don't know if you've ever been to the habitat, but "at night" it's surreal. Everything shines from foil and intensified lights. This murmuring sound is all around you. Weird, but calming. Some people say it's exhausting and they can't sleep, but for me it wasn't a problem at all. I like this otherworldly atmosphere. Staying late in the habitat is an amazing experience. On the one hand, you know that you are on Earth, but on the other, your imagination gives you amazing and terrifying scenarios. As I was the youngest crew member at age of 17, confidentiality procedures also applied to my parents. My parents were also part of our mission group, but only as silent observers. It was strange because I didn't contact anyone during the mission. There was one funny situation related to my age. Every morning we had to take additional measurements on a special scale, but for the first 3 days of the mission my measurements did not want to be taken. It turned out that the device requires an appropriate age - 18 years (when entering individual parameters). When I lied and entered a specific age into the device, the measurements started. In the habitat, we performed various tests planned by MCC for various scientists and institutions. Some were cool, some were interesting. But I bravely did all of them for the good of science. Some of the activities were repetitive - such as routine tests every 2 hours. But I got used to them and they didn't cause me any problems. We also conducted our own individual experiments. The interesting thing was that Natalia was doing tests with tears, so she needed samples. Whenever someone was feeling down, she was almost running to hand test tubes and special sticks to poke your eye. Another strange situation occurred during our simulated “emergency", i.e. a simulated asteroid impact on the base and damage to the base. It was supposed to be a test, and it was like that at the beginning, and then after a while It turned out to be real! All our life support systems, light and power went down, not

to mention cameras and other sensors. Even our accumulator, which we had problems with before. We almost had to abort our mission. But we survived! We all did a great job. Krupal and Ruchira repaired simulated damage, and then the real failure began. Kasia, our doctor, constantly monitored everyone's health (which is not easy in such a situation), Natalia communicated with MCC all the time as if she had three more hands, and Ewa carried out technical work to start everything again. I also quickly mapped all the cables, extension cords, cameras, sensors and lights to see what we could disconnect to restart everything. My inventory in the storage room was also useful. Even in the dark, I could quickly find everything we needed to save the base. Additionally, since Krupal and Ruchira did not know Polish, I kindly explained to them all the swears of the girls saving our base. We were a really well-coordinated, efficient, creative and cooperative crew. In the end, everything went quite well, but it was really stressful and the thought of aborting the mission was blood-curdling! And during the summary of the failure, our commander praised me that despite my young age, I did great, I was very calm, helpful and brave. Despite the ups and downs, I couldn't have asked for a more amazing crew. The girls were amazing. We supported each other in problems and doubts regarding our projects or simply short breakdowns. It was amazing and I will definitely go on an analog mission again. Maybe the mission was just too short.

Expedition 63, José D. Villanueva, Spain

Tachi Umada
08/07/2023 - 18/07/2023

Two years have already passed since I finished my work as a Commander on the Solaris 31 mission of the AATC, and even at that time, I thought I was too old for this type of adventure. Therefore, when Daniela Payan interviewed me for her YouTube channel and mentioned the possibility of organizing a Spanish-Colombian mission, at first, I wasn't very convinced due to the high physical and mental demand required to carry out an isolation mission for several days. However, when I began to get to know the potential crew for the mission, my thinking changed. The crew would be composed of 4 individuals with a world-class academic and professional level, and, more importantly, the enthusiasm these scientists showed towards carrying out the mission was spectacular. That level of curriculum isn't so hard to find if one has contacts and searches carefully. However, that level of enthusiasm is indeed very challenging to find. Therefore, I decided to get in touch with Dra Agatha to discuss with her the possibility of building an analog mission at the highest global level. And she agreed, everything started rolling. The mission's name would be Tachi Umada, in reference to Our Sun in the Embera aboriginal language. I was in Madrid, Spain, and there in Colombia, the crew members, Daniela Payan, Jose Dario Perea, and Juan Carlos Velasquez, began to move to find sponsors and finance the travels, space suits, and other expenses that the mission would entail. Jose Dario Perea is a world-class scientist and would be in charge of being the Scientific Director of the mission, as well as taking on the role of Communication Officer. Carolina Orozco, also a renowned scientist, would be in charge of the experiments developed during the mission. Daniela Payan, still a student, would be working under

the instructions of both in the experiments. Juan Carlos was supposed to be the mission's doctor, but a last-minute health setback prevented him from being part of the crew in Krakow. Andres Fadiño, a reputable scientist, would assume his position. Throughout the preparation, development, and conclusion of the mission, Juan Carlos was in our thoughts and, for us, he was part of the Tachi Umada mission. I would be the mission commander once again. My role would involve coordinating the entire mission and ensuring at all times that there were no misunderstandings or conflicts among the crew members. After months of preparation and meetings, we finally gathered in an apartment in Krakow and were able to meet each other in person. The next day, we set a course for the AATC and from there, headed to the habitat where we would spend 10 days isolated, conducting experiments at the highest scientific level. We bought the necessary food for the days of the mission, and we arrived at the habitat on time to be able to set up and familiarize ourselves with the environment, although I had already been in the same habitat two years before. As a curiosity, I'll mention that I used the same bed. Although all the crew members of the analog missions speak fluent English, when it's not their native language, one is always limited, no matter how good their English is. On this occasion, language was not going to impose any limits, as we all share Spanish as a common language, which makes the mission much easier and smoother. One of the biggest challenges of the mission was monitoring the crew's circadian cycles by the mission's doctor. We had to wear specific watches and chest belts throughout the day. Measurements of weight, consumed calories, expelled urine, body fat, and other metrics were exhaustive to obtain precise results on the impact of isolation and reduced diet. I must say that, unlike my SOLARIS 31 mission two years ago, in Tachi Umada, we have been eating really well, much better, primarily due to two factors. Firstly, we didn't have any mishaps with the cooking oven or any other kitchen appliance. Secondly, Carolina and Jose Dario are excellent cooks. I should also mention that breakfast, lunch, and dinner were accompanied by typical music from Colombia and Spain, making these moments more enjoyable and fun. The crew was experienced enough to act autonomously regarding the experiments. Some days, I could even hear the scientists working until the early hours of the morning. As the commander, I had to

ensure that the entire crew rested properly, but I'm also a scientist myself, and I know perfectly well that moments of inspiration generally come unexpectedly. I fully allowed the work to unfold in the best way that the Scientist Director (Jose Dario Perea) deemed appropriate. The mission was progressing normally; we were eating well, exercising regularly, and the experiments were going almost perfectly, of course, with the usual difficulties that could arise while conducting them. The hope is that future astronauts in space or Mars would be able to use the fungi as a source of vitamin D, to address one of the most pressing challenges astronauts face: bone wasting and nervous system regulation, exacerbated by their limited exposure to Earth-like sunlight. Future studies are needed to confirm the vitamin D content of the fungi and how effectively vitamin D from them would be absorbed into the human body. The mission reached its halfway point, and the experiments were very advanced. The hardest part of it all was having to shower with cold water. Conflicts among the crew were completely non-existent, and we started considering reducing the days in the habitat and going to a diving centre to initiate ourselves into this activity, although the Chief Scientist already had extensive experience in diving. And that's what we did. The last day in the habitat was typical: collecting belongings, a general clean-up of the habitat, and the final photos of the crew and the experiments. Our next adventure was a few kilometers away from the habitat, at a specialized diving centre. The day was physically and psychologically demanding, but we were very happy to have successfully completed the mission and obtained the international diving certificate. We had to spend the last night in Krakow, and the worst part was the farewell. Although we were sure we would stay in touch and continue developing post-mission, goodbyes are always very tough, especially considering that Spain and Colombia are very far apart, and a physical reunion of all the crew members in the future would be very complicated. Actually, that's how it's been at the time of writing these lines. Our virtual meetings are frequent, we're constantly in touch, and the activities related to the mission are plentiful. The scientific return of the mission has been remarkable, as expected, and the mission-related activities as well—scientific articles, talks, press releases, article publications, etc. It has been one of the most incredible experiences of my life, and I hope to repeat it in the future.

Expedition 64, Hanga Katreiner, Hungary

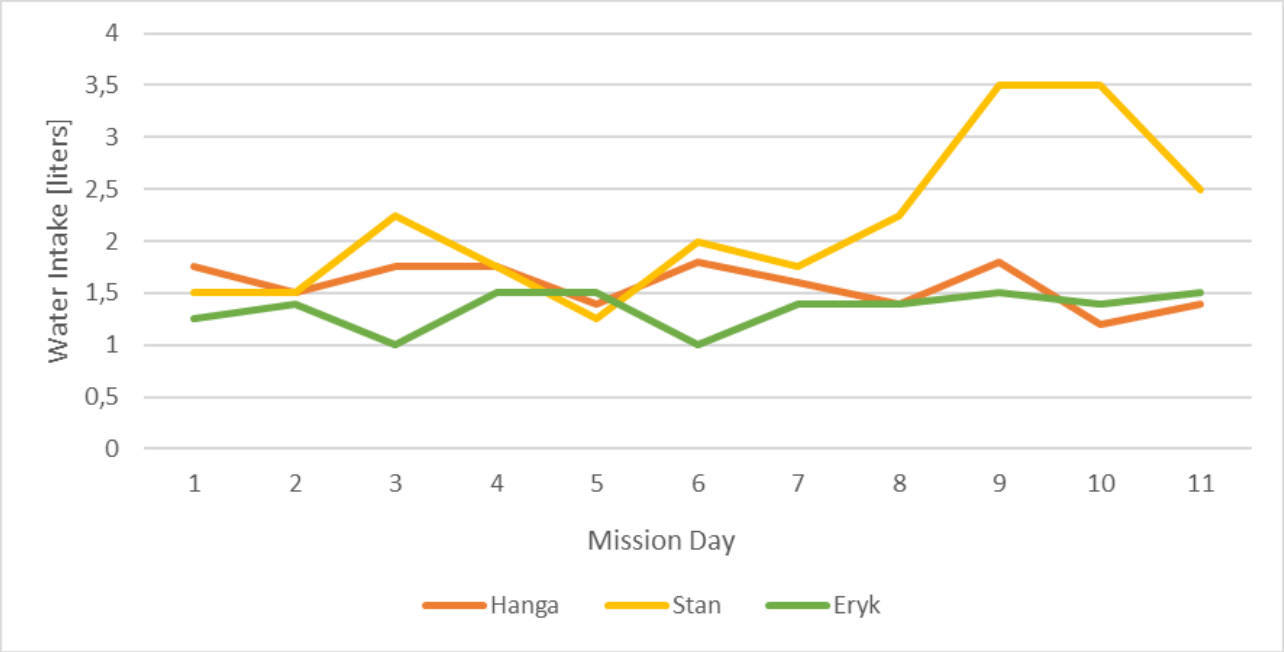
Perseidia - 2 week isolation
01/08/2023 - 14/08/2023

Mission Objectives

During this 2 week long isolation, our 3-membered crew had the opportunity to work on a specific experiment together besides the different daily tests and measurements. In this section we would like to introduce our mission's goal and our progress during the days we spent in the habitat. Our main mission objective was to design a spacecraft mission for future asteroid mining purposes and send our detailed description about this mission to the International Space Challenge 2024 competition by the end of the year. However there is still a lot of work left to finalize our ideas, we achieved a lot that is briefly introduced below. Our proposal holds a space mining station design with its internal mechanisms, such as grinding the materials into smaller pieces, separate the grined particles and store them in their corresponding containers. To clean the system we are circulating 99,9% nitrogen gas, hence we can assure that there is no unwanted particles left in the system at any stage of the process. The raw materials can be delivered to the station via different sized docker ports and the useful outsourced materials can be collected using a similar approach. The leftover rocky dust we can offer to future lunar or martian habitats, this way we can support these projects in the building process.

Water Analysis

In the isolation the crew members counted carefully their water intake each day. The graphical water intake/person can be seen on the following diagram as well:



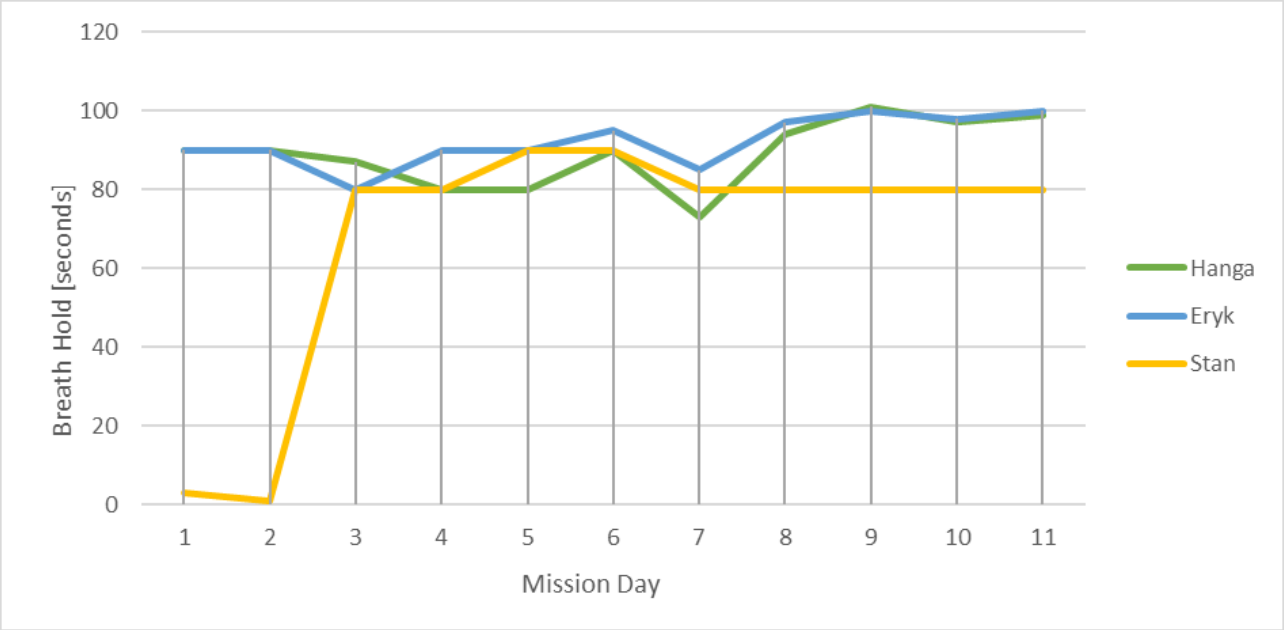
The average water intake for the whole crew was **1,67 liters** per day.

Circadian

During the mission our crew members measured their body weight [kg] and body temperature [°C] in every 2 hours. Below the graphical figures can be seen individually.

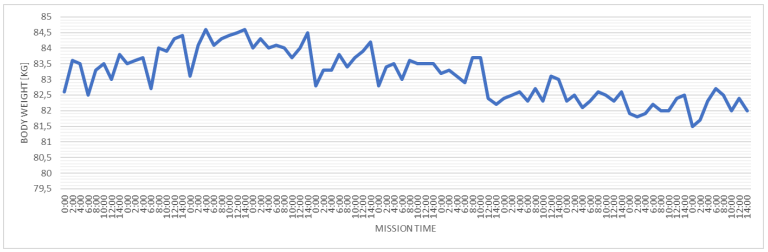
Hof Experiment

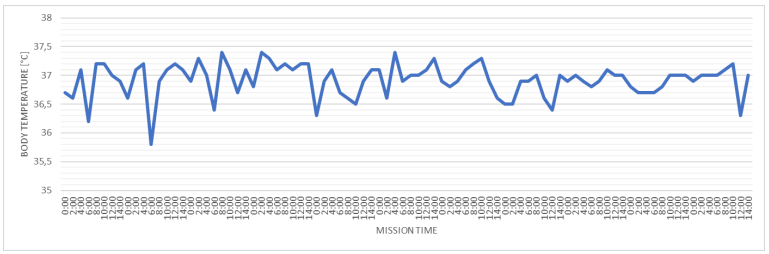
During this breathing procedure, each crew member had to measure his/her time of breath hold in seconds. The graph below shows the crew's progress individually.

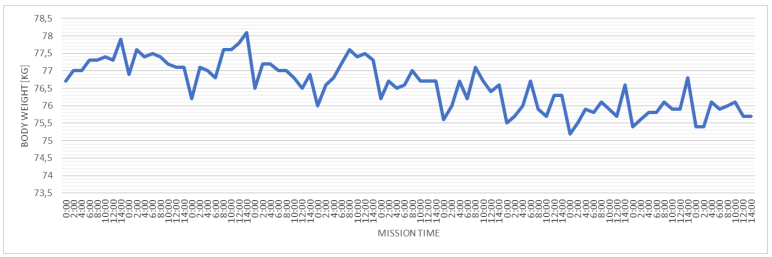


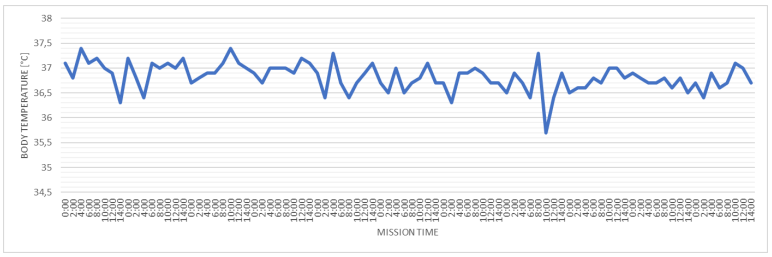
Body weight and body temperature

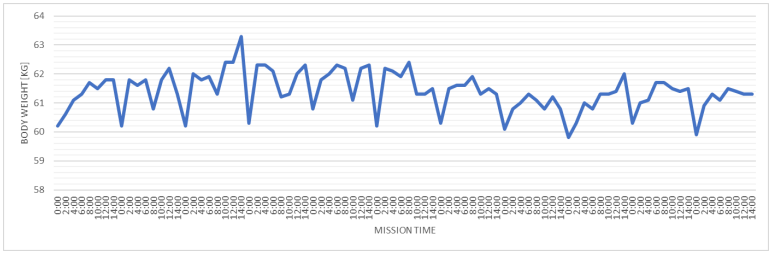
Our body weight started to rise during the first few days of the mission, but as the graph shows, is slowly got decreased after. The body temperature was oscillating.

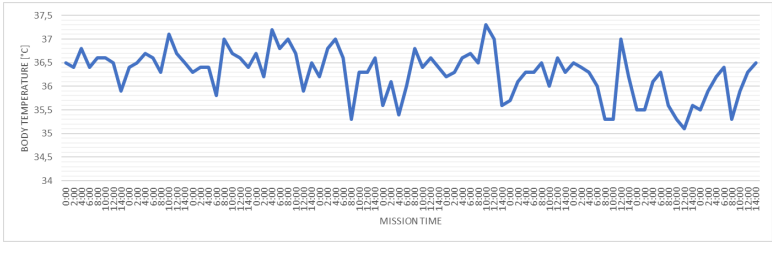






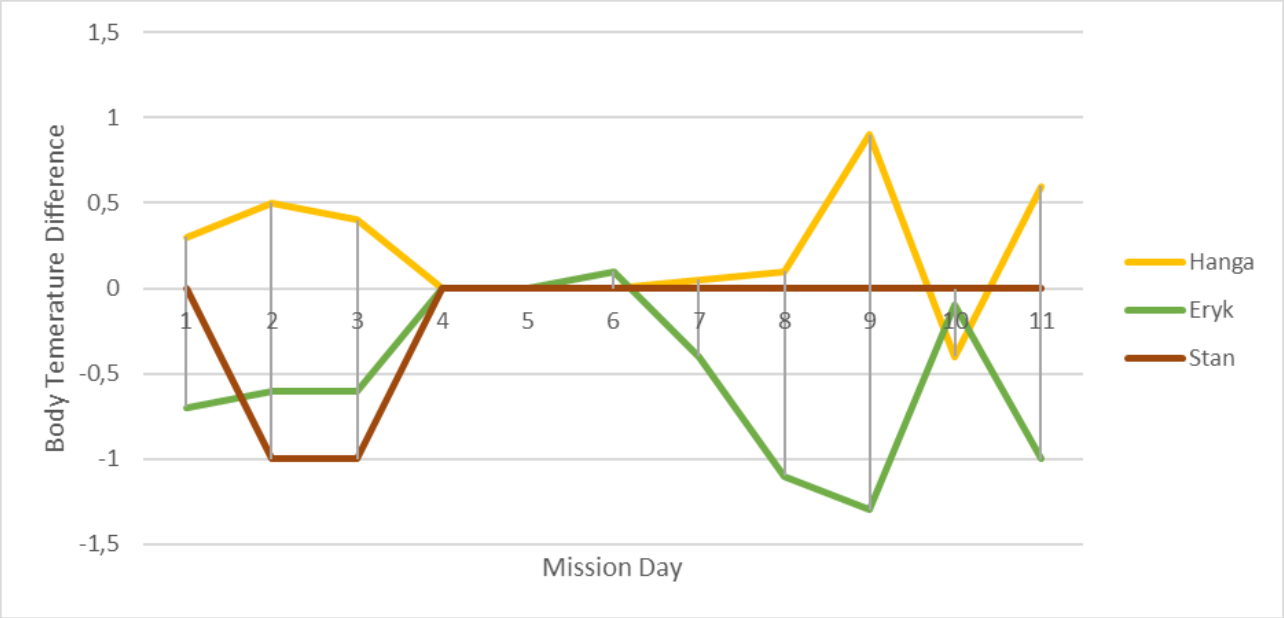




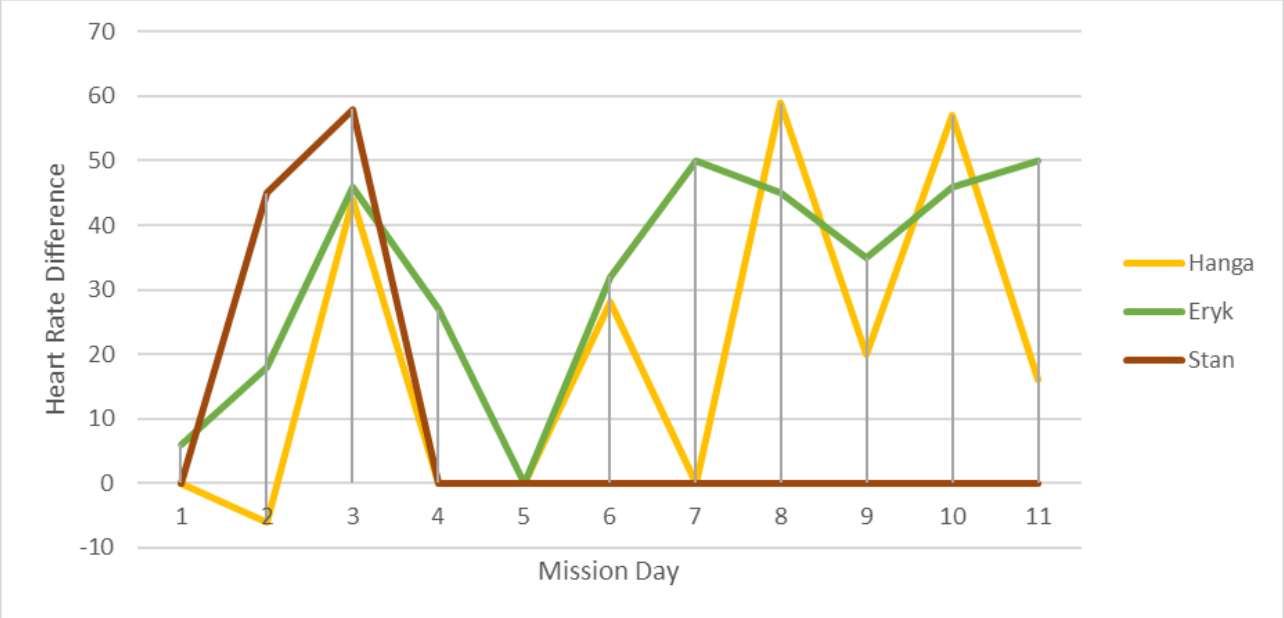


Sport Experiment

Sport is important in such a long mission, therefore the crew performed an experiment based on their sport activities inside the habitat. Everyone measure their body temperature before and after the his/her gym time, their heart rate before and after and the duration of these activities. The body temperature differences can be seen below:



And the heart rate differences here:



Space Mining Station - Asteria

Exp. 64 Mission Perseidia

01/08/2023 - 14/08/2023

Stanisław Maj, Eryk Kopa, Hanga Katreiner

The AATC PERSEIDIA-64 crew consists of three members, two Polish males, and one Hungarian female. They haven’t met with each other on a two-week-long analog astronaut isolation mission in Poland.

Stanisław Maj - This is a young boy with a plan for life, a second-year high school student. He studies extended math and physics. He's passionate about space exploration, astronomy, quantum physics, space engineering and architecture. He wants to combine his interests and work on architecture, not only on Earth, but especially on projecting future human colonies on Mars and Moon, but first of all, he wants to fix our home - our planet. His dream as a child was to become a fighter pilot and then an astronaut. He still believes that his dream can come true, and he will be able to see our Pale Blue Dot from space.

Eryk Kopa - A fresh high school graduate and a soon-to-be first-year student at Technical University of Munich, Aerospace Engineering by October. He is passionate about designing spacecraft and planning space missions. He aspires to become an aerospace engineer. He wants to combine his interests and work on aerospace engineering, not only on Earth, but especially on projecting future spacecrafts, but he also wants to make aviation more sustainable for our planet. Eryk is hardworking, quick to learn, and open to new people and new challenges. He really likes playing golf and traveling. He is enthusiastic about motorsport and hopes to go see The 24 Hours of Le Mans live.

Hanga Katreiner - A space software engineer graduated from the University of Technology and Economics Budapest. During her studies, she deepened her knowledge in system design and different gradient descent optimizers to make deep reinforcement learning techniques more efficient. She was an intern at ESOC in Mission Operations and currently working with GMV Space on a

new component design for the Galileo Second Generation Satellite Group for in orbit validation. She also starts her space engineer master course in April. In her free time, she likes to learn new things and work on her project; terrain mapping and navigation with autonomous UAV swarms. She likes gliding and sailing, learning new languages and focusing on her friends and family.

Mission Objectives

The following section includes the concepts of our mission, that we realize in the system design. Defining the overall mission objectives is a crucial stage since in this part the crew defines the goals or achievable goals and follows these ideas during the whole development process. “Why?” is important before the start and therefore our answers can be seen in detail below.

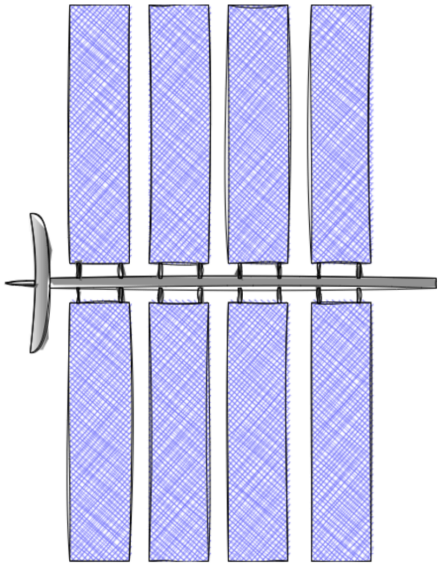
Our mission is to develop a space mining station in the Low Earth Orbit (LEO) - on ca. 400 km, that is capable of processing raw materials from asteroids collected by various mining probes. This station will not only extract valuable elements from any remaining materials. Our guiding principle is to maximize resource utilization in space by providing support for future mining missions. Additionally, we have a forward-thinking approach to repurposing leftover materials as building components for human habitats on the Moon and Mars.

Asteria Design

In this section the design concepts and constraints of the mining station will be introduced along with its crucial elements, tools and operating mechanisms. The designed station holds a set of techniques and technologies in itself in order to realize the mission objectives, that overall composition can be seen below. The following technologies and tools intended to be used for successful material processing in an efficient manner:

Shield - Before getting into the detailed descriptions of each component, we would like to initiate the constraints we defined for the shield of the mining station. This is a crucial part since it has to be designed in a way to withstand the harsh environment in space.

Wings - Following the shield, in this section we define our wings and their elements in details below. For a better understanding the figure of these parts can be seen here:



Dockers - Our concepts on the docker ports let the various sized future probes deliver their mined materials to our mining station. By offering both - smaller and larger ports for docking, we ensure that our space station emerges as a pivotal hub for servicing and refining raw materials extracted from asteroids.

Ports - Our strategic approach involves incorporating two distinct types of docking ports: a small port (S-Port) and a large port (L-Port). L-Ports accommodate sizable mining probes, enabling us to efficiently service and collaborate with spacecraft designed for substantial resource extraction. Simultaneously, S-Ports cater to compact mining probes, showcasing our commitment to inclusivity and adaptability in the rapidly evolving field of space resource exploration. This way we can ensure that probes with different dimensional constraints can dock and provide their contents safely.

Design Choices

Looking for the best solution from several aspects, the crew designed the docker ports as an individual component of the station that is attached to its side. This led us to an efficient usage of the grappling arm and create more ports without endangering the effectiveness level of the panels and other important elements mentioned on the outside of the station. This docking capability establishes a seamless link between our station and an assortment of mining probes, enabling the transfer of resources, data, and expertise that collectively contribute to the advancement of space mining endeavors.

Constraints

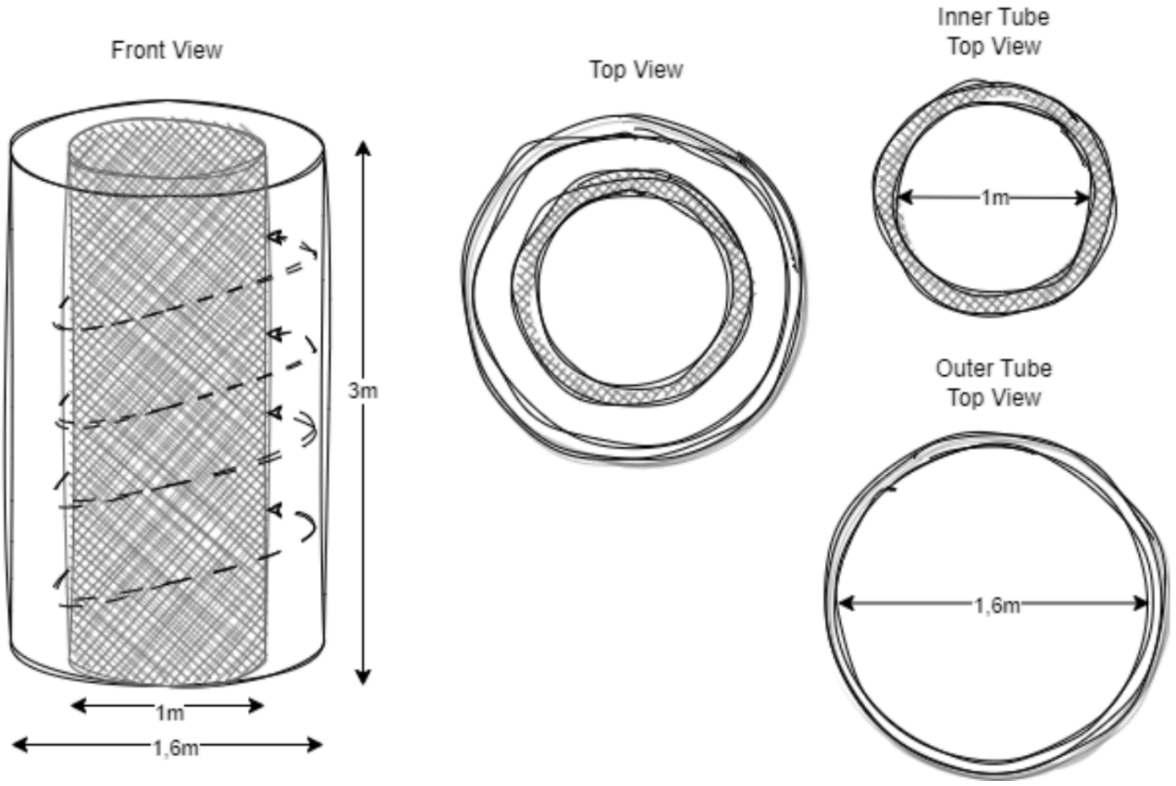
To provide exact models on the ports, the crew set the constraints that can be seen as per followings: Docker Component, Length: 2.5 meters, Width: 2.5 meters, Height: 4.5 meters. In connection with: Grappling Arm, S-Port: Material: Inconel 718, Form: Circle, Diameter: 0.75 meter, L-Port: Material: Inconel 718, Form: Circle, Diameter: 1.5 meters

Grappling Arms - After we defined the docker ports, there is a need of removing the asteroid chunks from the probes, and placing them into the corresponding Raw Material Storage. Therefore, for safely reasons, we decided to use grappling arms, that are putting these smaller-bigger rocks into the chamber mentioned previously.

Doing so, two robotic arms, one smaller and one larger, similar in design to the SRMS Canadarm, equipped with claw-grabbing units at their ends, will collect material from docked probes and transport it to storage. Their high agility provides us with an organized collection of materials from mining ships. This seamless integration of robotic technology ensures the efficient transfer of resources, setting the stage for subsequent processing and refining operations.

Internal System

In this section we introduce our internal system that is designed to be closed and circuitous and thus we can preserve more energy and resources, which allows us to decrease our costs as well.Our system includes 4 different chambers and 5 centrifugal separators.

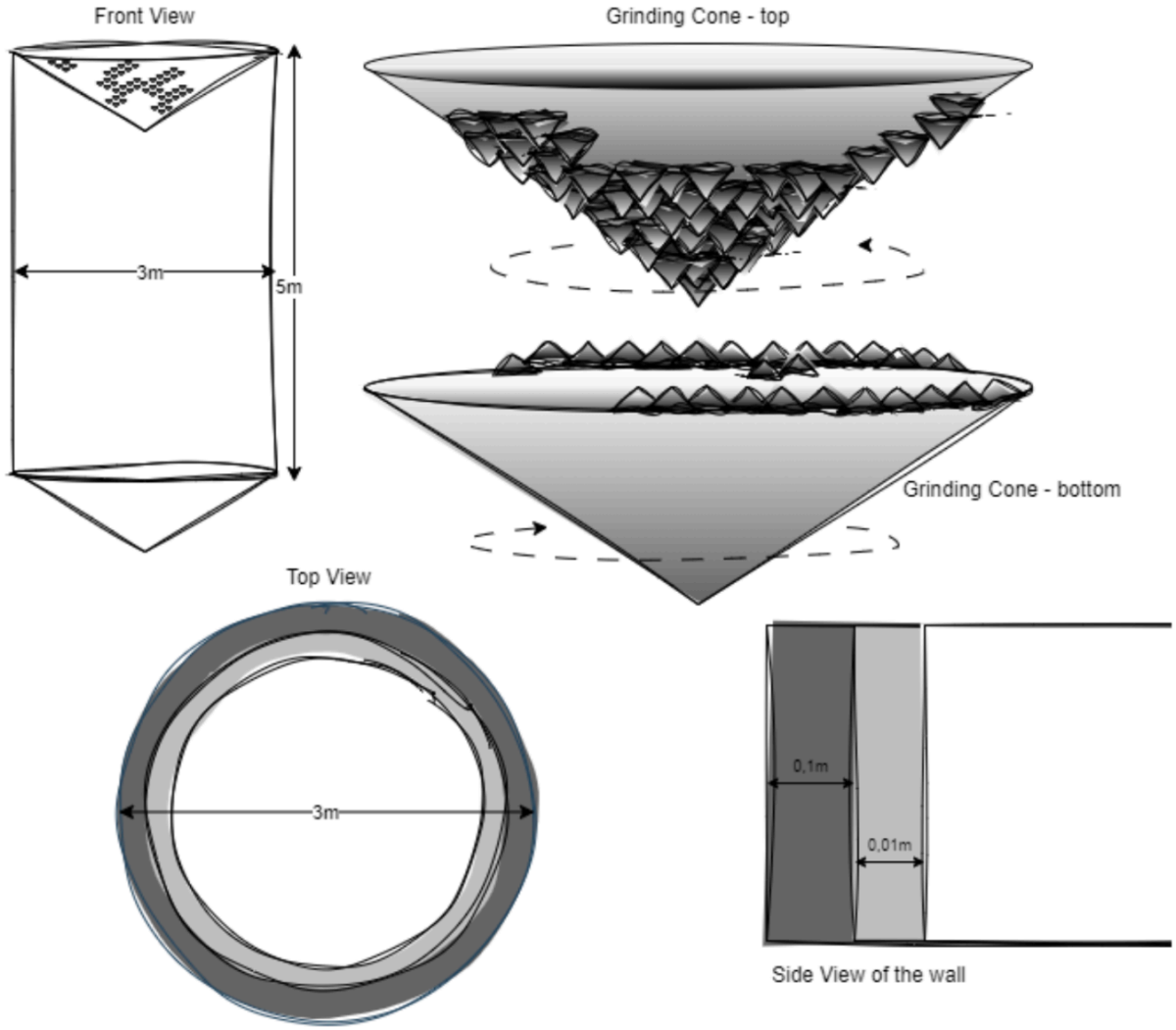


The individual actors and their roles will be defined in-depth during the following sections.

Raw Material Storage - After the introduction of the grappling arm, it is quite obvious that we store the unprocessed materials in smaller-bigger chunks in this container. To handle the materials accordingly, we have to shred them into smaller pieces, that our particle separators are able to separate the different elements. Therefore we introduce the idea of a grinding cone that operates within this storage space.

Grinding Cone - The grinding cone is -as its name shows- grinds the delivered asteroid pieces into tiny particles with maximal 1mm diameter. The cone and the bottom of the storage has several miniature knives (also cones), that can help create the grinding effect since they fit together perfectly. The effect is achieved by the rotation of the grinding cone and the storage itself, but they are spinning opposite directions. The cone on the top starts to push the raw chunks to the bottom, hence we are able to crush the content of the container into small particles. This way we can assure that our separators can process these particles faultlessly.

After the grinding process finished, we push the small particles into the Particle Separators with a piston.



Choice of Materials

However the Inconel 718 is highly durable, harder materials, such as iridium, wouldn't be crushed and nevertheless could cause harm in the inner walls of the storage. For these purposes, we would use hexa-Boron Nitride (h-BN). This material has a wide range of applications and can be used as an insulating coating due to its high level of hardness. h-BN is also known as synthetic diamonds because its hardness, ca. 10 Mohs on the scale. We would use this material due to its resilience to extreme mechanical stress and it is also widely used for grinding and squeezing purposes. To prevent the storage from any damage, a coat for the inner walls would be enough, however to be able to grind even the

hard materials into smaller pieces, our grinding cone shell made out of con-sized h-BN.

Constraints

To create a specified and detailed design, we set some constraints that are the followings: Storage: Material: Inconel 718, Hexa-Boron Nitride (h-BN) spray inside, Form: Cylinder, Height: 5 meters, Diameter: 3 meters, Thickness: 0.01 meter, h-BN coat thickness: 0.001 meter. In connection with: Gas Chamber, Particle Separators, Grinding Cones: Material: Hexa-Boron Nitride (h-BN), Form: Cone, Height: 1 meter, Diameter: 2.987 meters; Knives: Material: Hexa-Boron Nitride (h-BN), Form: Cone, Height: 0.005 meter, Diameter: 0.008 meter

Maximum Required Force - Determining the maximal grinding force that is needed, we used the worst-case scenario, where a huge plain iridium chunk arrives into the storage that we need to grind to the predefined sized spherical particles.

Particle Separators - The particle separators have a pivotal purpose, since they are separating the grind particles from each other. Such a centrifuge consists of 2 different parts, an inner- and an outer tube.

The outer tube is intended to hold the more dense particles and the inner tube is used for creating the actual centrifugal effect that pushes the particles to different distances based on their density. Thus the lighter grains (eg. rocky dust) stays closer to the center, while more dense ones get pushed towards the wall of the inner tube, closer to the wall of the outer tube. To be able to move these particles to the outside of the inner centrifuge, it is designed as a fine grained net. After the separation, due to the absence of gravitational force, we need to push the particles. To press the useful materials into their corresponding container, the Material Chamber, we designed a “bagel”. This is a piston with a hole on the inside that ensures that we are only pushing the metallic, more dense particles without the dust. Similarly, we use a piston to push the dust into the Dust Chamber. This tool sits inside of the bagel and fits perfectly into the inner tube. We took several factors into account, such as the inner tube’s net thickness based on the

needed centrifugal force for the sorting. These assumptions can be seen below.

Constraints

Our particle separators are designed in a way, to be cost-effective but still to separate the particles fast and precisely. Therefore the following assumptions has been made:

Number of separators: 5, Material: Inconel 718; Inner Tubes: Form: Cylinder, Height: 3 meters, Diameter: 1 meter; Piston: Height: 0.15 meter, Diameter: 0.99 meter; Outer Tubes: Form: Cylinder, Height: 3 meters, Diameter 1.6 meters, Thickness: 0.1 meter; Bagel: Height: 0.15 meter, Diameter: 0.6 meter; In connection with: Raw Material Storage, Material Chamber, Dust Chamber; Centrifugal Force for separation.

Thickness of the net using the centrifugal force we need, and based on the material it consists of, we estimated the thickness of the net:

Force and Pressure for pushing: Down below can be seen the calculated estimate on the force and the pressure that needs to be created by using the bagel and the piston to push the particles into their equivalent container.

Material Chamber

This chamber is our storage space for the precious materials we refine. It is coated with h-BN due to the protection from any mechanical damages that the iridium particles could potentially cause. After collecting the outsourced materials in this storage, it will wait for the pick-up and transport to Earth.

Constraints

Our material chamber is designed in a way, to be cost-effective but still be able to store a huge amount of separated materials. Therefore the following assumptions has been made:

Form: Cylinder, Height: 6 meters, Diameter: 4 meters, Thickness: 0,005 meters, Material: Inconel 718 coated with h-BN

In connection with: Particle Separators

Dust Chamber

This chamber is our storage space for the leftover rocky space dust. Similarly to the Material Chamber, this container will also wait for its pick-up and transport to the Moon or Mars to be used as a construction material for building human habitats.

Constraints

Our dust chamber is designed in a way, to be cost-effective but still be able to store a huge amount of leftover dust from the separation process. Therefore the following assumptions has been made:

Form: Cylinder, Height: 6 meters, Diameter: 4 meters, Thickness: 0,005 meter, Material: Inconel 718

In connection with: Particle Separators, Gas Chamber

Gas Chamber

Coming to a consensus, this component has an important role within the system. The gas chamber is intended to be used for internal cleaning purposes, described below.

Nitrogen - 99,9 %

Our choice lies on many different factors we took into account. First, we wanted to stick to a gas that can be used for both - cleaning and maneuvering in space. These aspects led us to nitrogen (N2).

This is an inert gas, meaning it does not readily react with other substances under normal conditions, which includes that it is a non-flammable and combustible gas.

However the burn resistance is crucial, on the other hand, we would use N2 for its common usage for pressurizing systems in space environments as well, eg. for fuel tanks, cabins. It can also be stored at a lower pressure due to the lack of atmosphere, which decreases our chamber’s volume, mass, and hence its costs.

Constraints

Our gas chamber is designed in a way to be cost-effective but still provide proper cleaning for the whole system. Therefore the following assumptions has been made:

Form: Cylinder, Height: 4 meters, Diameter: 2.5 meters, Thickness: 0.01 meter, Material: Inconel 718

In connection with: Raw Material Storage, Dust Chamber

Gas amount

Since the pressure is almost none in LEO, we can use the following equation to calculate the amount of the gas we can store. Notable that since it is a closed system in space environment, we can reuse the N2 after filtering, hence we don't need to store endless amount of nitrogen:

Circulation

To clean the system effectively, we measured the needed force that is necessary to reach ensuring the cleanliness in the system:

Communication with the Ground Segment

Specifying the communication with the Ground segment involves several aspects and components. In order to match our objectives and ensure that we have every important information, the design of the interfaces, choice of protocols has to be chosen carefully, because only this way can we decrease our risks as low as possible. Therefore the crew specified a variety of interfaces between all participant components, that are described in details below.

Spacecraft ←→ Ground Segment

In order to monitor the status of the spacecraft and be able to uplink commands from the Ground Segment, there is a need for communication. However we only have to receive the health status of the spacecraft, which does not require complex and huge data packages. The defined set of data is demonstrated below.

<<comm. data placeholder>>

As it has been shown above, the transmitted data pack is small enough in size and contains basic status information about the spacecraft, therefore the crew decided to use a low-gain antenna. This allows us to realize a low-level communication between the Ground Segment and the carrier spacecraft in order to transmit its status for monitoring purposes.

Payload ←→ Ground Segment

The payload will realize direct (DTE) communication to the Ground Segment, that means it does not transmit any data to its carrier spacecraft and vice versa. Since the leading objective is the physical processing of the mined asteroid blocks, the crew sticks to minimal data transmission between the above noted components.

Asteria OBD ←→ Ground Segment

In order to structure the downlinked data better, the on-board computer of Asteria is collecting the different sensory data packs from the different components. This way we can encapsulate the various information and hence we create the ability to transmit every necessary data in one single package. This choice supports software functionality, usability, efficiency, portability and integrity.

Consultative Committee for Space Data Systems (CCSDS) Protocols

Based on the noted antennas from the former sections, and on the downlinked data packages, the CCSDS protocol family is a perfect fit for these purposes. It is giving us nicely predefined ways and an extensive set of standardized protocols designed for space missions that correspond to low-level communications and more complex data reception/transmission as well.

Since this protocol family is large, we strict ourselves to 2 different types of it. The chosen protocols are meant to be used for in-space communication and widely trusted in the space industry, they provide us efficient, flexible and secured channels, that are:

CCSDS Telemetry Channel (TM): for transmitting telemetry data from the rocket to the ground.

CCSDS Command Channel (TC): for transmitting commands from the ground to the spacecraft.

Separated Source Transportation - not described in the project.

Payload Design

Asteria Space Mining Station will be composed of parts: Module for ships providing us the raw material, Material storage and Grinder, 5x Spinning Centrifugal Cylinders, 2 separated containers (for dust and for useful material), Gas container for technical use, Pipes connecting all the parts, Module for ships taking the material out and sending it to Earth

Spacecraft Design

In order to deploy Asteria, we have to carefully choose our carrier spacecraft as well. Based on the calculations and the design concepts of the mining station, our assumptions can be seen in details below. Since the space mining station consists of several modules that combined weight would cause a huge issue regarding the currently available spacecrafts' limit, we launch these components individually. However the modules remain to be heavy, the crew's considering to use the Falcon Heavy spacecraft that is capable to carry this amount of mass with the limitation of 64 metric tons to LEO. One of the major advantages of this choice is that this rocket is reusable, which plays an important role in our case due to the already mentioned reasons. This way we could lower the costs of the launches and stay more on the side of sustainability. The other major aspect is the proven reliability of the spacecraft. It has been successfully launched multiple times for test flights but this list also includes commercial satellites as well. Last but not least hence the secondary benefit of this option - versatility. It is designed to carry different kinds of payloads from satellites to probes for interplanetary missions and therefore we can minimize the risk of our components being damaged during this process.

Budget: 10 Billion $ (Crew made calculations in details and dozens of pages, which are not shown here).

Hanga Kathreiner

Exp.64 - Perseidia
01/08/2023 - 14/08/2023

Day 1

I felt a bit stressed at the beginning of the day, because we were delayed by ca. 2 hours but I adapted well to the new environment on this day quite quickly and I don't feel stressed anymore. I am happy that we are only by 3 so we can focus ourselves better on our experiment. The day really did fly by quite fast and in a good mood. I am comfortable with the people I am with and I am happy we don't have any kind of drama (yet).

I ate my meals, did the needed tests and was working on our experiment. I collected a bunch of questions on day0 that we started to answer today. I collected some ideas on the mining equipment and got into discussion about them. I think the team is on the right track and we achieved a lot by today. I took amazing photos of each other for PR material, created slides. I did the briefing and kept the crew up-to-date with the provided information from MCC during the day and formed their questions to MCC as well.

Day 2

I feel a bit burnt out because working on the experiment 6-7 hours is kind of brain melting, especially if we are discussing different topics under the design concepts that we have to keep in mind for each conversation, I feel working on this as an elongated brainstorming session that lasts for 2 weeks is not manageable and leads easily to actual burn-out. Would be nice to make the schedule a bit more colorful. → already reported to MCC. I ate my meals, did the needed tests and was working on our experiment. As a team, we elaborated on the below-noted topics regarding our competition material: Defined the spacecraft design, Defined payload design, Defined crucial components of the probe and

created a base concept of it, Elaborated on the return-home procedure of the storage block and the core concept of the probe's emergency procedures and backups, Gym: done, 1 hour, Communication: done the briefing and kept the crew up-to-date with the provided information from MCC during the day and formed their questions to MCC as well.

Day 3

I was really tired and a bit annoyed because I did not sleep so well. But at the end of the day I got slightly back to myself. We started to design the camera holders in TinkerCAD, experimented a bit with SketchUp too, closed phase1 for the competition material, did the needed test for day3 and rested after lunch a bit.

Day 4

Honestly the day went well and i don't have any problem with the crew. But I got some with today's debriefing session. I think we all understand that there are missing data that we have to fill out by the end of the day but there was no reason on MCC side for this kind of style as it was held today.. We also got some controversy I think especially with the data filling, since we all understood as of today that the Data Officer shall carry the data monitoring and he/she is the one who is responsible for that. However we got back that we all have to take care of the data of each of us, which seems to be pointless to me if there should be a data officer with such a dedicated role. I am not a fan of this style of communication at all. I would kindly note that we are here NOT JUST for the data, but for our experiment and after all for fun. Next thing: you don't have to type it several times. We don't need any tool for measuring the respiratory rate, we understand it for the first time as well. And if we do not have any pre-training we won't know about this, especially if it was not even stated until this day. The noted document on how to measure it is not found in the whole shared folder for this mission, so we cannot find it at this moment either. Another notable point from my side is that I felt that MCC person today did not really care about our progress and achievement, I felt he was not even in picture with that what I just told him, he said "good, ok" and placed a wall-of-text about missing data and how the crew is "progress below expected standards"... Excuse me, what the heck? For 4 days MCC stated that we are progressing

above standards.. So then what is the truth actually? I feel we did not exceed HIS standards likely. The next thing: if MCC can see us, then he could definitely see that I was currently typing my answer for the question he stated, but it's also visible in the signal chat. So there is no point to ask back 10 milliseconds later if I copy while I am literally texting the answer. After all: if the crew is getting so pissed off and annoyed just after 20 minutes of debriefing and they don't have any problem with each other at all, then there are definitely some issues. We take the critics and guidelines to improvements but with a manner. I know my report might feel rude, but this all was absolutely rude today… If the crew has to perform as the standards, you too. Thank you.

I won't go to the gym today because I am pissed. I did the needed measurements and tests, and elaborated on the experiment: payload design, communication realization, spacecraft comm

Day 5

Today we achieved pretty much, however it was also a bit stressful, because our crew had to completely redesign the whole mission starting with its objectives. We elaborated a lot on this new design and I think we are on the right track now. Still plenty of work remains that I am a bit worried about. Those are really advanced calculations and a huge effort needed from each of us. We will manage it until the deadline I am sure about that! Other than that I miss my boyfriend, we were living together in Germany for half a year but until I am in this isolation, he has to move out and go back to Hungary because of his studies. So I am a bit sad we won't meet in the upcoming month and I couldn't really say goodbye in person.

We redesigned the mission based on the competition rules and pointing system as following: Mission objective defined, Mission core design done, Space mining station preliminary design done, Some initial calculations on the separator is done, Concept is in an advanced state regarding the mining procedure that our space mining station will follow, Having a nap was great!, Did the needed tests for today, Had some fun time with the crew regarding the design decision 🙂

Day 6

I feel quite chilly today. I did not sleep too much but I could stay focused during the whole day I think and I don't feel as tired as a few days earlier. I like our new concepts regarding the experiment and getting energy by the conversations and fun times with the other crew members too. I think this really is a good crew! 🙂 The crew made a good progress today as well that are the followings: Put the whole design together, Calculated costs, energy, needed force and material choice of the raw material container, Calculated costs, energy and needed centrifugal force, with material choice of the centrifuge, Gas reusability concept for cleaning the internal system, Grappling arm for pulling the chunks from docked probes into the raw material container, Elaborated design on the knifes and the grinding effect in the raw container: force, energy, costs and material choice

Day 7

I feel quite relaxed today. I feel we achieved a lot and I really had some fun time with the crew during work, which I am happy about. However I feel a bit sad and stressed because of the things outside the habitat, especially work and being alone again in Germany after a long time. I hate living there and I don't really enjoy my time at my company either. I am working with 2 other people (3 member team) and they have 7-8 years of experience, which is great and I can learn a lot, but most of the time I only feel left-out, because if I ask something they don't really help me. Sometimes I cry (not here) during the night or even the day because they make me feel really dumb… I feel it does not matter how much I try and hogy much I develop because it won't ever be enough. I've never felt this feeling before regarding work. I really want to change but the company itself provides one of the best experiences in Europe as I noticed (at least regarding my field), so this is really hard because I cannot jump from one place to another especially in space-branch. I feel a bit my hands are tied and I cannot move forward with this. I got depressed by the situation and already have different physical problems because of the stress. (teeth, gut, stomach, eating disorder). This definitely does not have a good effect on my health in any kind of way… Another point is that my boyfriend moves out

tomorrow, we can't see each other so often, maybe once a month if I can go home, and this also makes me quite sad.

Today we performed a lot, we needed to recalculate some things because the calculations were wrong from yesterday, finished tasks: Choice of gas in the internal system, its mass, cost, reusability, circulation time in the system for proper cleaning, calculated, Calculated thickness of inconel 718 net for centrifuges, its mass, stress, costs, Calculated volume of the raw material storage, its thickness, mass, costs, Calculated volume of the grinding cones, its surface, number of knives, their mass, volume, overall costs, Pressure and force for the grinding cones, Centrifuges outer tube calculated: costs, mass, volume, thickness, Calculated bagel and pivot mass, volume, pressure, costs, Calculated force required to press the iridium chunks in the raw chamber, Overall design sketch, Tests for day 7.

Day 8

I feel quite chilly today, regarding my work-life outside the habitat. The situation is the same, I try to manage my feelings. I am a bit worried about Stan, try to cheer him up, or at least keep him in the current state at least, to avoid that he feels even worse. I don't know what the problem is, and I don't have to know, but it would be nice if I knew what could help him in this situation. Maybe more crew-time instead of work-time to feel less separated from the outside, I'll try. We could not make such a good progress as we planned unfortunately.

We could calculate the force we need in order to push the leftover particles from the raw material chamber, and we calculated the velocity of the gas we should use. Also found good ways to make the nitrogen into actual movement.

The reason we could not go further today was, it took pretty much time until we could figure out what is the most suitable way to get this nitrogen into movement inside of the system. We also started to take a look into the tools and techniques on how could we stabilize the temperature inside the station → this also takes some effect on the nitrogen flow so this is the other reason we got slow down a bit.

Day 9

I am feeling ok, a bit bad actually. I usually don't eat this much and I avoid dairy products, sweets and carbohydrates as well. I have an eating disorder, and sometimes it's really hard to eat and feel good at the same time. After many days eating food that I usually avoid, I started to feel the frustration and that I am getting fat even if I see on the tests that I am not. It's just hard being food for your enemy and some days I cannot cope with it well. We've create a draft document for an initial version of what we've done so far regarding the mining station, the followings are in the doc, either done or in an elaborated state.

Day 10

I feel a bit sad that we are close to the end of the mission. I really enjoyed my time here even if some days were tough. I am happy about our progress, and I learned a lot. I am happy that I met these people, also the crew and the MCC. This was a great 2 weeks and I hope I will meet these people again! I am good. The crew was really productive today.

Day 11

I am a bit sad that our time in the habitat has come to an end, I am grateful for this experience and the people I had the opportunity to meet with. I feel myself in my skin, these days focusing on what I really enjoy gives me back my self-esteem and I don't feel like I am worthless (that I usually feel while working to be honest). I got my motivation back that I highly appreciate! On the other hand I feel happy about leaving, I am waiting for a hot shower, some sunshine and mostly for fresh vegetables and good oolong tea.

Thank you for the crew and for MCC for this experience that I won't forget!

Expedition 64, Stanisław Maj, Poland

Asteria
01/08/2023 - 14/08/2023

Day 1

The MCC didn't wake us up and we were lying and being bored. However the day started off well, we were having so much fun taking the piss samples (that's actually so cool), then we were doing the Bioimpedance and Circadian experiments, next we were preparing breakfast (that screwed cocktail) which was really good, however it was too much. We are having so much fun complaining about the food, about the MCC, but we were and we are so happy working on our project and everyone was and is so focused on that. I am doing better than usual, I could sit there for months. We did our favorite meal - risotto, and as always we are doing it together which is so great. I hope we won't fight with each other but now it's like impossible for me. We are designing the spacecraft, we are just asking questions, thinking about potential problems, and answering and solving them. We are focused on that and we want to win.

Day 2

I woke up with no problems but I was a bit sleepy for 2 hours or more while working, however then I went to the gym and almost 'died' there so after that I felt so great that I was able to work and have fun and feel so good with that. I was frustrated while it was time to 'relax' - It's not good for me, I want to work harder, not to lie in bed and do nothing. I am not tired and I think we can do more than we are doing, I feel like I can do more, but I know the rest of the team are tired so I won't force them to do anything. Or should I? I think we need someone to lead but like for real, only with the project. The time here is so long, it's just the end of the second day but I feel like it's already the 5th or something like that. After all day I'm tired because before sleep there's a part that we're actually

doing nothing. So that's the problem for me. I don't know how to fix it because as I said I won't force anyone to do more - because we are already doing an amazing job, that's true. I once again, I feel like I can, we can do even more. Well, we were just specifying parts of our asteroid mission probe, there's nothing I can say exactly about that but we were working really really hard on it, we came to really good conclusions and I think we are doing amazing. We're doing circadian every 2h - nothing special, and I think it's nothing more.

Day 3

I don't remember, the day wasn't hard for us because we did everything so quickly that it left us with so much time to spare, for me it wasn't good because I have to keep my brain busy to not to go crazy but I think it might be ok just for that one time.

Day 4

Day was so cool at the beginning - I woke up with such good humor, our work was going so well during the whole day, we again did 200%. Then the real fun stuff begun - our new cap com (I hope not for long) was the best part of this day. And I'm talking to you dear Asit, are you not experienced, was that a test or are you just mean and passive aggressive? Just, explain it to me because I don't know. First, don't even dare to blame my crew for my oversights with data, I'm a Data Officer and every mistake is my mistake, so don't blame my people. Second of all, maybe read previous briefings to not ask the same questions a second time (that wouldn't be a problem, really, if you didn't do that so aggressively for us), next, why are you talking about things that we should do that doesn't exist? You are giving us wrong information. And what do you mean by: "however data shows you have not been performing to standards"? Krystian said to us many times that we are doing everything even above average, so what are your standards? Last but not least, are tables all you care about? Just, we have like so many better things to do than filling out tables, and again, don't blame my team for that, blame me, I don't care about it - I feel that I'm doing great and your aggressive behavior is not going to change that, however it affects my crew and they are

pissed off, I don’t want you to ruin our mission, so maybe consider changing your behavior and point of view, that’d be better for all of us, don’t you think? Fighting with each other it’s not the best option. I wish you all the best and better luck next time, I hope our future work will be better, thank you for your time.

Day 5

Now I really don’t have energy for elaborating on that but I’ll try my best. The day started so cool, even though my sleep quality was surprisingly bad - I fell asleep after about 4 h of lying in bed - it was too hot. Then the air conditioner cooled down the air so then I finally fell asleep. I woke up with such a good humor - I had a perspective that I would spend that day on 3d modeling probe - for our contest - however the plans had changed so we should do something quite different, namely designing the space station that will be a steelwork on the orbit, not the best thing to do after spending so much time on the quite other design, but I don’t regret that - I love working with my team, I love them, so it's worth it.

It’s too hard to remember everything about our project, however in the midday we decided to change our concept entirely, and it was quite shocking to me, suddenly almost all our work from previous days lost its sense. So we spent almost the whole day designing solutions for crushing, purification, screening, heating, evaporation, and centrifugation of regolith that might contain valuable materials. After lunch the rest of the team took a nap and I did my workout. When I finished they were still sleeping even though our time to rest had passed but I didn't have the heart to wake them - they deserved to rest. After they finally woke up we went back to work and designed machines for our Orbital Steelwork. I love brainstorming with them.

Day 6

Today was by far the worst and the hardest day yet. I woke up in a very sad mood, I don't know if I want to confess exactly why, but just let’s say I’ve been having a really hard time since the end of May and when I’m not busy I’m not capable of functioning normally. That’s why I’m trying to be busy almost all the time. Day

then wasn’t so bad when I focused on our work, however I had so many moments when I felt like crying and I actually did because I couldn’t help it - everything is just overwhelming me, I hate that. Focusing on the work wasn’t helping every time though - for a long time I was not capable of doing anything, I was just focusing on not to show my bad mood - it could affect the rest of the team and reduce our productivity - it’s more than we need, if I’m doing bad I at least should not have a bad influence on my team, that’s why I’m hiding everything - my sadness and sometimes even despair. I feel like I’m not going to make it - to stay here till the end - but obviously I have to and I will. That’s my duty to not to fail, I should and I will deal with that - that’s the best I can do about it. I should not complain. I have work to do and my emotions should not be more important than that. I know people from my team noticed something wrong is going on but I really don’t want to worry them - there’s no reason for doing that - that’d not be good for them and I should take care of the team, even though I’m leading sometimes I feel I am, and the leader should be unbreakable so my personal problems - no matter how big they are - should not be a reason for me to stop working and not being a support but a burden. Even though I’m trying my best to hide my bad feelings, sometimes I really can’t help it and I feel bad for that, that I cannot be strong enough, but for real, I am trying my best to deal with everything and I don’t even know how, I really thing I have to much on me and I cannot go through that. Now I’m really not sure if I’m gonna make it. I should do better than that, really, but I really feel overwhelmed and mission is not a reason - I’d feel the same anyway, on mission I’m doing even better than normally - reason is different but I really don’t want to confess because it’s to harmful for me and there’s no way that someone from MCC can directly help me, it’s just impossible for people who don't have magical abilities. If you can, please try to help me, I’d tell you what’s the problem and you’ll try to help me alright?

Day 7

I woke up feeling exhausted this morning after a restless night. Despite my fatigue, I was frustrated with myself for not being able to put on a happy face and pretend everything was okay. I didn't want anyone to see how sad I was feeling because it would affect our whole team. I'm overwhelmed by my problems and losing hope

that things will ever get better. But after taking a nap, I felt re-energized and went to the gym, channelling my despair into strength. I don't know what more to say. I just want to stop suffering, but working isn't enough and there's no way to fix anything, I failed and I have to suffer but I don't want to.

Day 8

I did not wake up on time - again. The team can see that I'm not alright, and they are trying to take care of me, which is so sweet and helps me, but I'm supposed to be the strongest, not the weakest in the crew, I'm mad at myself, really, and that's not good with all that sadness and despair controlling me and my body right now. I can't stand being here and working, but that's not bad, that's not the reason for my mood. I'm happy that I can do something, but I can't handle everything - that's overwhelming. That's just too much. I cannot fix that, and my despair doesn't let me function properly. I want it to end, I just cannot stand the perspective that in the end, everything doesn't matter because I cannot be happy, there's no way to fix it and I'm complaining again - it should not be like that, I should not show my weakness and complain, I should be strong to handle it all, but I'm not, and I want someone to help me, but I think that nobody can do that. I can't help crying in the toilet and passing out, I can't stand that, I need to talk to someone I trust but I don't think that'll help me. I've never felt so lonely in my whole life, because there was a person that could make me happy and lead me through the darkest depths of my life and now… When she's gone I can't stand it. I need it back and that's impossible. I can't stand it because it's my fault - I was not good enough and I'll never be. I lost. I lost my life, I lost my love, my happiness, my light, my guide, I am lost and I cannot do anything about it no matter how hard I try. I am a lonely, sad, lost person in the darkness. I don't know what to do.

Day 9

Days are worse and worse - that's not even because of the mission but I want to get out anyway. Team is trying to cheer me up and they are actually doing it great - like that. But during the day I was like: I have to wash all my emotions to be more productive and

work and I almost succeeded but I couldn't get rid of love - last thing that prevented me from becoming an emotionally empty person - the pure death. I got so scared because I saw what I could become and what I would become in the future. I just have no perspective in life, nothing seems to satisfy me any more. I want everything back and I know that's almost impossible and that's my fault. I just can't stand this pain of living like that, I am so alone even though I'm with 2 other people. Please I need help and I know that's impossible. I don't know what to do, I just want it to end please, I cannot stand it.

Day 10

Day started with an emergency – it was bad because of no chain of command and bad communication. My goal was to neutralize the HCl gas in the air and I knew how to do that but I know that some of these chemicals could kill us in real life, not imaginary like gas, that's why it took me so long. After that day was normal – bad. Again, I was not able to do anything and everyone thinks I'm just tired – physically. No, I'm not. I'm too depressed to do anything. That's the point. Lucky that was almost the last day, but I don't know how I'm gonna make it – I won't I think. I need help and I know it's impossible for now. I hate it so much. I'm just lost and I am in so deep shit that I cannot handle that. Things are not going good anymore and nothing satisfies me. I cannot feel happiness anymore because I lost everything again.

Expedition 64, Eryk Kopa, Poland

01/08/2023 - 14/08/2023

Day 1

The day was ok. We did a lot. It was fun sitting around the table and exchange ideas for a space mission. i got headache in the evening not fun I feel annoyed about it. I took Apap so it should

help. **I think our crew should have an alpha member(additional) to be the commander/project manager.** I found an analog astronaut book in the habitat. It felt really good to read a chapter about my old mission. Wonder if i can buy it from Agata. We spent the whole day sitting around the table laying groundwork for our project. My was interrupted because of the debriefing i don't'' feel good about it. I am a very picky eater, so trying new food is really challenging for me. Nevertheless I ate some during the day but not a lot, maybe i will lose weight during the mission. Wonder if my headache is due to not eating enough.

Day 2

Right now I feel ok, however during the day I felt I had a small burnout, started to feel slightly doubts because of the isolation, but I'm getting back to my normal state. Also time flies by very fast which i guess is a good thing. We nearly finished the preparation phase for the project. I think we will finish it tomorrow. I have doubts if we're gonna finish it on time, but we can't overwork ourselves. I still think we could have a experienced PM. For breakfast we had scramble eggs. I really don't like this type of food but I managed to eat some and I'm proud of myself. From my previous mission I know that the products we bought and products in recipes don't match intentionally because I didn't expect it to vary to this degree. But the good thing is that crew is more willing to experiment and change recipes.

Day 3

Today was very chill. We did everything we planned for the project and had plenty of time for relaxing and resting our mind. That was very important because it prevented us from serious burnout. I think we did A LOT with our project to this day. We have a mission objective, probe design and plan for the whole project plus paragraphs for the report. I'm worried that we are still not signed up. We finished the document with questions and came up with the paragraphs for the document plus we designed the holder for the camera. We did everything we wanted. I think we have a great working pace. The food was ok. I really like our lazy attitude about throwout cooking.

Day 4

I was feeling good this morning. I tried sleeping with an eyepatch. It was a fun experiment. I will repeat it tonight too. Project is moving forward at a rapid pace and we are waiting for Agata input which will be very valuable. I think we might finish it even before the end of the mission. My feelings are overall positive. The debriefing with the new MCC guy pissed me off like so much. Like Christ, how you can be so passive-aggressive and not even trying to understand the opposite side. Maybe he is new, inexperienced in working with humans or had good intentions but I didn't feel them. Better luck next time(if you are reading this), maybe he should try some communication course so that his intentions could be understood the way he intended. Plus he didn't seem to know what was happening on this mission. He didn't know our purpose, our equipment and he broke our immersion with the wrong wake up time. He told us to wake up on 25h like day has only 24h, plus he seems to not realize how much progress we have made with our project. We listed our impressive achievements and like the sheer scope of them should indicate that we are well in front of schedule. He was mean to us in general, at least that is my perception. I didn't mean to offend anybody, if somebody feels offended I'm sorry from the bottom of my heart. We did the experiment. Food was ok.

Day 5

My day was full of emotions. we suffered significant setback and we were so close to achieving our goal but now we start basically from the beginning the whole 4 days of work were super fun but we are 4 days behind i'm afraid we might not finish the project on time. I took a nice 1.5h nap. With the project we are starting designing our new vision which requires more time than I previously thought. I worried we might not finish it because a lot of unexpected stuff we need to do in field we have no experience in. The food today was okay. We are lazy and don't want to cook much I think we will run out of interesting food before the and of the mission.

Day 6

The day was okay. We took a longer than usual break during the day. We are working on our space refinery and perfecting the grinder design. We are on the right track to finish the overall design before the end of the mission. However I don't think we can finish the documentation before the end. Fortunately the deadline is in December so we can somehow manage. Today we did a lot of calculations for our project with the help of chat GPT, but he was not very helpful so we needed to squeeze the answers youtube of him. The food today was okay. We are lazy and don't want to cook much. I think we will run out of interesting food before the end of the mission. Wonder if after an emergency we could use the food from the fridge anyway. We have 45-50% food in the shelter, mostly good stuff such as cookies, Nutella and instant soup. MCC told us to reduce the amount to 10% but I added some more yesterday and I also put there most of our water.

Day 7

The day started pretty rough. I was super tired and had the worst sleep since the start of the mission. But mcc let us take a nap so i did and it was good. I had the best sleep since the start of the mission. After i woke up i felt really motivated to work so i worked. Calculations lots of different ones. Food was very ok today. We ate insta Chinese soup and pudding.

Day 8

The day was pretty uneventful apart from Stan having a breakdown I slowly starting to feel burn out but maybe it will go away tomorrow when we do something different. We could not make such a good progress as we planned unfortunately. We could calculate the force we need in order to push the leftover particles from the raw material chamber, and we calculated the velocity of the gas we should use. Also found good ways to make the nitrogen into actual movement. As always the food was ok. I tried making a tee today but somethING WAS wrong with the tee bag.

Day 9

Today was ok. The mission is slowly coming to an end. I'm feeling okay with this fact. 12 days is more than enough. We did a lot today. I am feeling happy because I can see in the document that we have done so much work during the last 5 days. We've create a draft document for an initial version of what we've done so far regarding the mining station, the followings are in the doc, either done or in an elaborated state:
- introduction
- mission objectives
- raw material storage design
- particle separator design
- gas chamber design
- payload and spacecraft design

As always the food was ok. The pink water is really good.

Day 10

Today was rough. We had barely woken up and out of nowhere we had an emergency but I guess that's why they are called emergencies. Our response to it left much to be desired but nevertheless we got a nice 7/10 if it was ok. I'm feeling a bit tense because the mission is slowly coming to an end and we haven't finished our experiment. We still have much to do and we will try to do as much as possible here. The crew was really productive today, we could cross out the following points on our list:
- design of the docker ports
- docker design written in the draft doc
- design and choice of the grappling arm, calculated costs
- grappling arm decisions included in the draft doc
- calculations adjusted (realized we need an extra coat in the inside, that changes the volume, mass, costs etc)
- designed the material and thrust chambers and their costs accordingly
- draft doc includes the dust and material chambers
- raw material storage design sketch in the draft

The food was okay. We skipped lunch today because we weren’t feeling hungry. I think I lost some appetite.

Day 11

Today was not really fun. I woke up without the will to do basically anything. I think like Stan I have reached my tipping point in isolation Today. Thank god it's the last day. We achieved a lot as well today, which means:
- Write the mission report
- Design the outside of the mining station: wings with solar panels and antennas, shield and docker port places
- Put figure into the daft for the wings, and sections about them
- adjustments of the docker, grappling arms, and raw material storage sections

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Expedition 65, Rym Chaid, Canada

CeareLUNA
13/08/2023 - 23/08/2023

Assessment of habitat design and isolation effect impacts on psychological well being

Isolation and confinement are concerning factors for astronaut's well-being in long duration spaceflight. On Earth, humans from all around the Globe have suffered from the effects of isolation following the COVID-19 pandemic. The purpose of my experiment is to use analog missions as a study of the psychological and emotional impact of isolation and habitat design for the preparation of future long term isolation of humans for Space and Earth purposes. In order to assess such impact, my aim was to conduct an experiment developed in 5 phases. The first 2 phases were conducted in collaboration with Thais Zuchetti, where she has been evaluating the ergonomy of Habitat 1.0 and I have been collecting data to evaluate the perception of Habitat 1.0 and the effects its design has on the psychological status of crew members. During Phase 3, I have been collecting data for evaluating the emotional status of crew members throughout the mission, by providing them a safe space and time everyday to openly discuss their feelings in front of a camera as a form of therapy session. Phase 4 focuses on performance. What were the expectations of each crew member for this mission and helping them assess their accomplishments, challenges, and lessons learned? I am also interested in evaluating how the design of the habitat and the confined spaces and isolation had an impact on the crew's performance. Finally, post-analysis will include cross-referencing the data collected by other psychological tests performed during our mission in order to build a more comprehensive understanding of the results. The end results would be to create a bank of data collection for factors and inhibitors of psychological and performance impacts during isolation and extreme environments which would then be used for future habitat, mission and expedition designs.

Effects of space-like environment analogs on yeast cells as a study for changes in immune system of astronauts

In pursuit of better understanding the effects of microgravity on the human immune response, I am studying with my team gene regulation in the yeast strain *Saccharomyces cerevisiae,* a model organism for Eukaryotes, under prolonged exposure to variable gravitational forces and space-like conditions. Space environment is believed to elicit changes in gene expression of Stress Response Element (STRE) genes, thereby altering signal transduction pathways and cell morphology. The objective is to examine gene expression of stress response genes in *Saccharomyces cerevisiae* II cells across various environmental stressors such as a stratospheric balloon flight, micro/hypergravity via parabolic flight and rocket launch payload, and controlled exposure to various gravities via a random positioning machine (rpm). The experiment will also allow for comparison between various space analogs for a more comprehensive data collection. With high UV radiation, extremely low temperatures and low pressure, the harsh environmental conditions of high altitude have positioned the stratosphere as a potential analog for the Mars environment. Parabolic flights on the other hand simulate for a short duration of time the effects of micro and hypergravity by performing numerous parabolas airborne. In order to conduct post-flight analysis of samples, specific stress response genes have been targeted for the study and will be analyzed through polymerase chain reaction (PCR) analysis on all flown samples and ground controls. PCR, which has been commonly used in yeast cells studies, will allow for detection of changes in the gene expression of the samples by studying the quantity of specific mRNA present in the samples. The scientific output of the experiment will provide information on which immune response- related genes mutate as a function of space-like environment, which can shed light on why astronauts and pilots experience more frequent occurrences of illness and colds due to weakened immune systems during spaceflight and airborne missions. The experiment will also contribute results to the pool of research initiatives that sets out to study the expression of specific genes in microgravity research.

Crew report CEARELUNA

Mission Crew:

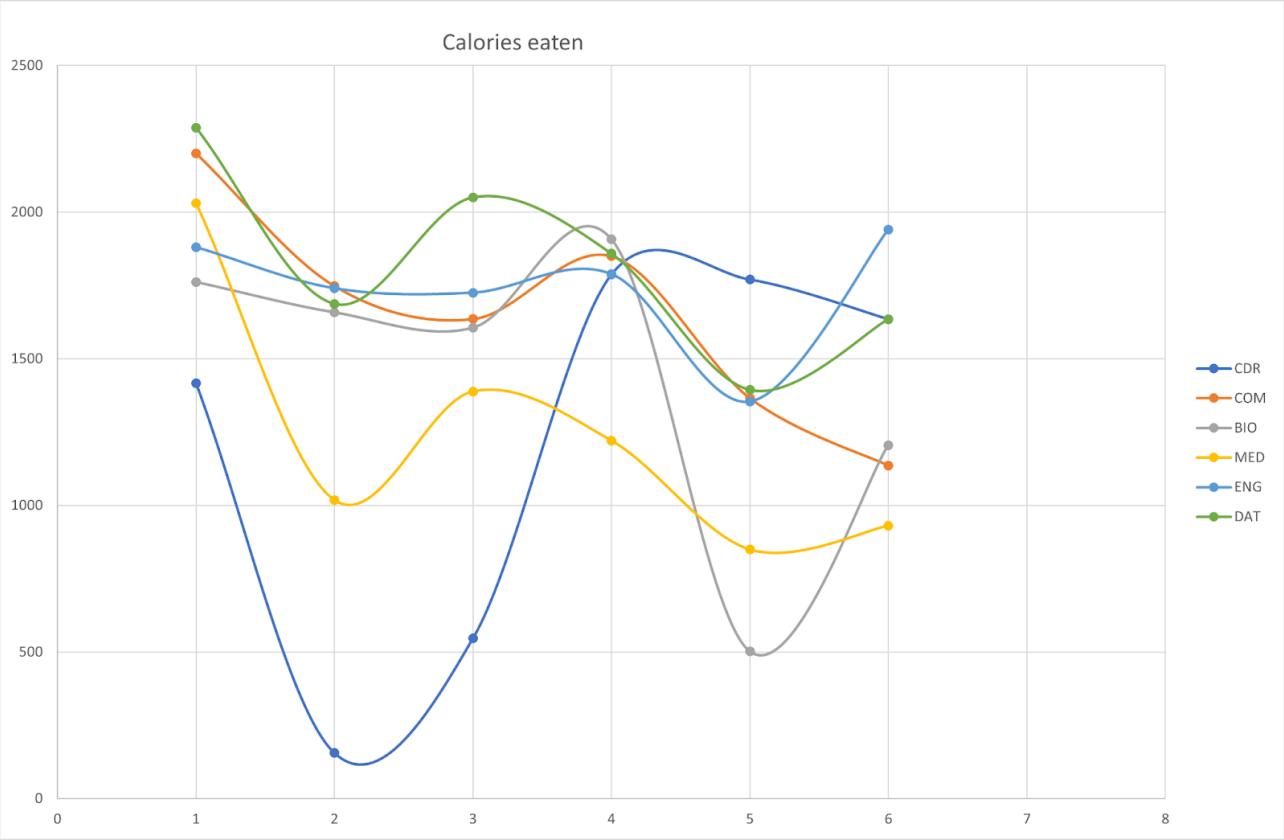
Commander: Rym Y. Chaid
Medical Officer: Ioanna Kakomyta
Communications Officer: Thais Zuchetti
Data Officer: Josselin Chenaye
Engineering Officer: Bartłomiej Bałecki
Biology Officer: Mohana Sai Amar

Mission Overview

Analogue astronaut missions provide on Earth an environment in which certain conditions of space exploration missions can be studied. Facilitated by AATC in Poland, the EXP65 (14-22nd August 2023) focussed on the psychological behavior aspects of the crew under isolation. A team of 6 analogue astronauts - commander (R. Chaid), communications officer (T.Zuchetti), medical officer (I. Kakomyta), data officer (J. Chenaye), engineering officer(B. Bałecki), biologist officer (M. Akula) shared the space of 55m^2 habitat for a total of 7-full days, resetting their "Earth clocks" to Mission Time clocks, restraining contact with the outside world so that the effects of isolation and constrained environment could simulate the conditions and the stresses that are likely to happen in a mission in Space when a group of people occupy a small space. The habitat has no windows, so the crew was also unaware of the natural conditions of the day or night-time and weather conditions. Throughout the days the crew performs daily health checks, reports sleep conditions, food and water intake. Every two hours on a daily basis, the crew reports to the "circadian" log in which basic information - body temperature, weight, respiratory rate - is combined with a brief description of each member's mood. This data is logged in one document that allows MCC - mission control center - and the members itself to keep track of vital status and mood changes through the days. Besides the daily monitoring tests, the crew's experiment of EXP65 was focussed on psychology, wellbeing, social interaction, and isolation effects in order to draw data to the PIs - principal investigators - to analyze traces and levels of stress, depression, sleep disorder and/or other possible hazardous effects of confinement. These experiments

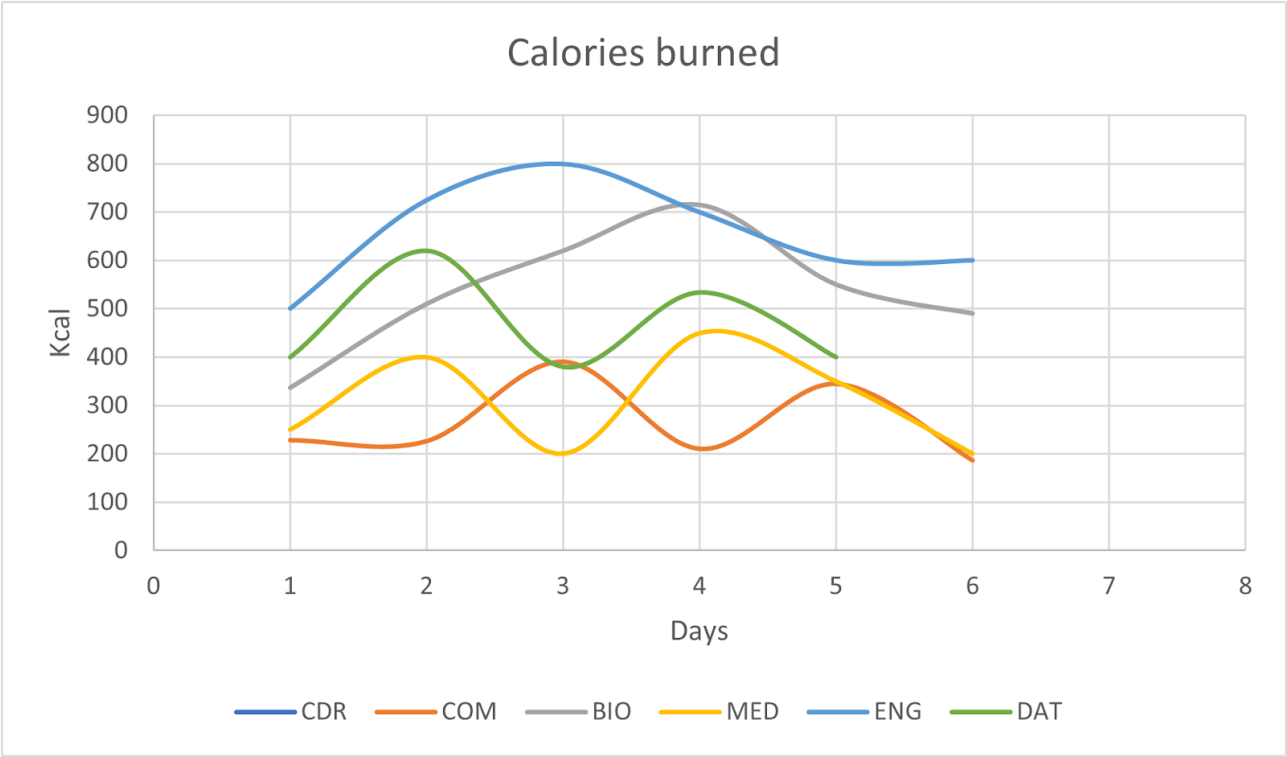
consisted mostly of dialyzing the mood of each day and answering questionnaires that focussed on the crew members' perception of oneself and the group dynamics. As mentioned on the campaign overview above, during the isolation period the crew members were submitted to daily collection of data in regards of:

Calorie intake: The crew followed a celiac diet and measured their calorie intake after every meal. Their daily calorie intake is shown in the table below:



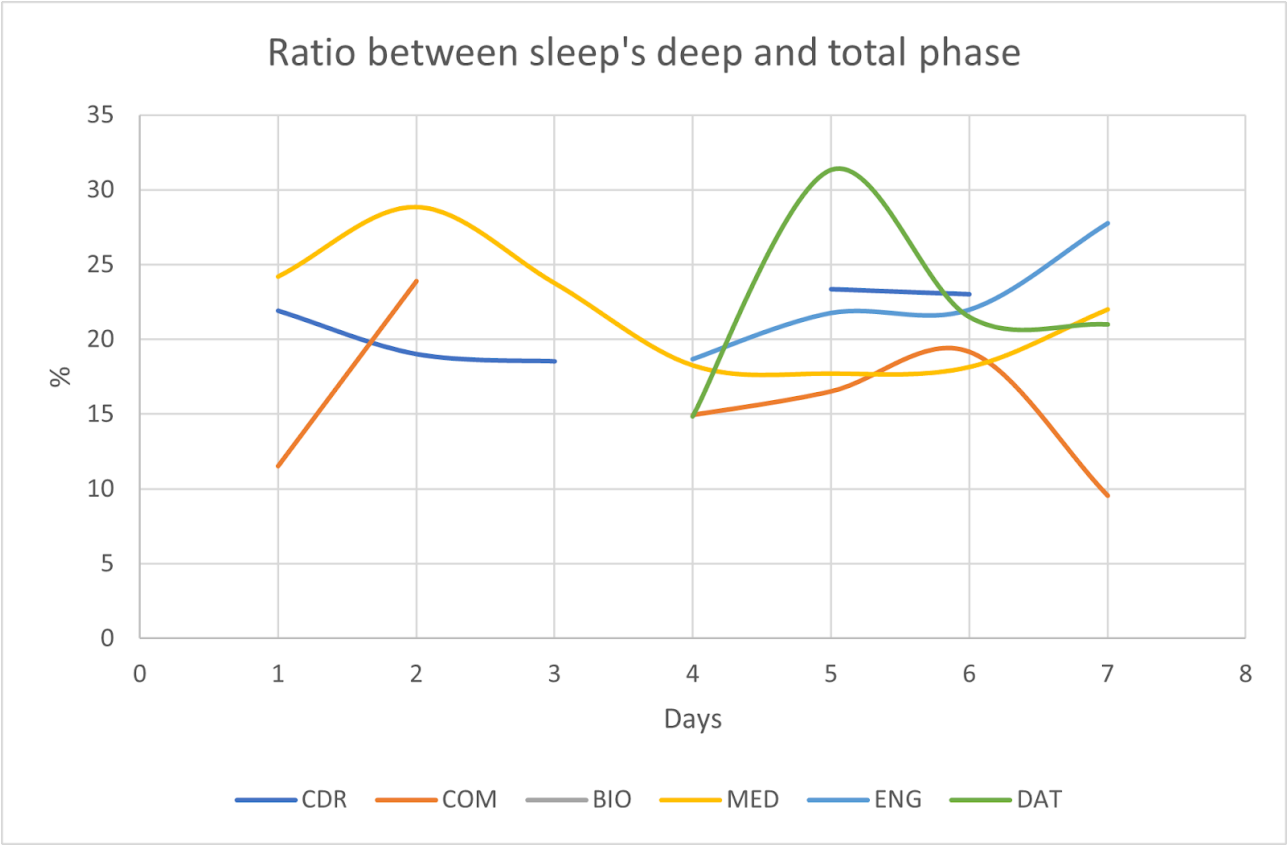
Calories burned:

Every day, the crew had 1 hour of gym time. The habitat's gym included an exercise bicycle, a treadmill, 1kg and 3kg weights.



Sleep phases:

Fitness watches were given to the crew when they arrived, which were able to measure the duration of different sleep phases.

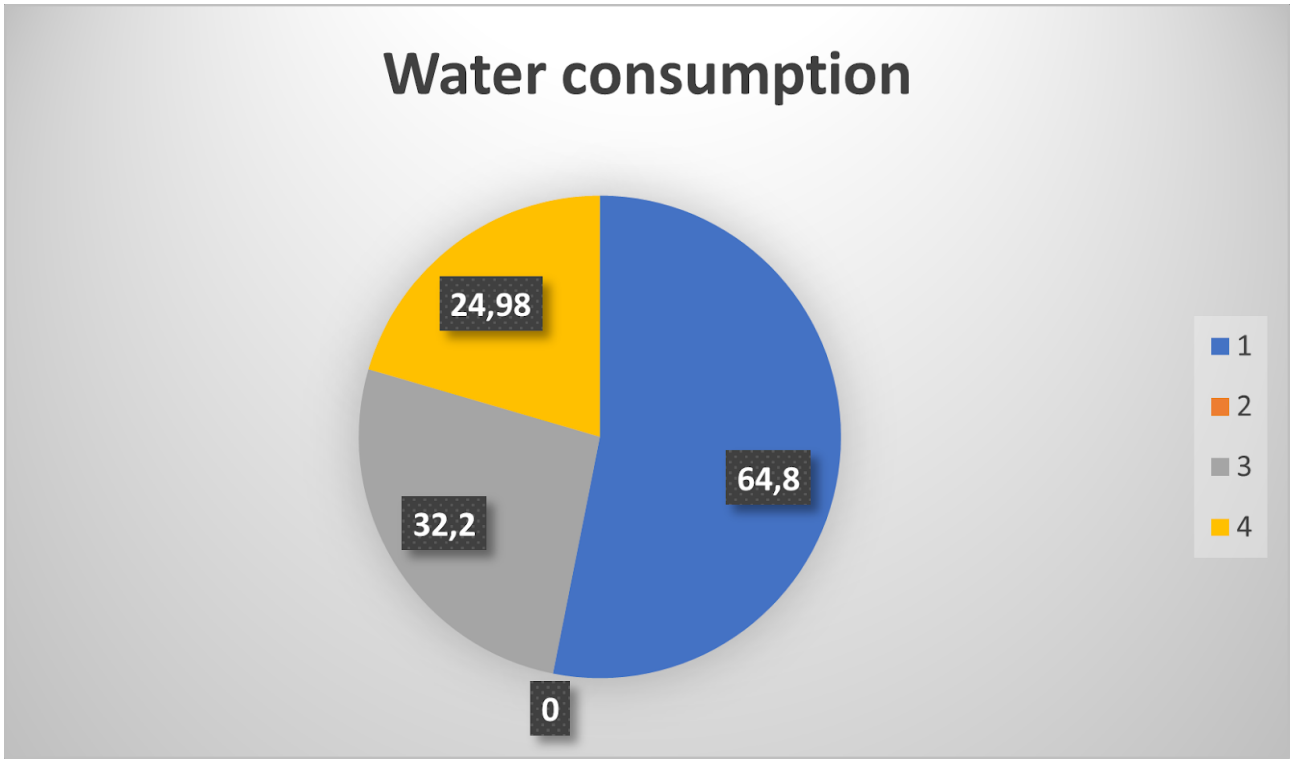


Water intake:

The crew did not have access to groundwater from the sink. Instead, it was using 5L water bottles to count their everyday water consumption and use for other purposes.

The following graph shows the stated below (total mission measurements):

- in blue color: water intake
- in grey color: water used for cooking and washing the dishes
- in yellow color: water used for hygiene
- hidden (value=0%): water used for hydroponics



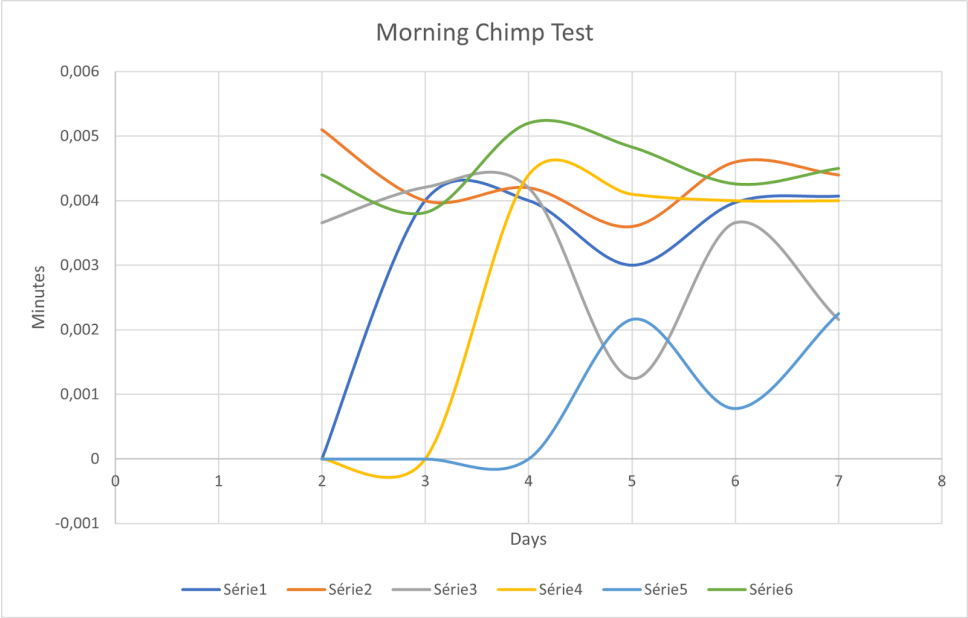
Chimp reflex test:

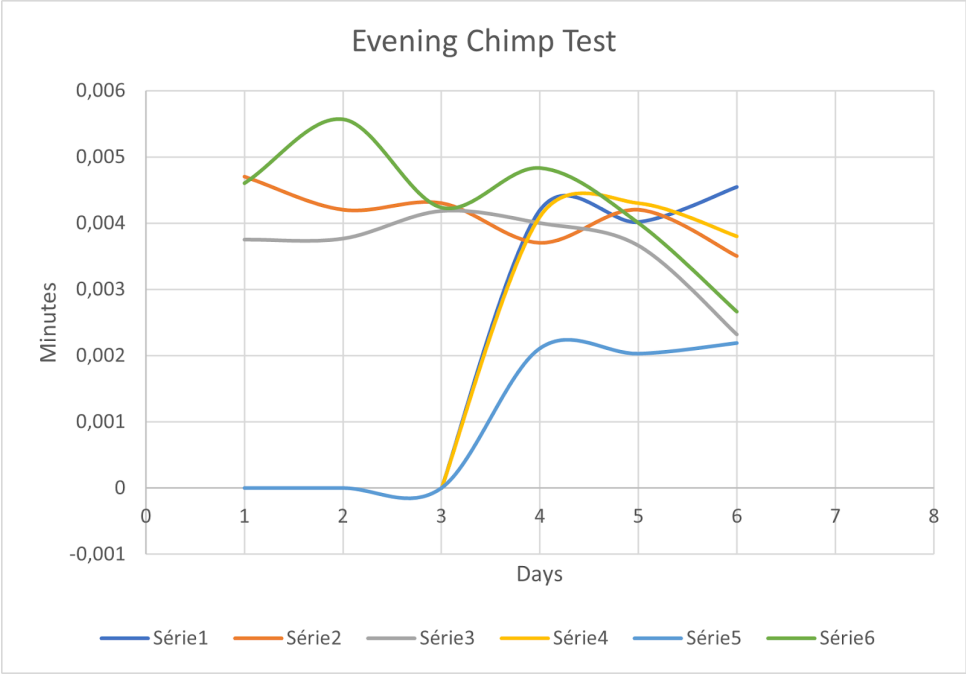
Each day, the crew measured their reflex abilities with the chimp both morning and evening. The Chimp test had the steps stated below:

1. Clicking the screen for the test to start
2. Red light shown on the screen

3. When green light appears, the person should click on the screen

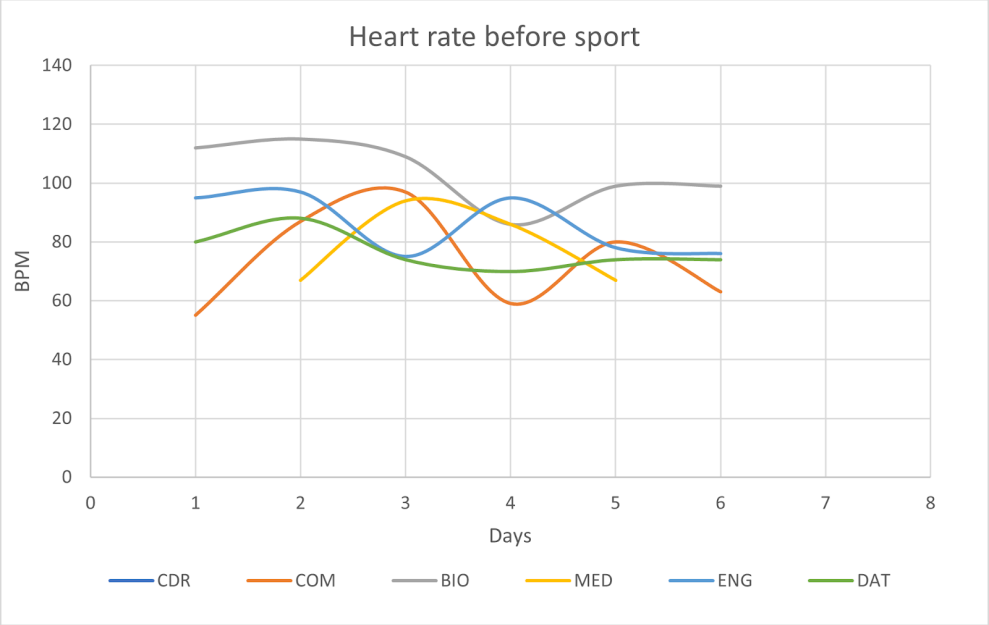
The test would measure the time in ms that took each person to react to the color change. The following graph shows the reflex time of each crew member each day of the mission

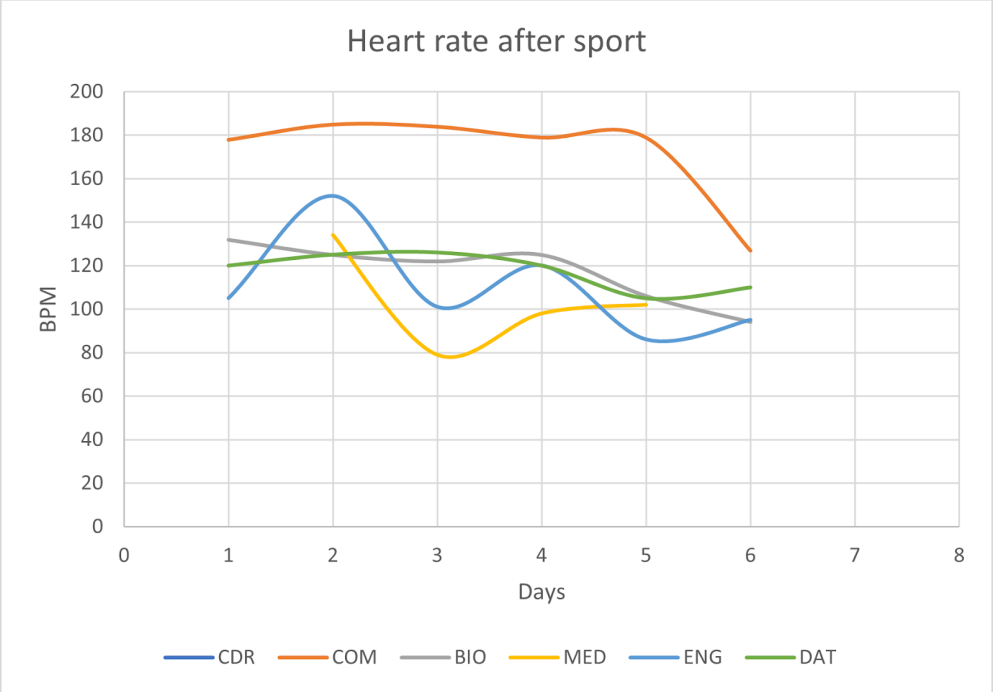




Crew's heart rates compared to gym

Before and after their gym time, each crew member had to measure their heart rate. The changes in its values can be seen in the graphs below.





Expedition 65, Mohana Sai Amar, India

CeareLUNA
13/08/2023 - 23/08/2023

Voyage of Solitude: An Indian Analog Astronaut's Lunar Odyssey

“Exploration knows no bounds, and analog astronauts are the pioneers of uncharted territories, testing the limits of human endurance and adaptability. As they venture into simulated frontiers, they carry the spirit of discovery, reminding us that every challenge is an opportunity to redefine what it means to explore and conquer the unknown”

Pre-Mission & Mission

In the heart of Poland away from Krakow city, beneath the expansive canvas of the cosmos, six nations converged in a groundbreaking International Lunar-Based Analog Astronaut Mission of isolation and self-discovery. Among the chosen few, I, representing India during August 2023, assumed the role of the crew biologist in this eclectic group of pioneers hailing from France, Poland, Brazil, Greece, and Canada. For eight days, we collectively embraced the challenge of absolute isolation, immersed in the lunar-like conditions that would shape our odysseys lived as an astronaut, navigating the challenges of complete isolation, the absence of external light, and a profound disconnect from the outside.

As the Sun dipped below the horizon, the sealed habitat became our haven—an isolated sanctuary that transported us to the lunar surface. The simulated absence of external light heightened our senses, plunging us into an otherworldly realm where shadows whispered secrets and every footstep resonated with the quietude of unexplored territories. Within the confines of the habitat, I

donned the mantle of a crew biologist, ready to unravel the mysteries of our lunar cocoon.The habitat is so good that we nowhere can associate ourselves with living on earth all the time. The habitat, meticulously designed to replicate lunar conditions, became my universe. The absence of natural light challenged my circadian rhythm, introducing a surreal dance between the artificial glow of the habitat and the vast darkness that surrounded me. Every step carried the weight of responsibility and the thrill of exploration, much like the pioneers who tread on the lunar surface. Communication with the outside world ceased, and our group of international analog astronauts found solace in the shared pursuit of lunar knowledge. We embarked on a collective journey, guided by the spirit of camaraderie that transcended linguistic barriers and cultural nuances. Together, we were a microcosm of Earth's diversity, fostering an intercultural symphony that harmonized our unique perspectives into a singular lunar melody.

The first 48 hours were so tough and habitat dominated me and my body's metabolism. I realized my body was operating from 3 different time zones simultaneously; one time zone change from India to Europe, two from Europe time zone to Mission Time as we only operate from Mission Time - NO AM or PM, NO MONDAY or SUNDAY and three from my own body’s circadian cycle. Another important thing I was conscious of was - Crew Dynamics, which is a must and should, especially in a confined space, and need to show utmost teamwork all the time. Being the first timer in these missions, the first 3 days I only settled myself understanding my body requirements and calculating my patterns throughout the day. From the 4th day onwards, I was able to enjoy every minute of Isolation as I could bring myself fully into the mode of mission. My metabolic parameters showed all normal levels, unlike the first 3 days. Group meetings with the Mission Control Centre (MCC) were fun as they bring an element of communication delay like the Moon and Earth. Most of our meals are pre-decided and calculated during the missions. Another important and interesting thing was ‘Emergency Simulations’, MCC tried to simulate an emergency and rate us how accurately as a team we are solving it and how quickly we are doing it as a team without dying(simulated :D) and without modules of habitat getting destroyed.

The most memorable moment is 3 for me during the whole mission, one when I got a chance to do a Google Meet with my university students, lecturers, friends, and family where I was able to interact with them from the habitat and tried to answer many questions from them, two is when we all decided one day instead of following the sports schedule of each candidate working out in gym we did a Zumba and it was so much fun we sort of managed our whole day length pretty much productive and this impact was there pretty much whole mission and third memorable moment when we got a question from MCC on one of the final days of mission morning briefings; what's the first thing you want to do after mission you exit from the isolation chamber and my reply was - coming from a country like India even till today we say Agriculture is our backbone and the relationship between man and earth touching it and walking on barefoot, yes I said I want to walk as long as possible on barefoot on soil. So these are a few of my best moments from the mission. I do have lonely and low moments, sitting on a commode in the toilet (4 fts length, 2.5 fts breadth, 6 ft height) collecting all the best moments of my life back in the country, thinking of my best well-wishers I used to regain the motivation and energy to continue in the mission. I have to acknowledge the fact that my energy also comes from the fact that I represent the world's most populated country and the globe's highest number of young people in this mission. As the mission concluded and the sealed door opened, we emerged into the natural light, changed and united by the lunar odyssey we had shared. Our footsteps echoed not only the trajectory of our lunar exploration but also the collective spirit of human endurance and collaboration. The International Lunar-Based Analog Astronaut Mission of AATC has transformed me into an ambassador of unity, resilience, and the universal quest for knowledge.The habitat, our lunar haven, may have been a simulation, but the bonds forged and the lessons learned were as real as the lunar soil beneath our boots. We left not as individuals but as ambassadors of a shared dream—a dream that transcended borders and embraced the universal spirit of exploration.

Post Mission

After almost 34 hours of flight journey after 18 days, I came back home and one of the first things I realized was that my taste buds

had become so sensitive to spice. I had difficulties with the metabolism of different organ systems. But As I returned from an International Lunar-Based Analog Astronaut Mission in Poland, the response from the people of my state echoed through the landscape, a resounding chorus of pride, wonder, and shared cosmic dreams. The news telecasting channels, usually adorned with local stories, now showcased a celestial odyssey that captivated the imagination of every household. Anchors, with a twinkle in their eyes, narrated the saga of an analog astronaut from our state who ventured into enduring complete isolation and living like an astronaut. The news broadcasts became portals, inviting every viewer to witness a hometown hero exploring lunar realms. Messages and calls from well-wishers transformed my return into a celebration. Every ping and ringtone carried with it a tidal wave of encouragement, uniting voices from all corners of the state. Well-wishers shared their awe and fascination, expressing a newfound connection through the journey of a local astronaut. Each word resonated with a collective spirit that echoed, "Our own among the stars."Invitations and felicitations cascaded like stardust from schools, colleges, and universities. Auditoriums transformed into cosmic theaters where students, educators, and thinkers gathered to unravel the mysteries of the lunar analog mission. Questions echoed through lecture halls, sparking conversations about possibilities beyond our planet, and the excitement of a future where one from their state had voyaged to the moon's shadow. The state had not merely witnessed a lunar odyssey; it had become an integral part of the cosmic narrative. We stood together, at the intersection of dreams and reality, where the cosmos had become a playground for the aspirations of an entire community. Overall, I have traveled to six different districts of my Telangana (state), India, and directly reached out to 3300 + students from the school level to the university and opened up every igniting mind a question and thoughts on Human Space Explorations and importance of Analog Astronaut Missions.

"As the reading ride comes to an end, I reflect upon the luminous tapestry woven across the habitat, bound together by the shared dreams of six nations. The International Lunar-Based Analog Astronaut Mission was not merely a journey into isolation; it was a testament to the resilience of the human

***spirit, the unity forged in the crucible of exploration, and the harmonious dance of diverse cultures under the cosmic umbrella. In the absence of external light, we discovered the brilliance within ourselves, and in the silence of isolation, we found the symphony of shared aspirations that transcend borders. As I return from the analog moonlit reverie, the echoes of trust, remind me that, despite our varied origins, we are all stardust-bound dreamers, reaching for the cosmos together.*"**

Expedition 65, Commander Report

CeareLUNA
13/08/2023 - 23/08/2023

Day 1

I am very happy about today's outcome. It was a very challenging morning as we needed to familiarize ourselves with equipment, procedures and habitat. We also did not realize how time consuming each time would be seeing as we had never done them before. I stepped in eventually and designated specific tasks for everyone and delegated procedures, and I believe this helped the crew work more cohesively, independently and efficiently. We also needed to address some tensions during lunch along with one crew member, but we took the time to hear him out and resolve conflict. I have also discussed in private with him later on and I am confident we will be able to build a stronger dynamic together. Overall, very exhausted by today but also very proud of our crew!! Experiments: chimp, glucose, bioimpedance, urine test, heart rate and blood pressure, cpr manikin demonstration with filming crew, vitals demonstration with film crew, assigning tasks to crew, assigning emergency procedures to crew, keeping constant track and overview of all crew members' updates for experiments, tests and reports, photo collection, presentation for PR, social interaction test, Celia's tests.

Day 2

Today I felt very good as I was very concentrated on tasks. The crew was also more familiar with the habitat, the tests we must perform, our schedules and each other.

UPDATE FOR MD-1:

I can sense that Amar has some stress and tension over him so I am talking to him often to monitor his status and his well-being. Yesterday, there was a moment of tension in the habitat prior to and during lunch regarding some comments made towards crew and CDR with regards to decision'-making. He is having some difficulty adjusting to the habitat and the current crew dynamics and I can sense that with his body language and choice of words when communicating. Monitoring his vitals also shows me that he is in hypertension and I have discussed this with a medical officer who has also confirmed the same concerns. I mediated the discussion over lunch and we all managed to resolve this talk in a calm manner, however I took the time to debrief with some crew members afterwards and they were concerned about his overreaction, to which I agree, but I believe that stress and vulnerable states are normal in an isolated space with people from very different cultural backgrounds and emotional reactions. One thing of concern to note is that while the conversation involved the whole crew, it felt very targeted towards commander and this was not the first instance that I had felt picked on by him a little (which was also assessed by the other members that debriefed with me) but I assumed originally that this was simply a cultural difference in methods of communication (tones, words..). I am not taking this personally or as an offense at all, but seeing as Amar seemed to have very strong desire to become the commander of crew hg, I am concerned as to whether or not he is having difficulty adjusting to the current roles within the habitat, so I have started to pay closer attention to his feelings to ensure he is more comfortable and does not feel left out.

UPDATE FOR MD'-1 OVER:

Today has been a very challenging day but we have managed to get through it. A few things happened today: the start of

experiments which added an additional layer of stress within the habitat, a tense discussion between 2 crew members that escalated into an argument, and our first emergency simulation as a crew. I will start with the incident. A tense discussion between MED and BIO escalated into a conflict regarding bio making accusations at med of leaving him out of the ultrasound experiment. While I was coming into mesa, I saw med and bio talking in the door of geolab. I could not depict what they were discussing yet but as I saw that their body language was very tense (wide open eyes, rigid bodies, hands open in “_stop”_ sign, vocal tones going up) I assessed that it would be important to intervene. I came between the two of them while still leaving the space between them open (so they could keep seeing each other and communicating) and I asked them to calm down and take turns explaining what had happened and what was the argument about. While med collaborated quickly, it took a lot of effort for bio to comply even after I explained that I was simply there to mediate and ensure the safety (physical and emotional) of all crew members. The situation between the two of them was not getting better and only escalated so I stepped in and requested they both stopped for a moment and explain to me (and each other) what was the issue they both had, what they were feeling and why they felt that way. I could see that bio was in a very agitated state (sweating, continuously interrupting, refusal to collaborate or comply, wide eyes, loud vocal tones). It is also important for me to note that as soon as I arrived on the scene (before I stepped in to mediate), he included me in his accusations and shifted his anger towards me which alerted me that the concerns that were noted the day before might be true? All in all, the three of us managed to end the argument and discuss further steps [cdr (myself) and bio explained that he was not left out of the experiment at all, but that the experiment simply hadn't started because other tasks had priority, and that he was welcome to start researching/ brainstorming on the subject if he wanted to]. I stayed to have a conversation with bio regarding the underlying issue of his stress level and his loss of temper with regards to other crew members. He opened up and stated that he was in a vulnerable state emotionally within the habitat.

Day 3

Productive. Thoughtful. Today is a new day and I intend to make the most of it. Today I continued to work on my experiments. For the yeast cultures, I have preselected some STRE genes after extensive research and am looking into focusing on genes for the PCR analysis. I am also looking into some indicators and some methodology for RNA later/protect with regards to my experiment. For the psychology experiment, I have continued with my list. review, and I have started creating the forms for data collection of the crew. Two of my forms will be in collaboration with Thais, and the others will be individual. Skipped breakfast and lunch today because my stomach was feeling empty.

Day 4

Feeling empathy and self assessment. Had a private moment with one of the crew members for personal time (we needed to talk and laugh together because we were working very hard and I realized I hadn't taken a single break since the moment I woke up until MT10 so I took time off and enjoyed talking with Ioanna). Started working on an ultrasound machine experiment. Collected data for experiment with ecg. Worked on a psychology experiment. Supervised and supported all crew members. Monitored all crew members physical, emotional and mental health.

Day 5

Today I felt depressed and had lots of self doubt. I am also frustrated because I have done the Francesco experiment diary 2-3 times today and it keeps bugging. I hope the data was saved because I don't feel like redoing it a 4th time especially since this is a personal diary where I took the time to open up and share vulnerable emotions so this is very frustrating. I noticed that I was not feeling good today. I was feeling disappointed with myself because while I have been taking care of everyone in the habitat, I have neglected to take care of myself and I ended up falling behind in my own tasks.

I have taken a moment today to self reflect as to why I was feeling these emotions and what steps I could do in order to better manage this.

I have concluded a few things:

- I realized that my body is tense, I haven't smiled and/or laughed in a while and while I am very serious at work, I typically am someone who is constantly smiling and laughing at everything so this feels off. While I have focused on addressing and relieving the tensions around the habitat after the incident on MD2, I am happy to see that the positive energy and love is back around in the habitat. I have also realized that I perhaps have been putting too much unnecessary pressure on myself. After we had spent some days together in Habitat 2.0 all of us together, the crew had requested that I be elected commander and I suppose I put pressure on myself not to disappoint them.

- Bio officer has been having trouble adjusting in the habitat and with the current crew dynamics so I have spent a lot of time with him discussing emotions, feelings, stress management and assessing his wellbeing in terms of vitals and making sure he feels a sentiment of belonging. I have observed many efforts from his end the past few days and this makes me very happy and extremely proud as I understand this might not be an easy task for him. His vitals are also reflecting his well being now and as he started being more joyful, I noted that he has a beautiful smile that I wish we will all see more of.

- Emotional health is just as important as physical and mental health when it comes to well being and ability to work properly and produce good quality results and this includes everybody in the crew, even myself!

- COM is doing great as well but I am trying to assess whether or not she has too much on her shoulders as a communications officer since this role has a lot of going back and forth. I have also noted that she has a good empathy level. However, she has a lot more empty time as the rest of

crew due to the nature of her experiments, and she steps in from time to time to check on the progress of people and give tasks, which is appreciated but at times it seems more controlling than helping and sometimes she steps in when it should be my place to do so without letting me proper room with other crew members. I can see that her intentions are good but I will keep my eyes open as helping fill the gaps is great and very appreciated, but overstepping boundaries is something that can easily change crew dynamics if it's more on the controlling side. Her and I had a chat yesterday (a general conversation and chit chat) and this topic was brought up by herself, where she was telling me that she was happy about me being CRD and my performance, and that she felt she would have struggled with being too controlling of everyone and every experiment if she had been CRD. After this I kept an eye open and I can see what she meant, as I am sensing that the more the days advance, the more controlling she becomes so I understand how this could have been an issue for some crew members. I will however note that I appreciate her enthusiasm for helping around the habitat and that it's evident that her intentions are coming from a good place!

- ENG might not speak much, but he has my favorite smile in the habitat. He is calm, soothing and grounding and I have remarked that this is having a positive effect on everyone. Him and I had a great conversation today and he had some questions on how to manage a multidisciplinary lifestyle so I am very happy that he reached out to me for help/talk even for something that would be good for him not only on mission but also back on Earth. I loved talking to him today, it always makes me feel full of positive energy afterwards.

Today I made sure to stay on track on tests and reports (myself included)! And I am happy that I managed to do so.

I haven't worked on personal experiments much today as I had other priorities to fulfill first. I did however spend more time with myself today and I trusted the team more to work independently. I have spent the whole mission working with them everyday and

guiding them and I felt today that I could provide them more space to be more independent and take initiative and some leadership where they wanted to. I also used this opportunity to spend more time on myself. I took a much needed nap as well as I wanted to listen to my body that was telling me signs of heavy sleep deprivation. I did however assign specific crew mates to specific tasks, for example, COMS was in charge of amulets, MED was in charge of circadian, BIO of waste, I was in charge of cooking today but COM very kindly helped me (I am not a skilled cook but I adapted and learned new skills alone and with help of COMS and in the end everyone seemed satisfied) , DATA was in charge of data sheet, etc… I also decided to organize a common crew session gym session today at MT instead of each member at a different time. We had a lot of fun and everyone seemed very happy afterwards!!!!!! We started with 30 minutes of Zumba and latin dancing, followed by 2 minutes of full body workout and minutes of group ritual. ENG reached out to me and asked me for feedback on how to fix the broken fan so I helped him with that along with DATA. He managed later to fix it so we are all happy in the habitat about working fans.

Day 6

Today I personally felt good about my own progress, until I had to interrupt my tasks in order to mediate a situation between MED and BIO. I had some discussion with med and I had some discussion with bio. I also organized a 3 way open communication conversation with myself, bio and med and moderated the discussion between the three of us. It ended up being a good conversation to address everything that was needed and both BIO and MED reported to me that they were very happy about how this was handled. I did have additional stress because of this however because it means that all my tasks were delayed once again due to the crew needing me. I also had to step in and help MED work on Stratospheric specimens with dilution and I will be helping with counting as well. Today I was very well advancing in my research for my personal experiments (I was able to isolate myself a little bit in my bed in order to focus on my research). But I had to interrupt the progress to step in for other crew members' needs and this

means that I had to sacrifice some of my personal tasks and personal interests. I had to work on dilution with MED for the strat specimen, I had a discussion with med regarding the non invasive abdomen experiment and decided to drop the ultrasound from the experiment and focus on Ecg. I managed however to prepare the yeast culture for my personal experiment prior in the day with med, and I am currently letting it germinate in a sterile l environment so that I can count them tomorrow. I also advanced in the research with psychological study and yeast microgravity experiments. I also stepped in to help DATA and ENG with their personal experiment in terms of design and troubleshooting.

Day 7

Today was a very good day. Very sleep deprived, but also nostalgic and thoughtful as today is our last day in habitat. I wish we had more time here as I believe we have now started to find our groove in terms of task completion, and I have also managed to have discussions with all crew members regarding some of the tensions that arose during the mission and all conflicts have been resolved. I am curious to know what could have happened if we had more time as a crew. While I believe some of the crew members would benefit from taking some time off to work on their emotional well being. I have also already taken the steps to look for helping each other out with publications and conferences. I will be helping particularly Thais with her publications, and will help her with conference presentations as well. I have also discussed with certain crew members about doing other analog missions together with the same roles and dynamics we have built here together! There was a little bit of frustration in the evening debriefing due to lack of communication regarding the expectation for personal experiment. MED particularly was affected by this but all the decisions and calls I have made regarding this tonight were approved by the rest of the crew nonetheless. I will try to cheer up as I can feel the end of the mission is a bit hard on her perhaps (on all of us really!) and I hope our closing ceremony will help all of us to relax and have an opportunity to stop and celebrate all that we have done! Today was a very good day. I managed to finish all of my objectives for this mission: sample collection, research, collaboration, methodology, documentation. I also was thinking

that it is very important to leave the habitat in a much better state that we found it from the previous crew. Therefore, the past few days I have assigned certain crew members that had shorter experiments to create an inventory list of all equipment in habitat and provide the status of the equipment to help AATC, as well as an inventory of food in the cupboard to avoid more waste from future crews. Today both of these inventories have been completed and I am very proud of our crew!

Expedition 67, Adriana Talianova, Slovakia

Asteria

10/09/2023 - 20/09/2023

Mousetronaut P. P. Bucket

Day 1

A crew of three: me (communications officer), Martin (medical officer) and Stanislav (emergency situations commander) started slowly settling in the habitat. We had already unpacked all of our food, partially planned our experiments and were getting familiar with all the data. Little did we know that that day we will be joined by a fourth “crew member” or as some call it, an alien species. While getting familiar with the habitat, Martin opened the glove box to explore his options for his experiments, however, probably the last thing he expected was a mouse running right past him, through the habitat and hiding somewhere behind a pile of boxes. He informed me immediately but because of the lack of panic on his face and the absurdity of the situation, I thought he was joking. Once he convinced me he was not making fun of me, we informed MCC and had to make a plan. First things first, of course we closed all the shelves with food and left no snacks out but we were not particularly happy about the idea of a mouse running through our habitat for a week. We must have not been the first crew with

this issue as the mission manual sent by MCC had a whole chapter dedicated to how to properly catch a rodent. That's when Stanislav took matters into his own hands and spent the next day building a mouse trap according to the given instructions. It was adapted to consist of an upright standing 1.5l water bottle cut in near the neck and bent 90 degrees, a trap door made of cardboard covered the hole to the bottom of the bottle. Additionally a ladder to the trap door was made out of boxes and tools. We even sacrificed a piece of chocolate and a spoon of peanut butter to lure the mouse into the trap. To perfect it even more, Stanislav decided to leave flour around the trap to see if the mouse came near. To my great disappointment, when we woke up, a piece of the chocolate was gone but there was no mouse in the trap and nor any traces of it. Instead of going from the front it must have climbed from the side, thus avoiding our trap while still enjoying the chocolate. We just got mocked by a mouse! Well Stanislav was definitely not gonna let that slide. Within seconds he opened his laptop and the next thing we could hear was "5 most effective 3D printed mouse traps" coming out of a YouTube video. Right after that our 3D design research project was put on hold and we started printing one of the traps he concluded would be the most effective. This time the trap was much simpler and it consisted of a one-way door attached to a plane that was then screwed onto a jar. The plane was further extruded to the sides of the jar to prevent it from rolling and thus opening the one-way door when it is upside down.

Day 3

During breakfast I could see the mouse running through the work table and hiding behind the glove box. "Is it the same mouse?" MCC asked. We haven't asked the mouse for its name yet. So what do we call him? Meteor according to a mousetronaut children's book? Jerry as a reference to the Tom and Jerry series? Or perhaps after the most used item in the habitat, the pee bucket? P. P. Bucket stuck but it was not until day 6 that we saw him again, this time in our 3D printed trap enjoying the peanut butter. Stanislav was smiling in victory because "the one who laughs last laughs the hardest". After this MCC called us insane for spending 6 days catching a mouse but we needed to know what to do next. Ideas such as drowning it or using CO2 were on the table, and

MCC was sending us mixed signals. Some said learning how to kill a mouse was the most fun part of their studies, others argued it was against the Geneva Convention.

We were also allowed to perform an EVA and let the mouse out through the airlock (it's a space mouse of course!) but we decided against it as it would almost surely return. Since most of the crew members were against harming the mouse, our only option was to keep it and build it a home out of laboratory equipment and a box. It could use some improvements but compared to the glove box, its a luxury mansion where we've been serving her oats of the highest quality. Now officially labeled Cpt. P. P. Bucket, we can proudly say crew 67 has the first analog mousetronaut!

Expedition 68, Frida Cabarello, Sweden

Third all female analog mission

D.A.R.K.
20/09/2023 - 30/09/2023

Pre-Mission

I cannot describe the feeling I had when I received the notification from AATC that I was accepted to the Lunar mission. The day I had fought for has finally come. After the announcement, I spent the summer in El Salvador, my ancestral homeland, focusing on my mental health and having my first vacation after some years. My relatives there were the first to hear about the news, but I had difficulty explaining to them what an Analog Astronaut is and what it entails. I still hadn't processed the fact that after the summer, I would go down to AATC in Poland and become an analog astronaut. Now the summer is over, and it was time for me to prepare for the mission. I had no training at all during the summer, so my goal was to try to get in shape before it was time to go to Poland, and also buy everything I need for my analog astronaut

training. Before embarking on this expedition, I sought the comforting presence of Maha, my best friend, and told her about the news and how nervous I am during our coffee gathering. The day has finally come, and it was time for me to fly to Poland and finally meet my crew: Natalia Godlewska and Dahlia Tagne. I had no idea what was going to happen or what I should expect in the coming days. Suddenly it was time to go into isolation and start the mission, Mission D.A.R.K (Deep Space Aid and Resilience Knowledge).

During Mission

I was appointed as the Mission Commander and Medical Officer., The commander is the person in charge, bearing the ultimate responsibility for the success of the mission and the safety of the Crew. As a Medical officer, I was also responsible for keeping the crew healthy both physically and mentally. It's an honor to be trusted with such a critical role. My mind often wandered through a labyrinth of questions. 'How does one manage people in crisis? What if there's a conflict? Am I really the right person for this role?'. I had no idea what was going to happen or what to expect in the coming days, but I was ready._Now, we have locked ourselves in the Lunar base. When I put on my space suit with the Swedish flag for the first time, I became a bit emotional. My first thoughts were, 'How did I end up here? Oh my God, am I really on an analog astronaut mission?'. But how did I, a Latin American girl from Ecuador and El Salvador who grew up in a suburb in Sweden, end up in Poland? Even though it's a small thing, I had a little internal conflict and identity crisis regarding my flag on the space suit. This seemingly small symbol of identity sparked an internal dialogue, a gentle conflict of belonging. My heart straddled two worlds – the land that nurtured me and the roots that defined me. Because even though Sweden is my home, I felt that I also represent Latin America. Life in the habitat, with limited light, water and surrounded by high CO2 levels and no fresh air, was challenging. Unfortunately, on the third day, I fell ill, adding a layer of vulnerability to the already challenging environment. I really struggled not to show vulnerability and to fight through it and be available for my team. It took me 6 days in isolation to break down, and all I could think of to calm myself down was the voice of my

high school physics teacher and mentor, Omid, who always had good things to say. The only time I had time for myself, and my thoughts was during the evenings before bedtime. Every night I listened to the song: 'Mean' by Madeline the person. I don’t know why that song, but it was my favorite song during this mission.I started to understand the importance of an analog mission, and how challenging it is. The dynamism and resilience demonstrated by my team, particularly in swiftly navigating and resolving conflicts, was a facet I deeply admired. My mind, at times overwhelmed and tired, struggled with simple tasks and maintaining simple instructions, leading to moments of gentle humor and human connection, like when Natalia patiently repeated the same instructions to me, bridging the gap between confusion and clarity. My favorite moments during the mission were us trying to catch the mouse, Captain Bucket, who literally escaped so many times that we lost track. We have cried, laughed, and shared many unforgettable moments. Someday, this moment will be just another story to tell, and I am more than happy that I got to do this mission with Natalia and Lilas.

Post Mission

The mission's conclusion has brought with it a profound sense of accomplishment, as we are now officially certified Analog Astronauts. The morning after, over breakfast in Krakow with Lilas before we headed to the airport together, there was a moment of reflection. We finally had a chance to reflect on everything and realized also how close we've become. I've always had trouble connecting with people and never thought I would make two new friends. It may sound cliché, but I strongly believe that I was meant to be part of crew 68 and get to know Natalia and Lilas.There are many lessons I take with me from the Mission, from the girls, and from my own little personal development. Embrace the highs and lows in life and enjoy the ride. Life becomes more meaningful when you realize the simple fact that you’ll never get the same moment twice.

Now is time to adapt to a new normal after 10 days in isolation of constant stress, running on cortisol and adrenaline. Analog astronauts and astronauts often feel this “decompression” after a mission. It is important to work on finding balance once you return

home. Give yourself grace through patience and acceptance. The first person I met after the mission was Maha. I missed her so much that I just enjoyed the moment that I even forgot to talk about the mission in the beginning. I was so touched when she told me that she got me a present. I will always be grateful to have people like her in my life, a reminder of the invaluable support network I am blessed to have. Upon my return to Sweden, a heartwarming message from Annalena, my former high school teacher, along with a photo of my feature on the front page of the local newspaper, awaited me. I got on the first page of the local newspaper with an interview about my analog astronaut mission and that I am AATC's first Analog Astronaut from Sweden. After almost two years, I felt that I could now visit my high school teachers: Omid, Ali, Albin, Annalena, who have supported me throughout my entire space career. They have seen how much I have grown as a person, and not just in my career, but also my personal development.

Post-mission, in a rare moment of solitude, my mind wandered back to those formative years in high school. Looking back, ten years ago, I couldn't have imagined where I am today. The final years of high school were shadowed by stress and worry about what lay ahead. It stirred a deep emotion within me, seeing the girl I once was in the mirror of memory. I would have wanted to tell my younger self that the path to her dreams might take longer and windier than expected, but it's okay. To tell her that the future, though uncertain, is nothing to fear. I resolve now, more than ever, not to let anyone make me doubt my intelligence or self-worth again. The strength I've reclaimed comes from realizing the truth in my mentor's words and wisdom. Now, guided by the lessons from him, I've learned the beauty of embracing the unknown. The future, once a source of anxiety, has become a canvas of possibilities. And for that, I am eternally grateful to those who believed in me, even when I struggled to believe in myself.

I will always be happy to visit them and tell them about all my space adventures, but what I most want to emphasize to them is my gratitude, love, and respect I have for them. I dedicate this mission to them, because without them, I would never have become an Analog Astronaut, or even dared to dream of a career in the space sector.

Expedition 68, Commander Report

D.A.R.K.
20/09/2023 - 30/09/2023

Day 1

This day was quite fulfilling.I’ve felt quite good in the beginning of the day. I really loved the sport part, surprisingly, I really never use the treadmill, so I was really surprised to see the number of minutes increasing and my mood related to that sport not being more and more frustration. I managed to run a full 44 minutes. I'm quite proud of that, in the end I spent a whole hour in the gym. As a result, I might add gym to my daily routine. I also had a very sad event, as 2/3 of the snails died during an experiment. Looking at all these little dead bodies was really heart-breaking. All of that because of a miscomprehension of the needs of the experiment. It shoes how much life is fragile. Hopefully we took the opportunity to make a hair experiment. My first one, hopefully it will help increase the sensitivity of the World to the afro community needs and then improve the chances of having a woman from African descent in Space and this inspire next generations. Obviously captain Bucket escaped again, I'm a bit worried that he might hurt himself. But we can't do anything about it. Tomorrow might a good opportunity to do things right. We need to prepare more, analyze our activity, in order to optimize our productions.

Snails experiments: we prepared 3 experiments, each with 3 Pétri dishes of 5 snails in solution. The first experiment was kombucha pure, the second half kombucha and half water, the third was pure technical water. After a chat with Agatha, we learned that the kombucha experiment was a conscious death sentence for thé snails, in the interest of the experiment, so 15 snails destinés to die, very very sad. Then 15 others died because the concentration of kombucha which is an acid was too much, much more sad. Then we redid the experiment from 0. Snails experiment 2: Number of individual 15 (+1 survivor from the kombucha failure). We

prepared 3 experiments each with 1 Pétri dish of 5 snails: the first experiment was water pure, from which were the only surviving snails ph of 8, with red and white Light. The second one was water +small quantity of kombucha, so that the resulting solution will have a ph of 7; kept ibmn darkness. The third was the witness solution of algae, ph of 8, with red and blue Light. The last one was the dealy kombucha solution, with sadly 5 dead snails ; kept in darkness. Then we had to make a solution of water with 5%agar, and 5% sugar. We approached it by measuring 100ml of water that we added to 5g of agar, and 5g of sugar. Then we assessed that some of the snails were escaping from the algae environment to the water one. We measured the pH of each, and added some solution. We have created a file to fill every snail experiment related data. 'snail experiment data' Gym : I had 2 Times 22 min. of walking on the treadmill at 5.5 to 5.8 km/h. I took a break in between to drink some water. Then I did some abdominal exercises for 5 min. Then I stretched for 2 min. Breakfast : i participated in counting and weighting the breakfast cocktail components. And finding solution to deal with the unadequated shapes and sizes of the cups. Briefing: we were late for the briefing due to misunderstanding, and difficulties managing thé medical Machines. I then had to explain thé tardiness to MCC. The internet disturbances also prevented us from receiving messages from MCC. I also need to find thé best way to Relay my comrades conversation to MCC. Hair experiment : we took a picture of my scalp and Natalia's After exercising. Took sample mix it with water and measurement thé pH. I also put aside a strand of my hair as sample. Médical tests : too much of them too many Times.

I ate a smoothie for breakfast, then drank water, then ate 3 piroguy for lunch as I wasn't really keen on it. For dinner I had aioli pasta. I didn't have any snacks.

Day 2

After waking up, I rapidly felt energized and excited by this new day. I didn't feel the lack of sleep perhaps is it because I persuaded myself of the close to miraculous effect of the power nap. Anyway I was really hoping for it to wipe out any sleep shortage induced tiredness. The others seemed to have quite negative feelings,

either because of the internet shortage effect on their activity, the precision of the procedures, or the research proposals. I was also feeling the negative impact of these disturbances, but in a more positive mood. I exchanged with them to find constructive ways to get answers or solutions to our issues.

Then I had a long discussion with Agata. I felt a little down when I realized how wrong my process was and that I had to redo my preparation, but all that was forgotten when she took the time to very very patiently explain the aim and the procedure of the experiments. We need to make 12 petri dishes based on that solution tomorrow. We will use some sample from nose, ear, mouth for this experiment. I'm really looking forward to that… it's exciting. And then she proposed other experiments, able to feel some of the needs of my comrades (solving the morning inconvenience) and ways to perform our experiments. I was really thankful for that. It got me energized and improved the mood in the habitat. The power nap sadly wasn't as energizing as expected, perhaps because I was a little anxious about the snails. Finally I was quite interested about hydroponics but as the pump seems to be broken, we might not have a chance to fully experiment it. We ended the day with a change of the MCC point of contact, quite disturbing, as he didn't have the same general demands. And there seemed to have been some loss if information in the process. About the dishes we are currently looking for ways to improve the cleaning process: reducing the amount of water, time, activity, paper involved in the process and most importantly find a time to empty to dishes from waste before it sticks.

Snails experiment:
During a long chat with Agata I learned that the circadian experiment is actually 3 experiments. After being extracted from their environment, the snails need 3 days to recover, so we will start the first experiment on them on day 4. So no experiment today, We just make sure to cover them, to avoid escapees, while maintaining air providing to keep them in good condition.

Hair experiment: we tried to use a quantum resonance magnetic analyzer, but we need a software, and we are not sure that it is the right mean to get the PH of hair / hair skin which was what we were

looking for. Nevertheless, we set aside some hair from each of us with the bulb, so that we can analyze them later on. We plan to get a set of hair each day.

Hydroponics experiment : as the pump of the main machine is not working Natalia has started to plant seeds in a simpler version. Today, under her guidance I added a layer in the small hydroponic system and sow spinach seeds.
Sports: I had 35 mns of treadmill today, walking at 6 to 6.5 km/h for 3kms, without any stops, straight. I drank water on the treadmill. Then I stretched for 2 mns
Breakfast: I made breakfast for everyone today. It was very difficult to eat, especially because of the texture and honestly had a taste that I didn't appreciate.
Lunch: Lunch was worst than breakfast, the taste was really awful.
Habitat daily life: toilet management, dishes management

Day 3

I woke up quite positive and confident about the day to come. Sadly the first news was that I was late for my medical records, awfully late. So I started with a little inconvenience on waking up. But we managed to do everything and were able to eat during the meeting, without rush. I also felt a sweet reminder of the taste of home when I found out that the girls had taken care of the whole breakfast and served me. Then I turned my attention to the snails, they were climbing along the petri boxes, feeling okay. I had my solution prepared for the experiment from the previous day but after a discussion with Agata I got some more precisions about the circadian experiment. One step was to make the crew lick the agar-sugar solution. So I decided to remake it in a more sanitized way so that the team member can lick. Then I spent some time having fun with the girls, and then I slacked on my experiment, and helped with the data loading. Natalia, feeling less tense, and relieved from the pressure of data, could have fun with the 3D printer. The atmosphere was thus most joyful in the habitat. I made a great lunch recommended by AACT, not salty enough but with great taste, the best we had eaten so far, which enhanced our mood

again. Then I had to solve the poo situation: since day 1, the toilets were clogged so that I couldn't use it, I didn't feel comfortable enough. The problem was that we didn't have enough waste water. Actually we were planning to use the liquid one out of the dishes cleaning added to hygienic water. But we were so efficient at saving water that we didn't have enough technical water to flush the toilet. Besides we all agreed that we didn't want to waste clean drinkable water for that purpose. Hopefully, Frida came with a solution: to save urine and use it as flushing technical liquid. We adopted the solution immediately, it was easy as we already had to bucket our urine systematically for mission purposes. Then I propose to manually remove the waste from the toilet, as I knew that this task would be very difficult for the other 2. It wasn't easy for me, but more easy than for them. While performing this task with the help of Frida, who couldn't smell anything because of her cold, we discovered that the main problem wasn't the organic waste but the paper. Thus we decided to only put organic waste in the toilet from then on.Then we flushed the organics after having got rid of the paper with 5l of urine. I felt really proud of my team as we managed to save so much water and we supported each other during the process to the best of our abilities. I ended up falling awfully behind with my experiment. Before sport, we took samples for the experiment, and I had one of the great laughs of my life as the exhaustion of each of us, especially Frida and I, led to very funny situations. I stored the experiments, tried to find a way to exploit the hair sample and use the microscope.

Snail experiment :

- Redo the petri dishes,
- took samples from the team, stored the samples

Hair experiment

- Microscope not worked

Gym 40 mns : 22 minutes walking, between 6.3 and 6.5km fr 2.6km, 3 mns running at 7.5km ; 10 mns abdominal exercises.

Day 4

I woke up in a wimp, for once, i was on time. We did all the medical tests, i was feeling alright. Not superwoman but ok. And the bad day started… the toilet was invaded by small insects. It made me

feel sick. This is actually the first time i really felt the weight of this experiment. I had goosebumps of horror. I really felt unable to enter the toilet, between the detergent odor and the insect. Despite Natalia telling me that these were fruit insect, i couldn't help but associating it with the toilet being dirty even if they are definitely not, as each girl properly cleans after herself each time. I informed the girls of my issue with the toilet (reliving it actually gives me goosebumps) and they were very nice. Frida took the initiative and decided to find the vacuum cleaner and to catch the insects with it while cleaning the toilet and the house (we'd been swiping ever since the beginning). As a result, the detergent odor was less present and we , and manage to get rid of most of the flies. I was a bit more at ease and able to move in the house. But just before having the briefing, I discovered that we didn't have enough material for breakfast, lunch or any other meal in the diet menu. Another big inconvenience for me. I can bear the questionable taste or texture of the food because i'm convinced that it is good for my health and to keep me in condition all through the day. Not having a proper diet was challenging my mood. We argued about the timing of the information transmission. But in the end, we all decided to be constructive.
In midday the flies came back and i killed one on a corner of my eye. They were aggressive. I really felt disgusted, attacked and surrounded. I tried to calm myself, but i know i only partly manage to do it.
I send the inventory of the cupboard for MCC, and discovered later that it was all for nothing, as MCC basically told us to manage by ourselves, without any help from their part. I felt myself feeling all of sudden totally fully angry. And i definitely wasn't in a mood for being constructive. For a moment, the will to express some of that anger, without control, was so high that i couldn't do anything but allow it to blow, only partly controlling the words, and some of the related emotions, while trying to associate a reason it. Following the first disastrous meeting of the day, i had to eat 2breakfasts as I was still hungry after the first one. Then we had lunch with borsch and ravioli (we suspect that i didn't get enough nutrients to be fed which made me angry) and popcorn. No sports.

Day 5

This day just fled but it seems like we didn’t have time to do much. I woke up agitated, I was worried about Frida… then we did all the medical stuff, I was quite focused, as i managed to be in advance on some tasks despite being tired. I feel frustrated overall about the experiment as I feel like I didn't do much… everything is late. no circadian experiment, no hair experiment… late for gym.
What did i fill my day with? i do not know… briefing, circadian, “shower”, talking, late for circadian, trying to take picture of snails and failed because of my phone resolution, tried another phone same issue, late for circadian, trying hair experiment on microscope and learning from scratch how to use it (yes my school days are far away), making food together, eating, late for circ again, Hof, then feeling sleepy, talking… getting angry at the flies has been a background feeling all day long. Nothing I was doing wasn't tainted with the disgust implied by the flies.
Then I think I ate too much fat, thus being sleepy often for digestion purposes, or was only missing my daily hourly nap, especially as I’m lacking sleep?… I don’t know we staged for the tour. the girls are very much into instagram, thanks to that it sooths me that we’ll have at least that to show. The briefing came and I had to communicate the frustration of the commander about the experiment. despite sharing it, I think I managed to keep a distance big enough to allow me to be precise in my communication. But despite our effort, we didn't get what we wanted, so that we still don't have enough information to perform the USG experiment and the dark eyes experiment. After the evening briefing we had dinner, and I decided against all odds to stick at least to the sports activity. I really felt good afterwards so much so that I was eager to repeat the activity the next day. I was feeling good, but sleepy. Then medical tests and others.

I woke up late as usual, and we had the same breakfast than the day before but more elaborated, oat coked in milk with apple and sugar. I avoided the peanut butter this time as I was suspecting my sleepiness of the previous days to have been a consequence of my deep attachment to peanut butter. Indeed it was true, I felt more energy and less tiredness all day long.

During the briefing, I was pleased to hear that our fly issue was taken seriously by MCC. the flies are biting us, and very aggressively. I was able to share picture of killed fly with red substance on the wall and on the bottle. And MCC proposed some ideas to solve our problem. The breakfast energy, added to the support of my comrades and the MCC gave me the will to overcome my paralyzing disgust, and to turn disgust into action. I decided to kill all the flies crossing my path, and a way too do it safely quickly came too mind. Paralyzing them with detergent kill them with my shoes once they're disoriented on the floor; this technique uses quite a lot of detergent, but it is efficient and I don't have to touch them.

Sadly, our microscope issue was no taken seriously. I cleaned every module of the microscope, every accessible lens was striped down and cleaned. Despite all that we still cant use the microscope over x40. Even while trying to find the focal point with the most accurate button. I felt energized and through the day, tried to be productive. After having failed at using the microscope despite all my effort, I turned to the snails, and decided to have a look at the detailed specification.

I discovered that i was supposed to heat the Petri dishes up to 36-37degrees but the tool at our disposal was missing a cable; so I've put a heater nearby the petri dishes; thus I turned to the snails, and started their circadian taking picture of them and their movement every 2 hours. I'm also happy about my today's gym session. I really felt good afterwards, and fully energized.

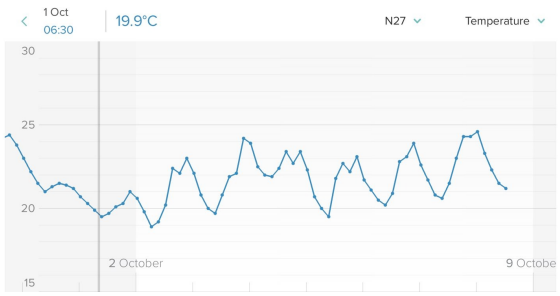
Expedition 69
Commander Report

D.A.R.K.
01/10/2023 - 10/09/2023

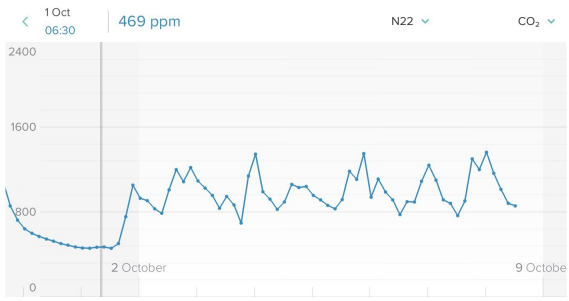
Mission Time	COM	BIO	DAT
0:00	Wake-up, Morning Tests	Wake-up, Morning Tests	Wake-up, Morning Tests
1:00	Breakfast	Breakfast	Breakfast
2:00	Reports, Briefing	Reports, Briefing	Reports, Briefing
3:00	Experiment	Experiment	Experiment
4:00	Experiment	Experiment	Experiment
5:00	Experiment	Experiment	Experiment
6:00	Sport	Experiment	Experiment
7:00	Experiment	Sport	Experiment
8:00	Lunch	Lunch	Lunch
9:00	Experiment	Experiment	Experiment
10:00	Experiment	Experiment	Experiment
11:00	Experiment	Experiment	Sport
12:00	Experiment	Experiment	Experiment
13:00	Dinner	Dinner	Dinner
14:00	Reports, Briefing	Reports, Briefing	Reports, Briefing
15:00	Socializing	Socializing	Socializing
16:00	Evening Tests, Sleep	Evening Tests, Sleep	Evening Tests, Sleep

Environmental conditions in lunar habitat

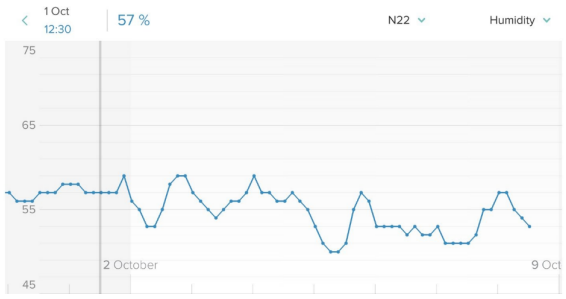
Bedroom temperature



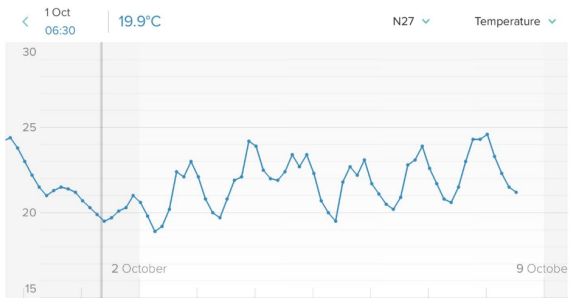
Bedroom CO2 level



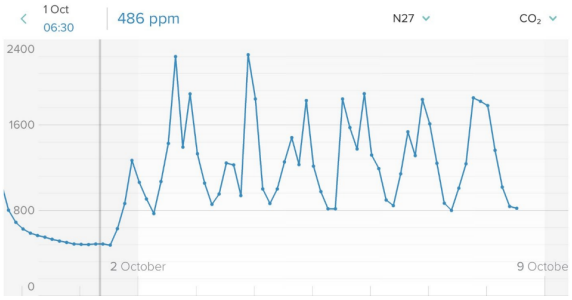
Bedroom humidity level



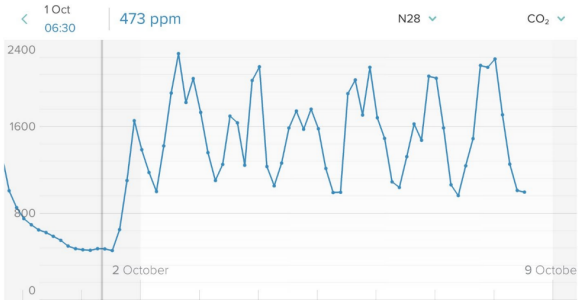
Gym temperature



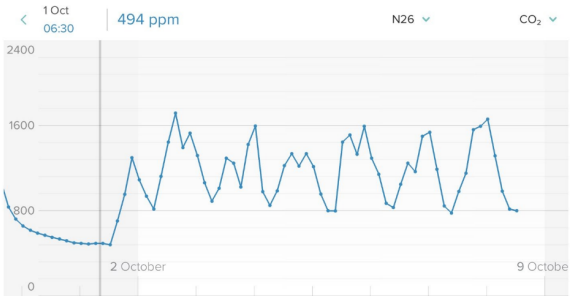
Gym CO2 level



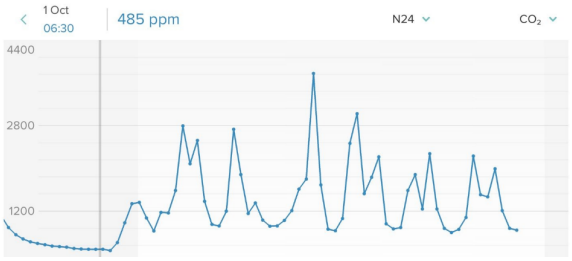
Toilet CO2 level



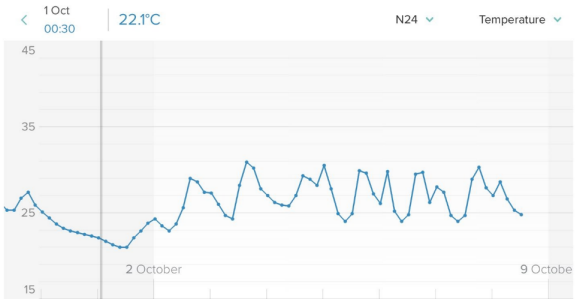
Geolab CO2 level



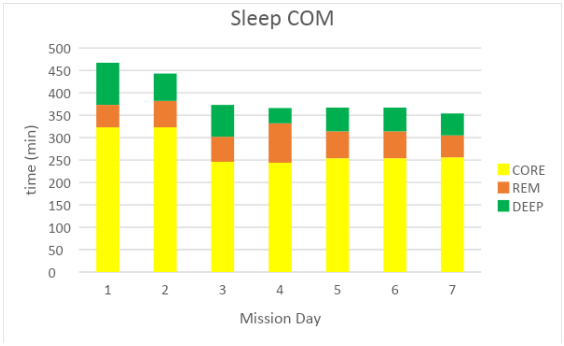
Mesa CO2 level

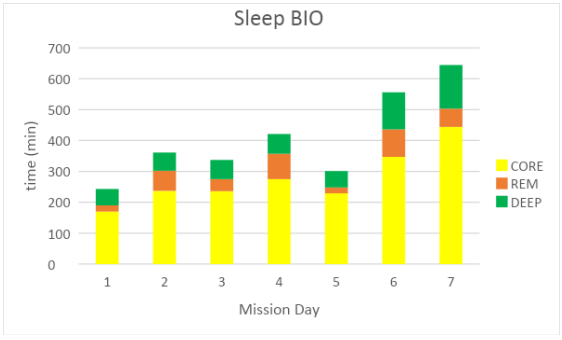


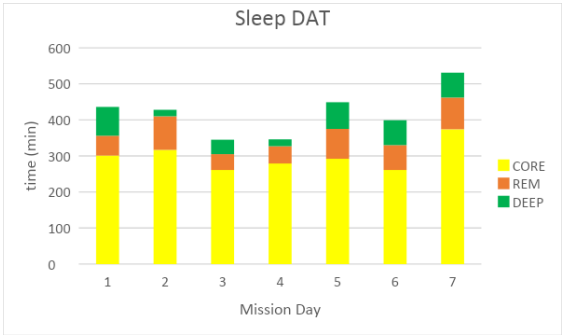
Mesa temperature



Sleep analysis

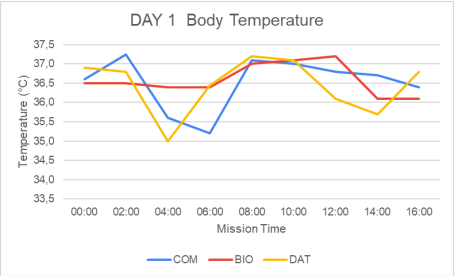


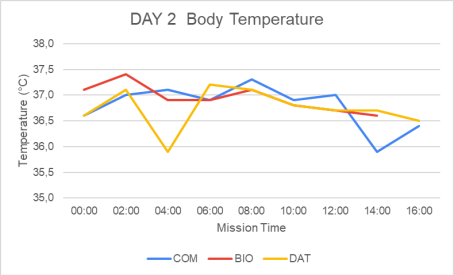


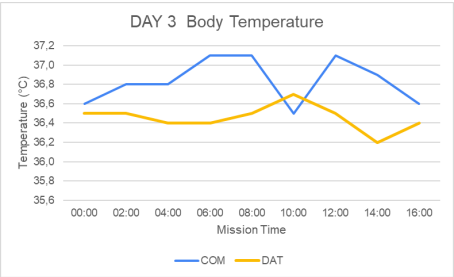


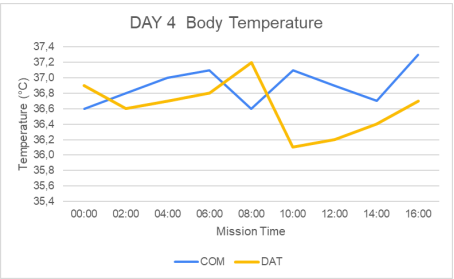
Circadian

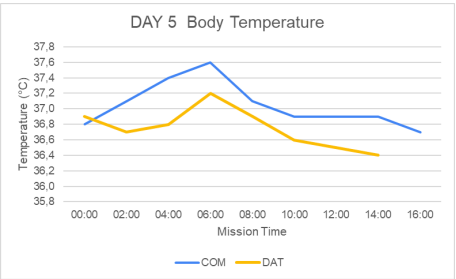
Body temperature



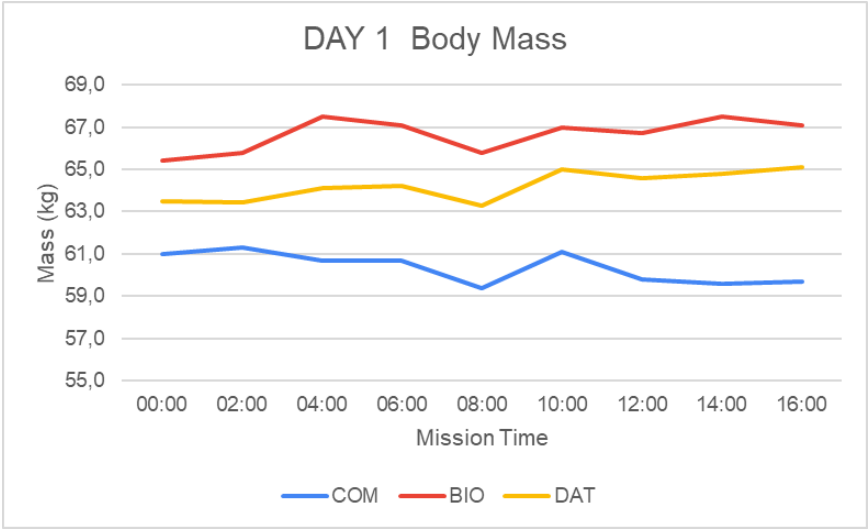




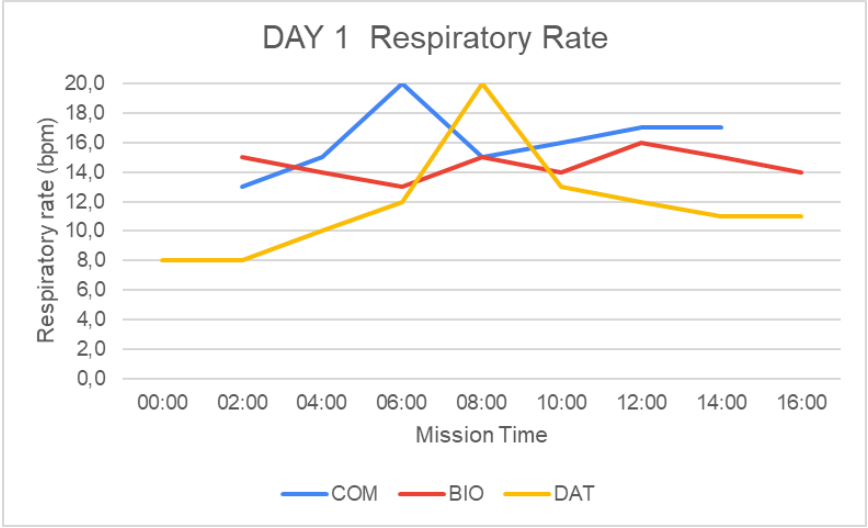


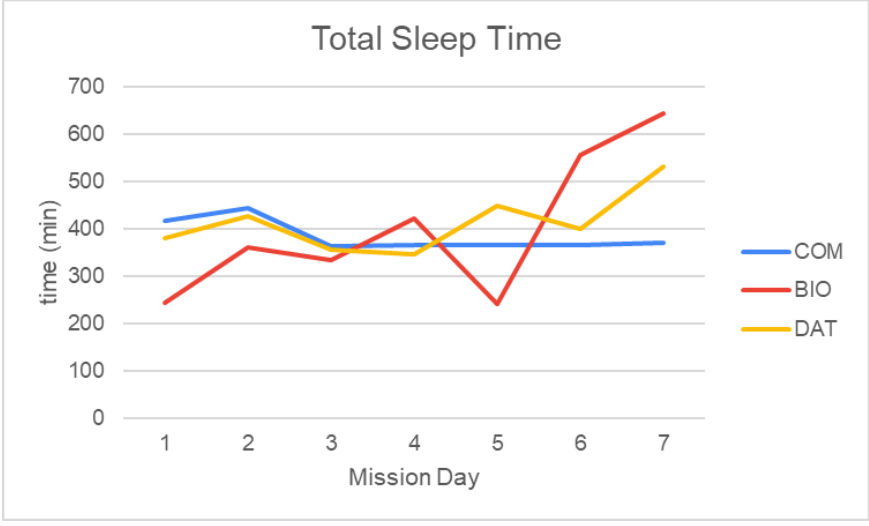


Body mass

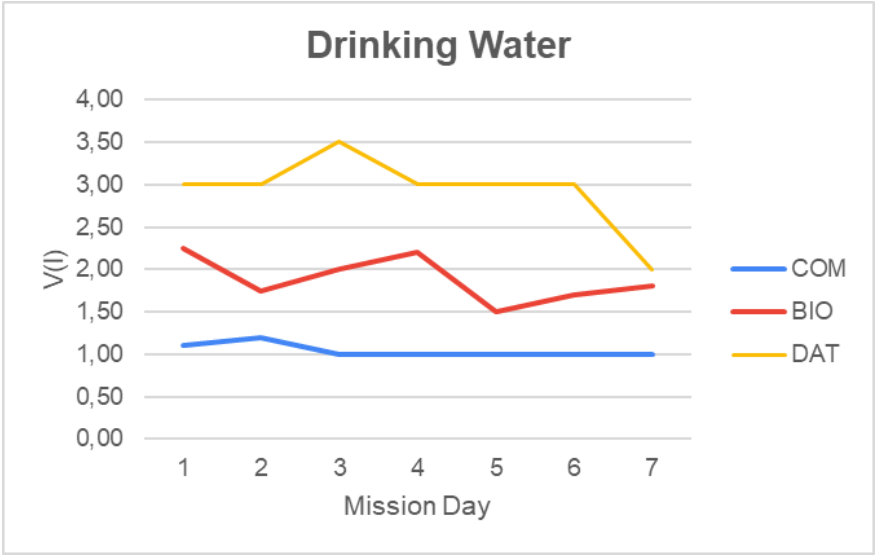


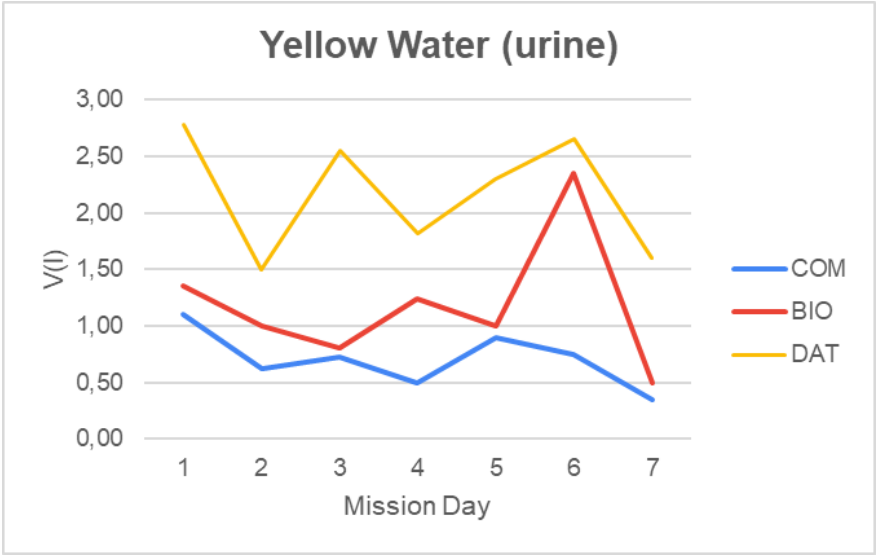
Respiratory rate

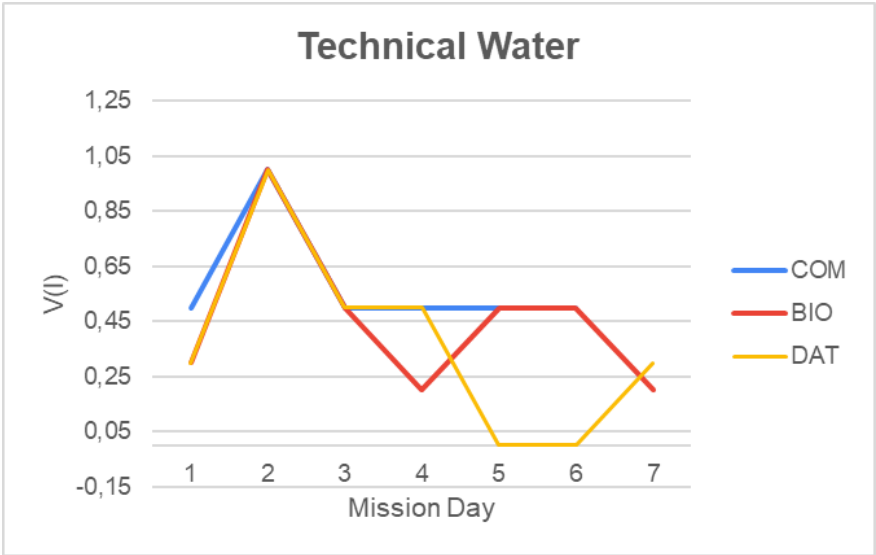


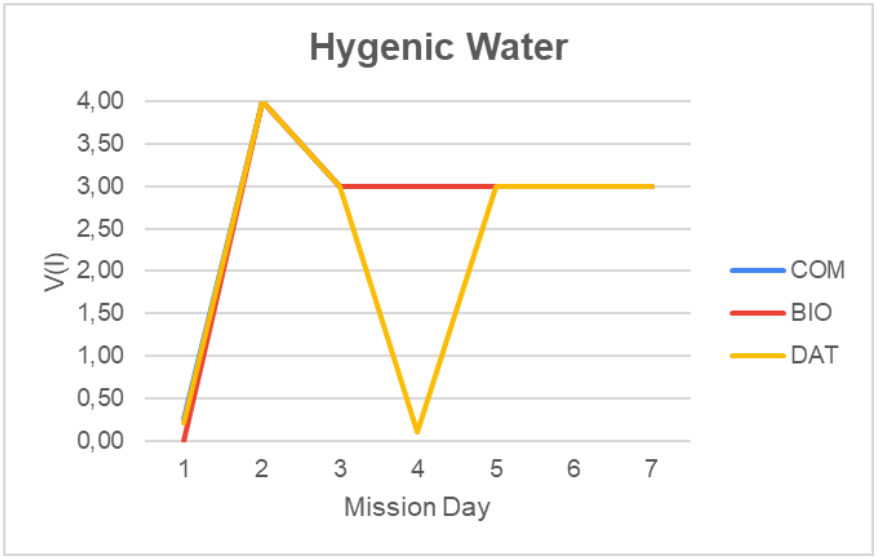


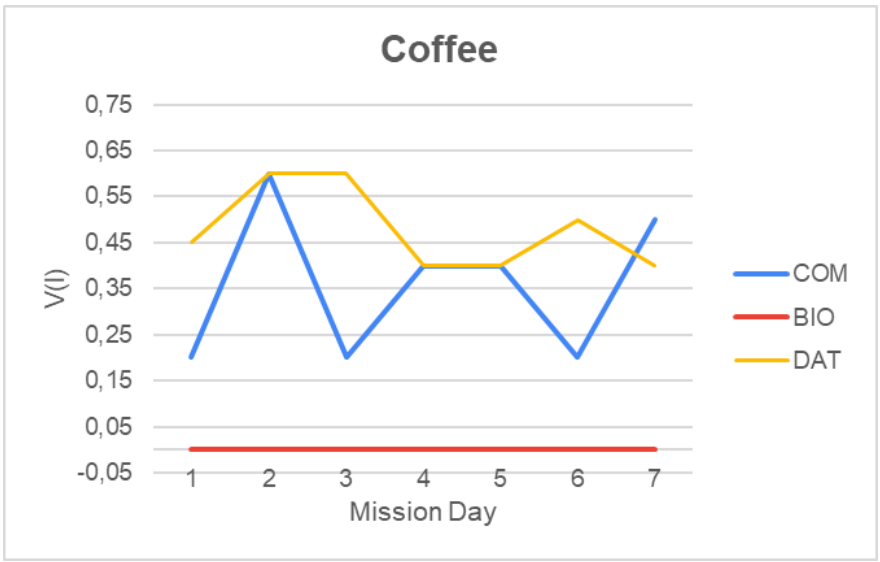
Water usage

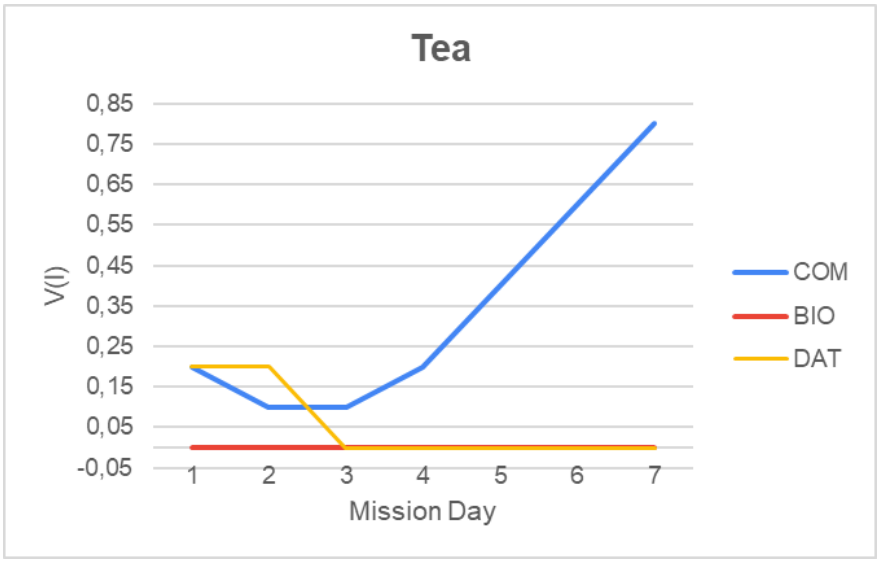

Drinking Water
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
V(l)
1
2
3
4
5
6
7
Mission Day
COM
BIO
DAT


Yellow Water (urine)
3,00
2,50
2,00
1,50
1,00
0,50
0,00
V(l)
1
2
3
4
5
6
7
Mission Day
COM
BIO
DAT


Technical Water
1,25
1,05
0,85
0,65
0,45
0,25
0,05
-0,15
V(l)
1
2
3
4
5
6
7
Mission Day
COM
BIO
DAT


Hygenic Water
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
V(l)
1
2
3
4
5
6
7
Mission Day
COM
BIO
DAT


Coffee
0,75
0,65
0,55
0,45
0,35
0,25
0,15
0,05
-0,05
V(l)
1
2
3
4
5
6
7
Mission Day
COM
BIO
DAT


Tea
0,85
0,75
0,65
0,55
0,45
0,35
0,25
0,15
0,05
-0,05
V(l)
1
2
3
4
5
6
7
Mission Day
COM
BIO
DAT

Day 1

I woke up very happy today and thrilled and excited to be here in the hab on Mission day one. The morning felt very rushed downloading software, figuring out which tests were required, how to use the equipment etc. It was absolutely wonderful to have Thijs on crew as data officer to help guide us through where each of the testes and excel spreadsheets were located. We got through it well. The meals were excellent and we enjoyed our time together eating and cleaning up. Thijs and I took turns cooking and cleaning while GG set up his experiment. I felt very energized and motivated right throughout the day. It was an excellent day. Had a busy day trying to figure out the various measurements and experiments that needed to be done and timing. Got through it. I continued to clean up and organize the habitat. I read up extensively on possible plant experiments I could do during this mission and thought of an experiment to grow radish sprouts and the Oyster Mushroom experiment. We will set it up tomorrow. I had an excellent gym workout using my Orange Theory Fitness (OTF) App (similar to what I do back at home). I worked out 44 minutes on the treadmill running 8 minutes and resting 2 minutes for a total of 44 minutes. OTF is a workout based on heart rate so with 21 minutes at 80% of max heart rate and 18 minutes at 85% to 91% of max heart rate. Excellent! I felt very energized afterwards (this was before dinner).

Day 2

Had another amazing day in the habitat. We all woke up late by almost 1.5 hours. I slept incredibly well throughout the night and woke up feeling very rested and energized. I continued to take medical measurements and also cleaned the hab extensively. Thijs and I figured out what we want to do with the plant experiments. So I am excited about getting that started on those which I believe should show results. I am also happy that BIO will get to complete his experiment in spite of today's setback (a HUGE thanks to Krystian, our superb and exceptional MCC). I was very energized throughout the day and felt that we had a good start to our Mission.

Today we researched three plant based experiments: (1) growing radish sprouts in the biosphere with different levels of moisture (the goal is to figure out how to rapidly grow sprouts in case of a shortage of fresh food), (2) Oyster Mushrooms based on different light conditions, (3) Mint in the jars (we need to think this out a little bit more). Gym workout was even better than Day1. My Orange Theory Fitness App workout was for 47 minutes with a run for 8 minutes followed by a rest walk for 2 minutes repeated. My heart rate was above 84% for 30 minutes and above 91% for 1 minute. Peak heart rate was 166 beats/min with an average of 151 bpm. 7,032 steps for a total of 4.26 miles. Because the gym fan was not working (significant vibrations) I needed to cool off for 15 minutes. So the total workout was 1 hour. Quite an accomplishment. I usually drink only 1 cup of coffee at home, but I drank three cups of coffee in the morning while working on reports and drank a cup of mint tea in the evening, also while completing reports. BIO made a delicious breakfast and lunch and dinner was also not remarkable and was a healthy mixture of carbs, protein and salad. I also ate one banana (we all ate one) because they were getting over ripe. I am eating healthier than when I am at home and I am also working out a lot more (I usually switch between my intense OTF workout, yoga for stretching and long hikes with my wife during the week).

Day 3

What a great day! Woke exactly on time thanks to my crew member Thijs. Felt very strong, rested and my mood was highly energized and motivated. Today we were going to get at least two of the plant experiments underway. And we did exactly that. The Biosphere experiment to grow Radish sprouts at varying moisture levels. The second experiment consisted of growing Mint in 5 hermetically sealed bottles. The third to grow the same Radish in sealed jars under different light conditions will be started along with the Oyster Mushroom experiment under nominal and blue light conditions. The highlight of the day of course the Falcon Lander delivering the much needed filters for BIOs experiment and the resulting EVA. Thanks to our MCC Superhero Krystian the filters were acquired and delivered successfully. This was huge boost to an already high morale level.We all took a much needed rest in the

afternoon for an hour, recharged and was ready for the briefing. After that I completed another intense 45 minute workout on the treadmill before having dinner and then completing the last of the medical tests and reports. I am now having a cup of black tea as I write this report. Thijs and I planted the radish seeds in the Biosphere along with another sample outside the biosphere. The five Mint leaf sample bottles were also seeded and the experiments are on-going. The third to grow the same Radish in sealed jars under different light conditions will be started along with the Oyster Mushroom experiment under nominal and blue light conditions.
What a day! I had another intense OTF workout.Gym workout was less intenser than Day2. My Orange Theory Fitness App workout was for 42 minutes with a run for 8 minutes followed by a rest walk for 2 minutes repeated. My heart rate was above 84% for 23 minutes and above 91% for 1 minute. Peak heart rate was 166 beats/min with an average of 149 bpm. 6,463 steps for a total of 3.85 miles. Because the gym fan was not working (significant vibrations) I needed to cool off for 15 minutes. So the total workout was 1 hour. Quite an accomplishment. Breakfast was simple this morning with a couple of slices of bread with butter and strawberry jam.Lunch was huge with chicken fillets, leftover rice/with curry that BIO made and tomatoes with salt/pepper and olive oil. Dinner was Tuna from the can with salad and bread. Snacks today were chocolate covered cookies, chocolate and the power bar. I am glad I worked out to burn through this heavy eating 🙂

Day 4

The radish sprouts in both the jars and the biosphere. Both are showing that the seeds are germinating. Excellent! DAT and I initiated the Oyster Mushroom study which consists of growing them in ambient light as well as blue light. We found a couple of papers that indicated that these type of mushrooms grow well in blue light. Well lets see on Monday the 9th morning if we can see a difference. If not, we will have to let the next crew tell us the results. I was happy to pull out the EKG machine and get it working. Now I need to figure out how to make a 3-lead ECG (on myself).

I couldn’t find my OTF heart rate monitor. It's somewhere in my belongings. I had a 45 minute run/walk which was very good. Overall it was a good day. We had a great breakfast of scrambled eggs and bread with coffee. It was excellent. For lunch we had spaghetti with tomato sauce and grapes. Some biscuits for tea and then sausages and bread for dinner. It was more than enough food for the day. I had several cups of hot tea and DAT brewed an excellent cup of instant coffee.

Day 5

What an amazing day today. I woke up after having a great night's sleep and woke up feeling energized and motivated. It was a busy day of research trying to understand the operational aspects and procedures for the EKG machine and the echo machine. After spending over an hour on the internet I found a 517 page copy of the Operating Manual. The operating manual was useless and assumed you already knew how to use it. After spending some time on the machine I came to understand its operation and was able to get some images and I was able to spend most of the day working on the echo machine. In the morning and in the evening I observed the plant experiments and took pictures.We did all of our medical and psychological tests and questionnaires.

Incredible day. I further researched the EKG machine and the Echo machine. The highlight of the day was obtaining true echo images out of the machine in our lab. I made a video call to a friend at my work who is a leading echo technician and asked her to walk me through the setup of the machine. I suspect that previous crew members who did not know how to operate this machine had played around with it and messed up a lot of the settings. Within a few minutes we had set the machine right and she had shown me how to use the Gain, Depth, Freeze, and Sharpness settings. After that she analyzed a video recording of an abdominal scan I did and she said Wow! You already have an amazing picture of your kidney right in the middle of the screen. It was exciting and thrilling. Then we imaged the carotid vein. We tried the color Doppler but the horizontal nature of the vessel did not give us a good color view of blood flow. This whole day has been absolutely thrilling and

exciting. I cant wait to wake up tomorrow and conduct the FAST experiment. I took a much needed rest from SPORT to rest and heal my body. I have done intense workouts everyday while I have been in Poland. At 59, I need to give my body a chance to rest and rejuvenate. I will be back on the treadmill tomorrow and the day after. I had a morning instant coffee followed by eggs and a tortilla. For lunch we ate a type of grain (in Polish) boiled in water with tomatoes and chicken strips. I sipped hot black tea throughout the day. For dinner I had instant Raman noodles. I feel great.

Day 6

I woke up refreshed in spite of the fact that I woke up twice during the night. A good portion of the morning was spent completing medical tests and psychological evaluations and taking measurements of the plant studies including photographs. I then spent a few hours trying to get the ECG machine to work. I got the machine turned ON and then got the settings right including getting the paper strip to work. But with the Welsh cup electrodes and the simplest 3 lead set of electrodes the machine just would not pick up and trace. I tried multiple times. I then brought out the Echo machine and did quite a bit of work on the FAST protocol and procedure. I was able to get some images posted on the Signal mission site. While as a novice I was not certain what the images showed – as we saw yesterday… an “expert” can guide a “novice” on a video call to get the right images. Unfortunately, my colleague was not available to guide me this weekend. I’m sure if she was able to, she could have guided me to get the right images. With a little bit of skill and guidance I think this is doable. Yesterday, in less than 20 minutes she showed me how to image both the kidney and the carotid vein.Overall, a good day. Made measurements and photographed the Mint plant experiment, the Radish sprouts and the Oyster Mushrooms. Spent several hours getting the EKG machine working and understanding how the Welsh Suction Cup electrodes worked. I was able to get the parameters on the machine working and the printer as well however numerous efforts to get a waveform was unsuccessful. The FAST protocol/procedure was assessed and several echo images were posted onto the site. While abdominal images were able to be seen I was not able to get

a four chamber view of the heart after multiple attempts. I had an excellent 45 minute workout on the treadmill. Breakfast consisted of a power bar, dried fruit and coffee. Lunch consisted of a variety of boiled rice, minced meat and salad. Dinner was leftover rice, canned corn and salad followed by a cup of hot black tea.

Day 7

We woke late by about a half hour late and got out of bed after receiving the briefing message from Agata. I was the first to wake up so I had some coffee alone and chatted with Agata before Thijs woke up. We had our briefing and then completed all of the required tests and started to wind down experiments and collect final data to write our reports. One of the small highlights of the day was seeing one of the Oyster Mushrooms start to show some small glimmers of germination (petri dish 2, blue light). It was a good day for our final day. Now we are busy writing up reports. We did all of the usual medical tests as well as the psychological questionnaires as required as well as all the other tests for our PIs.Measurements were taken for all of the plant experiments and we decided to leave them for the next crew that arrives on Tuesday. The rest of the day was spent cleaning and analyzing data and preparing to write our presentation as well as the Mission Report. Today I missed the gym due to too much activity. Had 2 cups of coffee with some eggs, bread and jam for breakfast. For lunch I had leftover rice and meatballs. Dinner was the best as DAT made some pizza.It was a great way to close out this amazing mission.

Expedition 70, Andrea Arcarisi, Italy

Hayabusa
10/10/2023 - 18/10/2023

"A small step for the CubeSat Hayabusa…

…a giant (solitary) leap for Astronaut Andrea"

To Giuseppe, Teresa, and Lucia, I have arrived here thanks to you...

The story begins with an inside joke in the title, a famous quote from Neil Armstrong that resonates in the history of space exploration and pop culture in the space domain. Why? Because there is no better way to make you experience the emotions of an astronaut than through these quotes. Each subsequent part of this story will open with a quote, allowing you to immerse yourselves fully in my thoughts.

This is my story, the story of Andrea Arcarisi, a Robotics Engineer who lived an extraordinary experience as an Analog Astronaut during a mission in Poland in October 2023. Through these pages,

I will take you on a journey filled with a thirst for knowledge, determination to pursue a career as an astronaut, and the reasons that drove me to embrace a dream so distant yet so powerful.

From a young age, I harbored a deep curiosity about the universe and the challenges that space exploration presents to humanity. While pursuing my studies to become a Robotics Engineer, I acquired the necessary skills to understand the complex dynamics of the cosmos and an insatiable thirst for knowledge was born within me. It was this thirst that led me to my mission as an Analog Astronaut (a necessary step to embark on a future astronaut

career), where I could experience life in space in a controlled and simulated environment. But despite the challenges and sacrifices that this path entails, I never stopped dreaming of exploring the depths of space. I worked tirelessly, dedicating myself with passion and determination to perfect the skills required to become an astronaut. I want to share with you the profound motivations that drive me to pursue such an ambitious and fascinating goal. Through my experiences and reflections, you will discover that dreams can be the engine of change and personal growth. I will show you how the audacity to imagine a future beyond Earth's boundaries can be a catalyst for progress and innovation. I invite you, the readers, to reflect on the potential that resides in each of us when we push beyond the limits imposed by reality.

In these pages, I will accompany you on my journey in search of knowledge and toward my dream of becoming an astronaut. I invite you to immerse yourselves in my story, share my emotions, and explore together the depths of your boldest dreams. Together, we will discover that there are no boundaries we cannot overcome when we have the determination and courage to pursue what we are most passionate about.

Part 1: "In Search of the Stars: A Journey Toward My Space Dream"

"*We used to look up at the sky and wonder at our place in the stars – J. Cooper, Interstellar.*"

My heart beat in unison with the universe as my gaze wandered among the stars. Since I was a child, I dreamed of becoming an astronaut, of sailing through infinite space and exploring unknown worlds. But like many dreams, it seemed an impossibility, a goal too far to reach. However, my passion and thirst for adventure never waned. Then came a movie that changed everything: "Interstellar," hence the first quote of the chapter. This cinematic masterpiece awakened in me a burning desire to preserve Earth's life on other planets and urged me to fight for my dream. I am Andrea Arcarisi, a Robotics Engineer from Sicily, with a journey that took me from Pisa, through ESA workshops, AIRBUS projects, and a specialization in Aerospace Robotics. And now, my goal is to become an astronaut in ESA selections around 2030. To prepare

for this epic challenge, I decided to undertake an extraordinary journey: the Analog Astronaut Training program at the Analog Astronaut Training Centre in Krakow, Poland.

A cosmic silence greeted my steps as I crossed the threshold of the *Habitat*. The program involved an 8-day isolation period inside a spacecraft-like structure. In that place, like a modern space hermit, I found myself completely alone, with no contact with the outside world. It was an experience that would test my resilience, adaptability, and inner strength. Time seemed to stretch as my body and mind adjusted to solitude and the absence of earthly references. It was as if I were in a temporal suspension, a preview of life in space.

During those days, I learned to confront my deepest fears. The fear of not being up to the task, of failing on my journey to the stars. But every time that fear threatened to suffocate my courage, I remembered why I was there. I looked at the grand and majestic image of the Moon in the "*Lunar GeoLab*" module, so beautiful and distant for many centuries for humans, which reminded me that the biggest dreams require sacrifice and determination. I clung to the belief that the audacity of pursuing my dream was a tribute to all those who, like me, dream of extending the boundaries of human

knowledge. Every day, during training, I immersed myself in simulations of extreme situations, from psychological and physical adaptation to performing complex tasks under pressure. Every challenge was a step closer to my goal, a fundamental stage in my preparation for the stars. I was determined to overcome every obstacle, to learn from every mistake, because I knew that my purpose was larger than myself. As the days flew by and my isolation came to an end, I realized that this intense period of analogue training was not just a test for my body and mind but also a journey of self-discovery. I had learned my limits and resources, and cultivated patience and resilience. Most importantly, I learned to believe in myself, to believe that a dream, no matter how big it may seem, can become a reality if you are willing to give your all.

Now, as I write these words, I can still hear the echo of cosmic silence, the warmth of the passion burning within me. My dream of becoming an astronaut may seem like an impossible feat, but I am ready to face every challenge the future holds for me. My journey to the stars has just begun, and I can't wait to discover what the universe has in store for me. I am Andrea Arcarisi, and I am ready to leave my mark in the infinity of space.

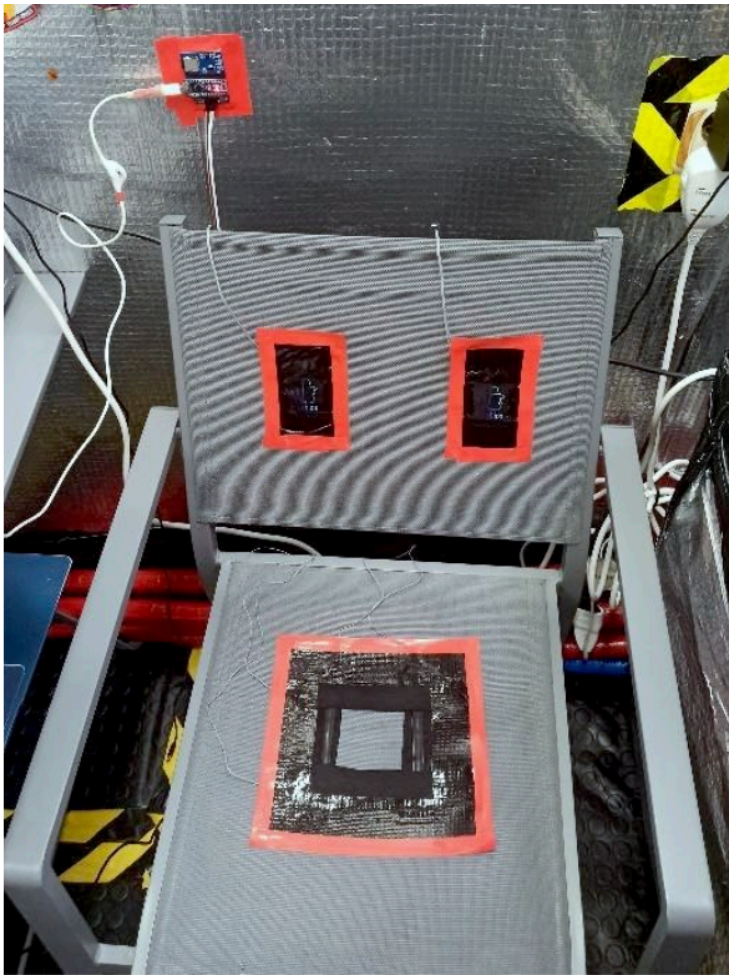
Part 2: "EPX70 Hayabusa: A Solitary Journey into the Future"

"*The universe is a very big place, it's bigger than anything anyone has ever imagined before. If it's just us, it seems like an awful waste of space... doesn't it? - E. Arroway, Contact.*"

The EPX70 "Hayabusa" mission - the name itself evoked the audacity and determination of those who dared to explore the unknown. Hayabusa, in Japanese, means peregrine falcon, a symbol of speed, agility, and a sharp gaze towards the horizon. Just like the falcon, I prepared to take flight into new frontiers, embarking on a solitary mission on the lunar base.

The lunar habitat would be my home, a period of complete solitude in which I would have to rely on my physical and mental abilities to face every challenge. I had a predetermined routine, much like astronauts, that helped me maintain control and navigate through lunar days.

My communication was limited to the Mission Control Center (MCC), which kept me company during briefings and provided crucial instructions. The presence of MCC was a ray of light in the darkness of solitude, a reference point that made me feel connected to the outside world. Every moment was precious, yet loneliness at these levels was frightening. However, thanks to rigorous mental training, I learned to manage emotions and find calm even in the most difficult moments. Specific physical training was an essential part of my routine. Like an astronaut, I had to keep my body in optimal condition to cope with the stresses of the lunar environment. Astronaut-level physical tests challenged me, pushing my limits and strengthening my endurance. Every step, every push-up, every jump was a step towards complete preparation for my role as a solitary explorer. But it wasn't just the body that required attention. A carefully calibrated diet was a fundamental element to ensure physical and mental well-being during the mission. Each meal was designed to provide the right balance of nutrients, energy, and vitamins. The kitchen, although limited in resources, was a moment of joy, even though I couldn't



help but think of my mother's sweet and sour meatballs, which I missed terribly. However, the primary purpose of my mission was science. Scientific experiments were the beating heart of every day spent in the lunar habitat. In collaboration with "*Weabios"*, (my sister) Lucia Arcarisi's company, a leader in the field of wearable sensors, we had an ambitious goal: "Weabios Balance." Our experiment involved studying posture-related stress in astronauts using a sensor-equipped chair that precisely measured body position. We aimed to contribute to improving the health and well-being of astronauts in space.

But there was another experiment that held a special place in my heart: "Hayabusa." It was one of the phases of a larger project aimed at creating a CubeSat to be launched into low orbit in the future. The experiment required the development of a Reaction Wheel controlled through robust PID controls and powerful navigation based on the Madgwick algorithm to estimate orientation using quaternions. It was a challenging yet fascinating task. Each step forward, each success or challenge encountered during the experiment, represented a piece of the puzzle that would contribute to the future of space technology. The EPX70 "Hayabusa" mission was a unique experience in my life.

Every day, I faced extreme solitude, overcame fears, and learned to rely on my abilities. Physical training, clinical tests, scientific experiments, and psychological techniques all contributed to my

growth as an individual and a space explorer. The mission had its difficult moments, but also moments of joy and satisfaction.

Every training and daily activity was a step toward achieving my goals. Every scientific experiment represented a challenge to be faced and a contribution to human knowledge. Every moment spent in the lunar habitat was an opportunity to push limits, discover new frontiers, and reach new heights of personal achievement. The EPX70 "Hayabusa" mission was a milestone in my life, an unforgettable experience that profoundly changed me. It taught me that solitude can be faced with determination and proper mental training. Looking back, I realize that the EPX70 "Hayabusa" mission was not just a solitary journey to the Moon but also a journey of self-discovery, of my abilities, and my limits. Most importantly, it was a testament to the power of science and space exploration in shaping the future of humanity. Whether it's a peregrine falcon soaring into the void or a human venturing into space, what matters is the courage to tread less travelled paths, face challenges with determination, and look beyond the horizon. The EPX70 "Hayabusa" mission was one of those roads, a path I chose to take, and it enriched me in ways I could have never imagined.

Part 3: "The Solitude of the Explorer and the Meaning of Humanity"

"We are finally ready to set sail for the stars... - C. Sagan, Cosmos."

In the solitude of the lunar habitat, where absolute silence was only broken by communications from the Mission Control Center, I found myself facing the deepest and most introspective thoughts. The EPX70 "Hayabusa" mission led me to reflect on themes that go beyond science and space exploration: fear, trust, science, courage, and curiosity. The fear of the unknown was always present. Sitting in the habitat, separated from the cold and dark cosmic void by mere inches of metallic and insulating material, I felt insignificant in the face of the immensity of the universe. However, it was precisely this fear that drove me to seek answers, to desire to understand the laws that govern the cosmos. Curiosity was my guide, fueled by the certainty that science could lead us to

discoveries and revelations about our place in the universe. Trust was a beacon in my solitude. Despite the disappointments I felt in witnessing human errors and selfishness, I always had faith in the goodness present in small souls. I believe in humanity's ability to collaborate, overcome differences, and pursue common goals for the well-being of humanity. Humans are an extraordinary species, capable of oscillating between two opposites: good and evil, selfishness and altruism. It's precisely this oscillation that makes humanity astonishing and worthy of preservation.

As an astronaut, a human, and a scientist, I felt my role as a cog in the grand machine that will transport our species to new worlds, preserving it over time. I recognized that my purpose went beyond the individual and the mission itself. It was a call to a greater sense of responsibility, a mission of protection and preservation of humanity. Regardless of the difficulties or obstacles I would encounter along the way, I would continue to advance on this path, aware of the broader significance of my role. The solitude in the lunar habitat taught me to know myself more deeply. I discovered that fear can be overcome through courage, trust, and determination. I learned to embrace curiosity as a guiding light illuminating the path of exploration and discovery. I recognized that science is a powerful tool that can help us understand our place in the universe and find solutions to the problems that afflict our species. As I contemplated the infinite cosmic void, I realized that the essence of humanity lies in its ability to adapt, evolve, and push beyond boundaries with courage and insatiable curiosity. We are unique creatures, with a complex combination of virtues and flaws. But it's precisely in this complexity that our beauty lies.

The EPX70 "Hayabusa" mission was a journey that pushed the boundaries of my knowledge, both as an individual and as part of a species. It allowed me to reflect on our human nature and the meaning of our place in the universe. As I continue my journey, I carry with me the awareness that science, courage, curiosity, and trust will always be my companions.

Andrea Arcarisi – Engineer/Commander – EXP70 Hayabusa Navstar Mission

Expedition 71, Prof. Dr. H. Balcioglu, North Cyprus

Cosmos
01/11/2023 - 10/11/2023

The Way to Digital Spacewalker
Since I was a child, I've been fascinated by microscopes and telescopes. I observed the ants at work all the time and saw how anxious they were to finish their tasks by following the path to their incredible living places. I used to climb trees to feel like I was close to the sky. I was constantly scanning the sky for stars, planets, and the Moon. As if the environment above us was a hat on our planet, I was attempting to comprehend it. Everything appears to be small, like ants, but floating in the sky and shining.

My interests and opinions were not valued by society in my neighborhood at the time. My mother was also dissatisfied with my interests. She always wanted to educate me because she was unable to attend school, but she encouraged me to become a math teacher. My father, on the other hand, encouraged me to pursue my dreams. I've decided to go the scientific route, but with my mother's approval. As a result, I selected 'Theoretical Math' and was awarded a scholarship. Depending on scholarships, I plan to pursue a master and PhD in 'Business Administration' and 'Economics' respectively.

I begin to learn about life when I study in foreign countries away from my family. I've begun to accept the new places as my permanent residence. Everything was being taught to me in great detail, and I was gradually improving my communication, management, problem-solving, conflict resolution, and vision creation skills. I was able to network and find opportunities to see a variety of businesses and work in international culture. I was pleased to see a variety of workplaces, including universities, quality assurance agencies, laboratories, oil companies, trading companies, shops, business startups, and others. Throughout my field's journey, I developed the discipline to survive with limited resources and find the best alternative ways to ensure sustainability.

Everything was fine until my mother was diagnosed with Alzheimer's disease and my father was diagnosed with ALS. We realized as a family that there was no cure for either ALS or Alzheimer's disease. I was looking for test groups at the time for my father, who had agreed to be tested for new healing methods. I researched these diseases extensively and decided to major in "Microbiology and Immunology."

I've also studied and observed ancient medical practices. At the time, I realized that my interest in "Ancient History" in all of its facets had grown. After going through many difficult times with my parents and eventually losing them despite my best efforts, I became more interested in the meaning of life: life on Earth, life in space, and 'GOD,' the source of all life. I wanted to pursue my

passions because life is shorter than I thought and I could make a greater contribution to society and myself than before.

I wanted to see what the Analog Astronaut mission centers were doing to better understand space life. I was very impressed by Agata and Matt's biographies. I've decided to apply for the Lunar Analog Astronaut mission. I was chosen and had a crew of two more people. One Mexican lady and one Costa Rican gentleman.

The New Residence of a Digital Spacewalker

As I previously stated, I am not bothered by different environments. I've never felt trapped, nervous, stressed, or anything else negative at the habitat. The crew members were pleasant and responsible individuals. From the first to the last day, we were like a family. We ate together, shared responsibilities, and made decisions together. We were learning a lot from one another. The unorganized/ displaced tools and miceys (mice) were the most difficult aspects of the habitat. Mice droppings were everywhere, in the cupboard, on the plates, on the bed sheets, and so on. The most important thing for me and the crew was to keep each module clean and organized.

My personal method of observing the quality of the air in the habitat was to watch the growing of leaf vegetables in the kitchen area, where lettuce, mint, and other leaf vegetables were placed in water bottles so that we could consume fresh and healthy food. While entering the habitat, I noticed a fly in addition to the mice (at least 5). It appeared healthy to me because it was moving around and feeding itself. It was not losing speed or appearing unbalanced to me. The fly was another indicator of the air quality besides mice because the mice were moving around quickly and eating the poisonous food (not functioning properly?) that I was placing in the corners to get rid of them. We enjoyed our food because Lorene (the Mexican lady) cooked it so well. She was making Michelin-starred dishes out of the food and the Tahin (a miraculous spice blend). I washed the dishes and cleaned the kitchen afterwards. It was enjoyable because my stomach was constantly singing because of delicious food. Tony (a Costa Rican gentleman) taught me how to use a variety of electronic tools. The time spent in the

habitat was memorable for me because it was where I celebrated my birthday. It was a lot of fun.

In the habitat, I conducted two experiments: the Biocontamination Test and the Emotional Immune Response. The biocontamination experiment was carried out in an environmentally controlled and hermetically sealed "Analog Astronaut Mission Habitat" which was divided into seven distinct compartments: the bedroom, the hab lab, the MESA, the geo lab, the storage, the bathroom and the gym.

To observe the biocontamination in the habitat, a mixture of wheat flour, tomato powder and sugar was prepared. It was critical to identify the locations in the zone that could cause the most contamination. Three different compartments of the mission area were chosen for this purpose because they were thought to be the best locations for biocontamination. The mixture was prepared and poured into Petri dishes. To keep contamination at bay, the dishes were covered and placed in the selected locations: the bedroom, the MESA and the geo lab.

The mixtures were examined using the WF16X microscope. Molds have been observed to form significant numbers in the mixtures. The bedroom mixture had the highest level of contamination, followed by the kitchen area and geo lab had the lowest level. Molds have been observed to grow in significant numbers in environmentally controlled and hermetically sealed environment (primarily human-centered locations). Mold issues should be one of the Analog Astronaut Mission Habitats' primary concerns in order to ensure the health of their crews. Molds have been linked to a variety of diseases, including respiratory issues, allergic reactions and infections. Molds can easily contaminate habitats because they produce spores that are easily spread through the air. To protect the crew and citizens from diseases that the crew could spread, Analog Mission Centers should develop a biocontamination control strategies: designing contamination-free process systems, checking process systems for contamination and providing proactive measures in response to contamination events.

In a Desmond experiment, each member of the mission crew received a MOOD RING for Emotional Immune Response. Participants used the ring in conjunction with the mood card to determine what the ring's colors represent in order to record their feelings over time and in the moment. Black represented fear, yellow represented anxiety, stressed condition represented light orange, nervous represented light green, mixed emotions represented green, blue represented normal, purple represented calm, dark purple represented relaxed, love represented dark pink, romance represented pink, light pink represented very happy, and orange represented passion.

The goal was to determine which organs of the body of the crew were the most affected in the isolation. Stress, for example, and uncontrolled reactions o stress can cause kidney and heart damage. Sadness, on the other hand, affects the lungs, liver and heart, potentially alerting their functional relationships. Sadness and grief cause heart and /or liver blood deficiency and may also affect uterus functions. Furthermore, analog astronaut trainees' emotional immune responses drive the search for solutions to negative emotions as well as the need for better living conditions. It could serve as a model for future enclosed habitat formations on Earth or in other places.
The crew responded to the following questions:
1. Make a list of your emotions in the mission center.
2. Determine the percentage of emotions experienced during the 16 hours of daily work based on the color of the ring.
3. What do you notice when you become emotionally involved? List some of the indicators.
4. How do you deal with the emotional fallout?
5. What advice would you give to mission environment trainers and designers in order to keep the living conditions stable in the environment?

Crew members have reported feeling the effects of stress, which was not sustainable in the long run. It could be recommendable to grow plants and vegetables in the enclosed mission habitats. It boosts morale while also providing nutritious food and clean air. It was also advised to keep the mission centers clean and to begin the mission in a controlled manner.

The interpersonal dynamics of the crew become the most important point in the enclosed area. Interpersonal conflict can lead to inefficiencies and the redesign of a more efficient system. The requirements for becoming an astronaut should be changed from superhuman automaton to capable team player with long-term positive emotions in order to keep the immune system in good shape. Sensors, databases, and machine learning technologies could calculate crew health and assign a quantifiable value to it, which could then be digitally passed to intelligent systems to relieve the crew of unnecessary responsibilities.

To better balance what people can do with the stated mission goals, crew members should be assigned tasks that take their health, science objectives, and equipment status into account. Automated tasks save crew time on repetitive tasks (for example taking temperature readings every two hours, drawing space dragons and more) and can be programmed using the most up-to-date science.

Digital Spacewalker with Maturity

People with passion have always shaped life on Earth. It gave me a good feeling to see how much Agata, Matt, and their families care about life on Earth and in space. After gaining experience in the enclosed habitat and reading the book ‘Analog Astronauts in Digital Missions’, I have decided to pursue a career in immunology and space exploration. I would strive to better understand myself and contribute to the future shaping of Earth and space life. According to what I've learned, some special occasions cause our lives to transition into a new phase, much like the stages of a butterfly.

Living organisms typically adapt to a variety of conditions and extreme environments. As a result, adaptations to the lower oxygen levels typically found at high altitudes could be another possibility for future human evolution. High-altitude residents produce more red blood cells, which transport oxygen more efficiently. What I believe in more is the brain's strength. If we can find ways to vibrate at the same frequencies in space, we will no longer require space suits, exercises, or other facilities.

At that point, I believe we will be able to consider the Kardashev scale, which describes three basic levels of advancement in terms of harvesting energy that a civilization should pursue. There are three types of civilization, according to Kardashev, and humanity has yet to achieve Type 1. Type 2 and 3 civilizations have near-divine abilities to manipulate solar systems and even galaxies.

I would like to thank Agata and her team for this wonderful opportunity and the opportunity to meet new people who have proven to be very nice friends.

Crew 71: Anthony, Hasret and Lorene (Mexican lady).

Expedition 71, Anthony Ramirez, Costa Rica

Cosmos

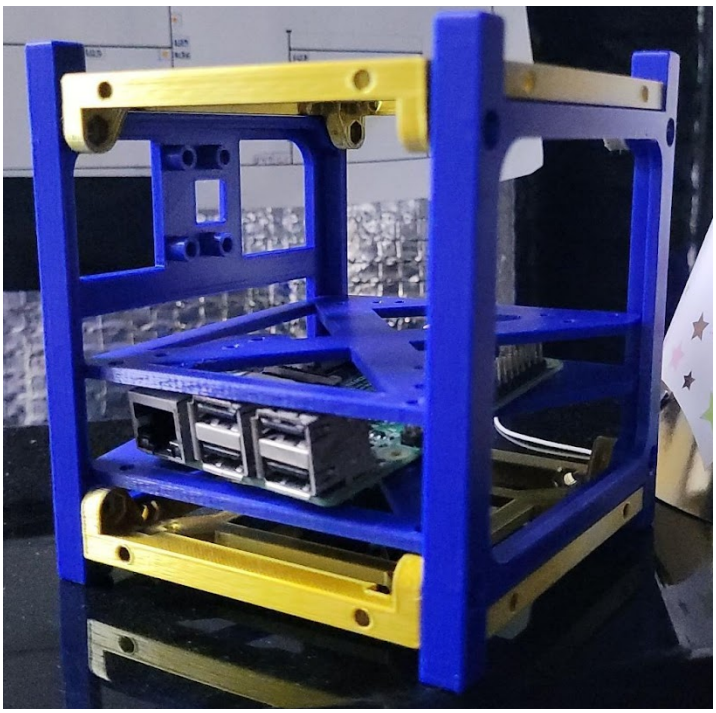
01/11/2023 - 10/11/2023

Day 1

Excited, motivated, my first day as an astronaut, to be part of a mission with these girls is great, normally I don't share time with people with their ages and their backgrounds, they are marvelous . I feel so happy because I think we will finish this successfully. Clean, reorganize everything in the ElectronicsLab, set the Movisens sensors, use the Agata's old laptop to configure them, look for a monitor, the cables and set everything up. I needed to look for the HDMI cable to connect the old laptop to the screen, because the display is not working. After that, I needed to connect the sensors with the electrodes, update their firmwares, then ask the crew to fill the data. Now we are all having the sensors running in our chests. I also went to the gym. I did some cardio on the treadmill, a little bit of bicycle and some stretching.

Day 2

Hasret's birthday was so good, we truly feel like a family. I needed to teach them using some tools to continue with the documents and everything, that stressed me a little bit but we could manage it. I started to try the 3D printer, printing our new friend, a little Curiosity rover. Started the first trial of the 3D printer, I needed to use the software that is in the Thinkpad computer next to the 3D printer, because my pc does not have any slicer software, I had the models in my pc, I send them and then convert the STL to the G-code needed, I printed a model that I had from NASA of the curiosity rover.

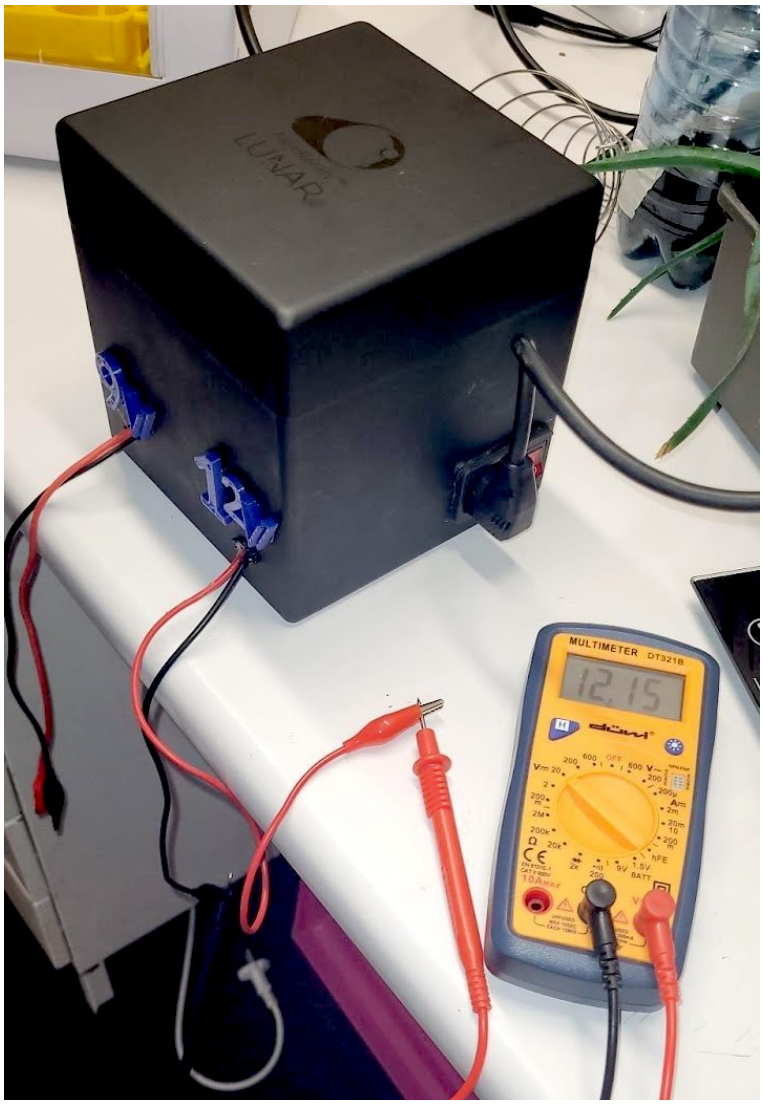


The quality is good, the printer is so friendly, it took 5 h 40 min to print, it was pretty good. Now this was the preparation to print the new CubeSat platform. Also is on preparation a new power supply with the materials we have in the habitat for the laboratory, probably, I will name this place the “E-Lab” it doesn't have a name and we definitely need a name for this place, we need to build

experiments in there related with avionics, 3D printings, soldering, Arduinos, Raspberry Pi, cable harnessing, Robotics.

Day 2

Hasret's birthday was so good, we truly feel like a family. I needed to teach them using some tools to continue with the documents



and everything, that stressed me a little bit but we could manage it. I started to try the 3D printer, printing our new friend, a little Curiosity rover.

Day 3

This is the first time having a model of a CubeSat in my hand, that excites me so much. Also, I did the first communication of a simulated satellite in our habitat. The board was working the whole

night, without any problems. I feel happy. I did not make exercise because I had burst blisters on my feet, and I was even limping. The experiments are good. Now I am preparing all the assembling of the CubeSat platform. The new power supply for the habitat is about to be done, it is working now I need to assemble it as well.

Day 4

I did not dream, I was worried about all the spreadsheets and tasks we had to do. I planned the day, this was the most productive day I had, I cleaned all the mess that I had on the kitchen with the electronics devices, and at the same time, I had to 3D print the rest of the part for my experiments and assemble them, also as a Data Officer I had to have everything nice and neat, teaching the crew how to use some tools and also, the Medical Officer does not have a computer, so I needed to make her a setup with Agata's old laptop so that she can work on her spreadsheet, the main issue is that she needs a screen because the laptop has the screen dead, so she can only be working on the Electronics Lab, which is most of the time a bit uncomfortable because I have wait until she finishes her tasks to continue with my working, she cannot use the projector because I also need the second screen and we only have one HDMI to HDMI cable, I can say that is something hard. I assembled the first power supply for the habitat, I realized that there was not a PS in here, and it is pretty important for any Electronics Lab to have it in order to test circuits, Arduino programming, etc. So, with the material that I found I built one with 2 outputs, one with 9VDC and other with 12VDC. I also finished printing the CubeSat Platform to teach about CubeSats, unfortunately I will not be able to assemble them because they do not have the proper screws for the printed model, so I will wait to arrive to Earth to assemble it and deploy it in Space. Regarding the physical activity I was worried because I was literally not able to do any activity given the amount of things, tasks and everything I had to make.

Day 5

I was worried about the presentation and the spreadsheets, also the emergency procedure, and the Space Dragon, I believe it was a really stressful day, I felt that I did not have any time to do anything. I worked on the presentation, I finished it, I went to the gym, I am about to finish the CubeSat model for the habitat, I repaired electrically the bicycle in the gym, I also learnt how yo use the dosimeter and the Geigers counter. To repair the bicycle, I electrically the connector was wrong, I was broken and the parts were inside the bike, so Lore had the idea to put hot glue inside but it did not work, so I had to make it differently, now electrically is repaired but now it has a mechanical issue inside. I went to run in the gym in the treadmill, I taught them a little of Karate stretching, we did the space dragon, I am pretty close to finish the 3D model for the habitat

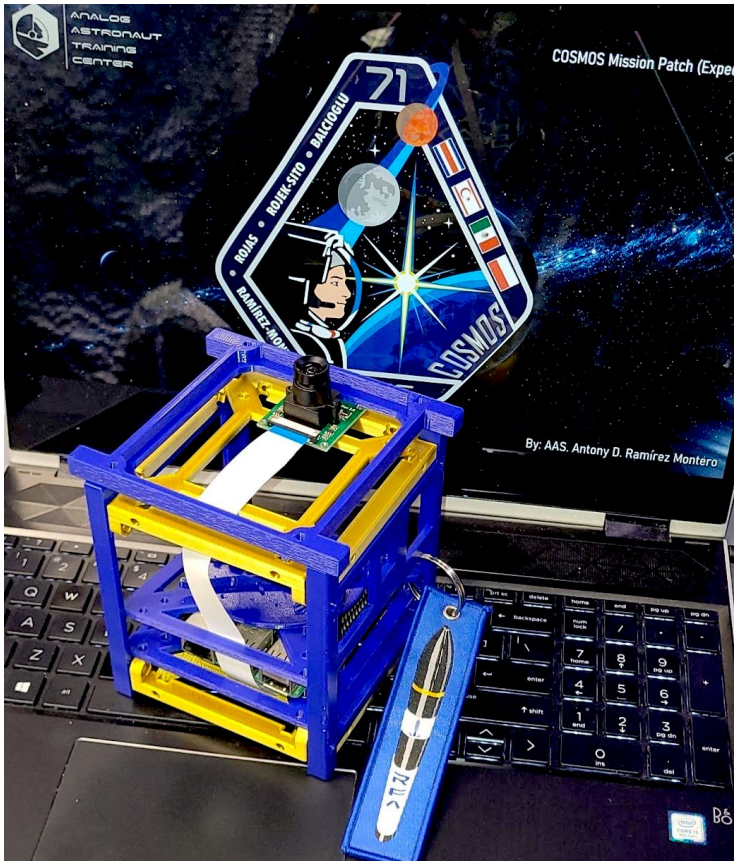
Day 6

The most stressful day with no doubts. The emergency procedure failing, the information that we still needed, the presentations for the conference, spreadsheets, finishing all the experiments, reaching all the necessary data. It was a hard day to be honest. MCC team was busy, I felt kinda alone. But I could handle it at the end. Walk in a treadmill, having some ideas of projects, filling spreadsheets, tasks, and preparing.

"Cosmic Connections: The Odyssey of a Costa Rican Astronaut at the Analog Astronaut Training Center"

In the vast expanses of space, where terrestrial borders fade away, and nations converge in intergalactic exploration, emerges a unique and transcendent story: the journey of the first Costa Rican graduate of the Analog Astronaut Training Center in Poland, Antony Ramírez (@tonyinspace_), a young enthusiast of space sciences with an immense desire to innovate and be part of humanity's collective effort to explore the final frontier—the outer space.

This tale, infused with perseverance and dedication, weaves a captivating narrative about the connection between two distant nations: Costa Rica and Poland. At the heart of this connection lies the Analog Astronaut Training Center, led by the visionary Dr. Agata Kołodziejczyk, one of the finest individuals one could encounter, whose horizons transcend geographical borders and challenge the limits of space exploration.



Before immersing himself in the monumental challenge of space simulation, our protagonist faced arduous trials during a fascinating internship at a rocketry company in Augsburg, Germany. Initially, a lack of development and support made the journey challenging, coupled with economic issues that proved quite impactful. Yet, perseverance and a love for these areas allowed him to survive and accomplish his goals. This chapter of the odyssey highlights the unwavering determination that characterizes those who venture into the unknown, pushing the boundaries of their capabilities in the relentless pursuit of knowledge and the future development of STEM in Costa Rica, designing the first Analog Mission environment in the Central American region, "StarLab," part of the

aerospace startup "BioMechaX Tech" (@biomechax_tech), of which Antony, our protagonist, is the CEO.

Within the simulated habitat, our Costa Rican astronaut, in the mission dubbed "Cosmos," the 72nd in line, faced a series of unique and complex challenges where adaptability and resilience became his most reliable allies. The inhospitable features of the training environment became the crucible where he forged crucial skills for future deep-space missions, all while being part of a distinctive crew.

In an act of educational commitment, our astronaut built a CubeSat model, a nano-satellite representing innovation and the future of space exploration. This gesture not only symbolizes his contribution to scientific advancement but also reflects his desire to share the knowledge gained at the frontiers of space simulation. With this nanosatellite model, the aim is to teach in these isolated environments about space systems and communications, as these simple systems provide significant opportunities for development and learning across various aerospace engineering subfields, offering knowledge, development, and the possibility to create a breeding ground for future projects and scientific papers.

Equally significant is the printed gift: a model that will stand as a testament to the experience, waiting to be launched into the stars in the upcoming training cycles. This act underscores the importance of international collaboration and knowledge transmission, transcending geographical barriers and fostering a sense of cosmic community.

Upon completing the training, our astronaut had the opportunity to present at an aerospace workshop at universities, an experience he cherished and considers one of the most beautiful moments of the year 2023.

This story is written as a time capsule, hoping that future Costa Ricans and individuals on the path to explore the stars will know that with effort, even if the road is challenging, it is possible. The support of people like the MCC staff at the AATC is crucial. This message is for all those space dreamers: don't give up, don't be

swayed by negativity. If you enjoy this, give it your all. You will always find passionate and intense individuals like us who love nature, who love space.

Expedition 72, Aneta Chmielińska, Poland

Titania
13/11/2023 - 23/11/2023

Every evening in the analog space station, each crew member must perform the Wim Hof meditation, which helps train the immune system, respiratory system, as well as nervous and circulatory systems. After each round of guided meditation, the participant stops breathing for at least a minute.

BETWEEN BREATHS

I was not breathing again. Another evening in a row.

And once again I sit down to this Excel which asks me how I feel after this non-breathing session. And how am I supposed to answer this question when there is no **I** anymore?

I've been counting breaths for the past few days and there are fewer and fewer of them.

9
8
7
6
5
4

The countdown continues.
And with each breath, I am closer to some different space.

The less I am breathing, the less there is of me. And I do not stumble over myself.
I disappear.

To fully **BE.**

Usually, I don't think about breathing at all. Who has time for that?

It doesn't matter.

But here?
It's different.

And it will be different **THERE**.
Everything counts. Every single breath.
Because breath is the thing we truly yearn for in space.

How will it be to be out there?
I don’t know.

But maybe we have to finally start being **HERE?**
Slow down our hearts and breaths
to find here
Another dimension of space.

QUANTUM MECHANICS OF BREATH

You say it's impossible.
And let me tell you, that you've never been
Between breaths.

Where you can be and not be at the same time
A particle of the world and its wave.
Where there is no time that the human body measures
With a breath of air and a quickened heartbeat

Immerse yourself in the wave

That the wind brings in,
In the timelessness that sand does not measure.

In the stars circling in the sky
In the rustle of leaves.
Between swaying poplar trees.

This is where I am when I am gone.
When time freezes.
And the heart slows down.

…

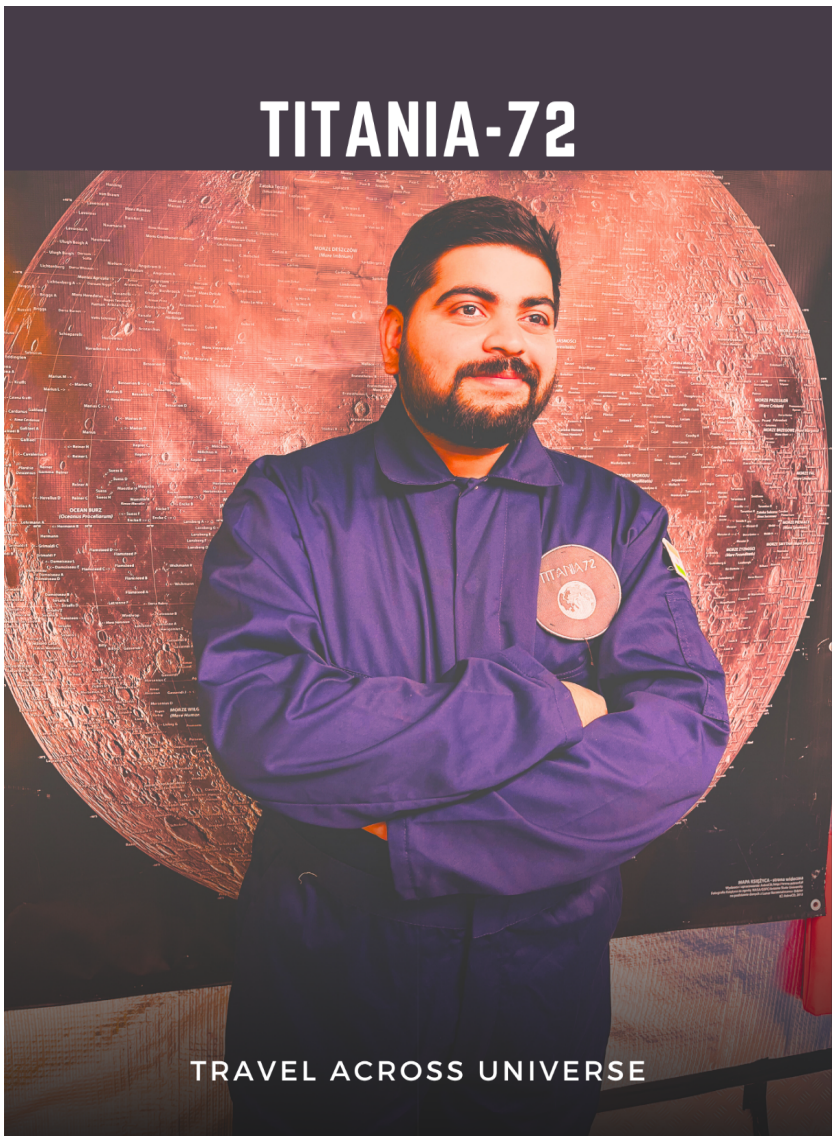
"Mood Rate after" [select] - Excel asks me.

“Connected” - I say.
Because there is no other way.

To be a particle of the world and its wave.

Expedition 72, Raj Shekhar Peri, India

Titania
13/11/2023 - 23/11/2023



A Complete Tour and Experience of the Lunar Analog Habitat Mission

Introduction to Analog Lunar Mission

We humans have come a long way in terms of civilization, and development and have done a lot in terms of advancements in technology. Human beings have started progressing in their journey from living in caves and finding shelters to leading a lavish lifestyle in the current day. There has been a lot of exploration and utilization of majority of the resources that took place on earth. As we are all aware of the Saying – “Sky is not the limit”, humans have started to go beyond the new normal of staying and settling in the earth to the Space exploration.

Space exploration is the upcoming new normal that is supposed to be adapted in the coming decades and centuries. A lot of groundbreaking research work is being done to make the Space exploration more feasible and cost-effective. We are exploring the space for finding the possibilities of existence of lives in the other planets in the solar system other than earth. While we explore the possibility of life existence or trace of life in other planet, a major question arises to why there is a need of exploring the other planet when we have our mother earth?

The over utilization of our resources that we got from nature is also one of the reasons that contribute to the idea of space exploration. Many current day expert researchers and scientists are of the opinion that the earth is already over polluted by human activities and disturbance in the ecological balance of the system. Although this is also an underlying reason for Space exploration but should not be ignored.

There are other purposes behind Space exploration including:

- Human Space flight helps us in exploring and expanding the knowledge of the entire universe apart from Earth.
- Astronauts test new technologies and study the microgravity effects on the human body to develop creative and innovative solutions for those challenges.

- Human Space flight has always strengthened the bond between various countries because Astronauts from various countries work together on Space missions and share knowledge, promote unity, and diplomacy, and foster international relations.
- Other than serving as role models to STEM students and aspirants, human space flight has always contributed to improving the quality of life on Earth with the help of advanced monitoring techniques and systems.

Humans have always had an excitement about how the universe as a whole would look like?. This has increased the number of aspirants to study various branches of Physics and Engineering. while gaining the highest educational qualification alone doesn't make an individual eligible for Human Space flight. There are a lot many factors like Underwater survival(SCUBA), Physical standards like maintaining Blood pressure normal levels, etc that are considered before shortlisting an Astronaut Cadet.

Now that we have criteria set for the eligible Astronaut cadet, the next question is to where are those cadets trained and how. To bridge such a wide gap, the Analog Astronaut Training Mission programs have been designed. These programs are designed to acquaint an individual with the situations that a cadet is expected to face while space mission. The analog astronaut training takes place in a habitat that is designed in such a manner that it resembles the real space module where the candidate is expected to stay in isolation from the outer world and conduct an experiment in those conditions. The idea is to check the Mental and psychological state of an individual because we humans are designed to socialize and get along with others. In the case of isolation, how the body works and responds to actions is also primarily studied.

Getting to Know Crew

Before getting to know more about the crew members and their roles in the mission, there are some basic details that needs to be known. The name of the Mission is TITANIA-72, in this TITANIA represents the name of the mission and 72 represents the mission number. The organizing institute is Analog Astronaut Training Centre also known as AATC located in Krakow, Poland.This training mission was conducted from November 10th till November 23rd 2023.The crew members who were shortlisted and finally made it the expedition were 4.Other than 4 members, there are crew members from Mission Control Center(MCC).The crew from the Mission Control Center(MCC) would be located remotely distant places from the habitat and monitor the activity all the time via the cameras installed in the habitat.

There are other parameters that are remotely captured and monitored in MCC. Levels of Carbon Di-oxide(CO_2) are constantly monitored via arrangement of sensors that are installed in around >35 in numbers at various locations within the habitat.The crew members isolating within the habitat will inhale oxygen and exhale Carbon Di-oxide and during this process, maintaining a constant balance in the levels needs to be done.In isolated environments, the availability of fresh air to dissipate the Carbon-Di-Oxide is typically less than in standard conditions. Therefore it is very important to monitor the levels of Carbon-Di-Oxide and for that purpose, the sensors are installed and monitored all the time.

We would get to know more about the 4 crew members in depth about where they belong to, their educational qualifications and their future career plans.

1.Er.Raj Shekhar Peri – Analog Astronaut & Space Engineer(Technical Engineer).

Er.Raj Shekhar Peri, an Analog astronaut was born and raised in India. Raj Shekhar developed an early fascination with the mysteries of the universe. This passion led him to pursue a career in Mechanical Engineering, earning a Bachelor's degree & Post

Graduate in Aerospace engineering.His interests include Space propulsion, Aeronautics and Space exploration.
Raj Shekhar's intelligence, physical fitness, and unwavering determination made him pursue Analog Astronaut training at the Analog Astronaut Training Center. His ability to handle high-pressure situations and his exceptional problem-solving skills made him a natural fit for the astronaut corps. He aspires to pursue a PHD in rocketry and then be an Astronaut in the future times for Lunar Missions and Mars missions too. He is experimenting with various 3d printed materials (PLA,ABS and Silk based) to test their material holding or absorbing capacities with Soil,Flour etc.

2. Aneta Chmielińska – Analog Astronaut & Medical Officer.

Aneta Chmielińska is a writer and science popularizer. She uses her journalist and pedagogy education to host an awarded family podcast “Dzikoprzygody” to make people fall in love with nature

and astronomy. She also writes popular science books for families. Privately she is interested in neurobiology, herbology, ballet dancing and long-distance hiking. Before joining 72nd Lunar Mission Aneta hiked 1400 miles through Pacific Crest Trail in USA and West Highlands in Scotland. During mission she works on physiologically induced flow state to achieve more efficient work in space and on Earth.

3. Bartlomiej Zietek – Analog Astronaut & Communications Officer.

Bartlomiej Zietek Bartłomiej Ziętek from Poland is first-year student chemistry student at Jagiellonian University. He is interested in chemistry, maths and biology. He wanted to try working in unusual conditions, so he joined 72nd mission where he serves as Communication Officer. He is responsible for staying in contact with MCC and passes on instructions for the crew.In Habitat he is trying to obtain durable materials from kombucha fibers.

4. Mikolaj Gabka – Analog Astronaut & Commander.

Mikolaj Gabka despite having just returned from the frozen corners of the Arctic, where he faced polar bears head-on, and shortly thereafter attended the largest astronomy-themed conference in Azerbejian, Mikołaj cannot resist the call of adventure. After one year he decided to visit Habitat once again.Full of passion, a fourth-year Biomedical Engineering student at AGH, as part of his stay at the station, is working on an engineering project where he is building a plant incubator for cultivation in extraterrestrial conditions.
The crew members present in the mission Titania were from various backgrounds and held their unique experience in terms of their professional and personal front.Their ideas and experiments are the perfect example of how a mission can be successfully carried out in terms of scientific.

Facilities in the Lunar Analog Habitat.

The Lunar Analog Habitat in the Analog Astronaut Training Centre led by Dr Agata is completely equipped with all the necessary facilities. The habitat consists of the following compartments:

1. Entrance area.
2. Washroom / Bathroom.
3. Gym.
4. Kitchen and living room.
5. Bedroom (Bunker Beds).

Ad.1. The entrance area in the habitat is where one is expected to step in and it also has lots of other facilities other than just being an entrance. It comprises of the following:

a) Closet with shelves: It contains four shelves for accommodating the glass containers filled with acids and chemicals in them. There are a set of acids and also some explosive chemicals that should be handled with extreme care and under supervision.
b) Table: The table is not just an empty table, it contains the Siemens Clinitek urine analyzer for analyzing the urine samples of each crew member on Day 1, Day 3 and Day 6.The table has an egg incubator and apparatus for hydroponics/aquaponics for conducting experiments like growing some aquatic life(herbs) underwater in habitat conditions.Also, the table accommodates the drawers which comprise of various office supplies and stationary items for use during the habitat stay for activities and experiments. Also, there are various other instruments like a Photometer for light intensity conditions check and other mechanical instruments in it.
c) **ECG Machine:** The purpose of an Electrocardiogram (ECG) machine is to record the electrical activity of the heart. It is a non-invasive test that helps healthcare professionals diagnose and monitor various heart conditions. An ECG machine measures the electrical impulses generated by the heart as it contracts and relaxes, providing valuable information about heart rate, rhythm, and the overall health of the heart. It is commonly used to detect abnormalities such as arrhythmias, heart attacks, heart muscle damage, and other heart-related conditions.

d) **Refrigerator :** A large refrigerator is provided in the entrance so that all the basic essential foods and ingredients can be stored and can be consumed later for either cooking or direct consumption purposes.

Ad.2. A washroom is provided on the second left of the corner and end of the entrance where there is no shower facility provided and crew members can only use toilets during the stay and no shower is allowed.

Ad.3. Gym: A fully equipped gymnasium is provided to keep all the analog astronaut crew members fit and healthy. Also in the real-time missions and trainings, the astronaut cadet is expected to workout for at least one hour to keep their body and mind under control and stable.The gym in the habitat comprises of Treadmill,Cycle and dumbbell of various weights starting from 2kgs to 10 kgs.The gym also has a mat facility for the yoga.

Ad.4. Kitchen & Living Room: The kitchen has a microwave oven for heating and baking any food items, an induction stove for cooking or boiling the food items, pan for frying or cooking curries etc.It has all basic cutlery items as well.It has even dining table and chairs arranged for gathering and eating together.Also, there is a platform where all the electrical charging points,3d printers are all installed so that any 3d printing can be done.

Ad.5. Bedroom: The bedroom has three bunker beds, each bunker bed has two bed facilities so there are 6 in total for crew members and also maximum 6 members are only allowed in a particular mission in general.The bedroom has also a white board to write and demonstrate anything a crew member wishes to.It has an arrangement of a cupboard where a lot of biological games and other tests like Moron test board etc are found.

Ad.6. Biology & Engineering Lab: There is a small lab in which there are various scientific and engineering instruments that can be found: test tubes, microscopes and all other supporting laboratory materials like safety kits etc are found.

Other than the above-mentioned facilities there are other many interesting pieces of equipment, tools and components provided in the habitat like Breadboards, Arduinos, Rovers and their parts, VR Headsets, toolkits, electronics and other auxiliary parts etc are all provided in the habitat so that a range of experiments from across various fields can be performed.

My Personal Experience

Before the start of the mission, I was a lot nervous and skeptical about the stay and experiments in the habitat. The mission dates allocated to us were from 13th November to 23rd November for a total duration of 10 days. I am an Indian Citizen residing in the United Kingdom and I obtained my Schengen visa for a short-duration stay of 15 days. I got my visa issued quickly because of my training purpose. Thanks to Agata for providing me a letter of recommendation and a formal invitation.

As soon as I reached the Polish Embassy office in Central London, I was questioned by the Officer about the purpose of my trip, after hearing my answer she was more excited and did all the formalities with a lot of energy. She wished me All the very best for my scientific Analog Astronaut Lunar Mission expedition. I made all my arrangements for the expedition and prepared myself mentally and physically for the mission.

Although I was not that physically fit as per standard requirements, but my statement of purpose and other criteria made me eligible for the mission. I had a word with the Director of the Institute Dr.Agata regarding the same and she agreed on one condition to admit me if I made sure I am getting fitter for the upcoming missions and trials. I assured her of the same, and then finally she rolled out an admission offer to me in the month of January 2023.But due to personal and other professional commitments,I had to postpone the mission to November 2023.

I was asked about my research proposal/statement of the research experiment to be conducted during the stay. I always believed in having a unique aim and original ideas.I consulted with Krystian Komenda and Dr. Agata as well regarding the idea and they were okay with proposal being submitted on the orientation and induction day in Poland or even being sent before the commencement.

Having studied Propulsion Engineering, I initially thought of conducting experiments related to mini/micro launchers, testing some ignition delays of some propellant combinations, etc in an isolation/analog environment. However, there were constraints of conducting such high energy and explosive experiments in such conditions without strict supervision and guidance of an expert although following safety precautions was not at all an issue. I had to back off from the propulsion topic.

I kept toggling between the topics to understand the feasibility of performing the experiments in a restricted and isolated environment. Alternative areas ranging from Aquaponics, Robotics (Rovers based), Electronic systems, Cube sat, and Materials were available to be chosen from. After a long struggle, I chose Materials

as my area to work.As a Mechanical Engineer, I am quite aware of the importance of the Material Science. The study of materials play a vital role in almost every aspect of our lives.Every product that is manufactured/produced is done mainly keeping the requirements of the product and type of material to be chosen.
I informed the team and MCC about my arrival and further plans to and from Krakow. On 10th November I was supposed to travel from Birmingham to reach Krakow on the same day. But due to some unforeseen circumstances,I had to postpone that to 13th November 2023 Monday. I rescheduled my flight from UK to Poland and departed to Poland on the new travel date.
I was excited, nervous, happy and anxious(Mixed feelings) from within.A day prior to my departure I informed my close friends, family members and relatives about my upcoming mission and the responses that I received that day were unbelievable.Everyone was so happy about my mission and few people were extremely proud of me like my School teachers, colleagues, seniors and friends of my University. A lot of my seniors and colleagues were from the Department of Aerospace Engineering from various reputed universities across India and the world.
Everyone was so excited that they even posted about me in their WhatsApp status,Instagram stories and wished me the best.
A few special admirers in my circles other than my own family members who always were very supportive during my journey are 1. Mr. Sougat Chakraborty, whom I met him for the first time in the Amazon Development Center Hyderabad during the training days of my first ever job. He has always been a constant support to me and a true admirer who always wished best for me. 2. Dr. Saranyamol VS, a Phd from IIT Kanpur who is currently pursuing her Post-doctoral studies alongside her husband in the USA, she is also an Astronaut Aspirant candidate.Happiest People were my parents and family who wished the best all the time.I am very thankful, humble and grateful to them.

Finally on the day of journey, I started to Kraków from Birmingham International Airport at 01:30 PM (UK time) and the scheduled arrival of the aircraft to Kraków (Poland) was 5:00PM (local time in Poland). Poland was one hour ahead of the UK time. Although I was supposed to reach the Venue by 2 PM so that I could have the briefing and meet fellow crew members.I informed Agata about my

flight schedule because there were a limited number of flights and that too in the Mornings and evenings. She happily waited for my arrival and also made sure that she picked me up in her Mercedes Van. I landed safely in Kraków at 5PM and by the time I had finished my immigration and visa formalities, the time was 5:30 PM. I called Agata and informed her that I reached Kraków and she gave me a few instructions about the meeting point from where she can conveniently pick me up.
I finally spotted her vehicle outside the Kraków Airport. I met my director who was herself there to pick me up and she drove all four of us to the isolation where the mission was expected to commence from the next day. I met other crew members in the van, the other 3 members were from various other parts of Poland, so they managed to reach early.
We purchased mandatory groceries as per our diet(it was decided to have only a vegetarian diet) because me and Aneta(Medical Officer) were adhering strictly to vegetarian diet. Post shopping, we headed straight to the Analog Habitat which was located in quite a remote location and away from the city on a hilly region.

On our way to habitat, Agata showed other AATC facilities like an Antenna for data capturing and even satellite communications which were owned by AATC but not in operation due to some Poland Government and Military intervention and restriction about the Antenna being a potential reason for unwanted issues in the future. A small observatory is also maintained by AATC.We got down from the vehicle and it was dark everywhere except two places, one is AATC facility house which had a few lights and the other were moon and stars in sky.Although we were not that lucky enough to witness natural lights of the nature for long because clouds started covering all over.We started further to reach the habitat on time so that briefing can be done and we were expected to eat and hit the beds on time so that the schedule commences properly from the next day.

We finally reached our destination, I was getting nervous thinking how is it gonna be in the isolation and during the mission. The vehicle was parked half a kilometer away from the isolation because it was very difficult to climb up the hill and moreover the land was very wet and slippery. We carried our luggage and other

consumables to the habitat. As soon as I entered the habitat, I could see an image of the rover as a wallpaper that NASA sent on the MARS. I immediately became confident and decided to perform my experiment with focus and do something different. We were asked to drop our luggage aside and were taken on a tour of the habitat and facility. Dr. Agata took all four of us to show each and every knock and corner of the habitat.

We started with the entrance where there was a refrigerator which is usually for storing only consumable and food items that was bought to be for the analog astronauts. There was a large table beside the refrigerator that hosted a lot of equipments for the experiments. The table was also kind of platform for performing any experiments depending on the requirements of the candidate. The table had Seimen's Urine test machine,It had all laboratory chemical compounds, test tubes, beakers, pH straps, Incubator, Aquaponics/Hydroponics test equipment(typically for performing the experiments related to Hydroponics). There was a lot of space on the table so that the experiments can be performed.Also there were different drawers in the table which had instruments to check luminous intensity or light intensity, lots of tools for fixing electronics and other devices, various thermometers (for body temperatures), Office stationary items, Some games (cardboard) and even drawing paper and crayons set for upcoming activities in the habitat.

There was a store room for keeping some reserve items like dry shampoo, tissues and other items and as well as some ventilation systems for balancing the entire oxygen and carbon dioxide level and to maintain temperature inside the habitat. We were instructed not to touch them. Beside the store room, was the restroom without a shower facility in it to maintain the conditions as in the real time mission. We were given dry shampoo for applying it on the hair and also perfumes etc. were given to us. A Gym was also provided opposite to the restroom for working out to maintain proper metabolism and keeping ourselves fit as we were not allowed to move out at any cost from the habitat. In short, for the next 2 weeks we never had any access to the outside world. Also in the real time mission training Astronaut cadets are asked to perform training and exercise of their choice at least for an hour. We had a treadmill, cycle and even dumbbells of different weights like 2.5kg, 5kg etc. provided to us. Now heading inside the second

room where we had a kitchen facility to cook the Breakfast, Lunch and Dinner for all of us. There were shelves for keeping tea bags, sugars and coffee etc for having any time.There was a table that was used multi-purpose for both dining and also working there.Beside the table there was a platform that was provided where all the major electrical sockets, charging facility and even 2 - 3D printers were placed for printing items. Even Fitbit bands were charged there so that they could be worn throughout the day so that a lot of parameters could be monitored like heartbeat rate, Sleep quality like sleep time total duration(not less than 6-7 hours) and deep sleep duration as well. Opposite to that there was a huge shelf which had all the reserve food ingredients stored and also some chocolates and snack items were placed. Besides the shelf, there was a partition that was created for a small lab with two microscopes, gravity meters, and other necessary setup to perform experiments. It had lighting arrangements like having a blue and pink lighting system within the partition area which gave us a legit laboratory experience. Last but not least final compartment was the one where we had all the bed arranged for the cadets to sleep/ take rest.

Our Daily Routine in the Habitat

We were instructed in the mission briefing that we would have our own fixed schedule which was supposed to be followed by every member in the habitat. The routine is tabularized as follows:

S.No	Time(T+ Hours)	Name of the Activity	Comments
1.	(T+0) Hours	Sleep report,Circadian,chimp test,urine analysis,STP,Mood and Bioimpedance	Urine test on Day1. Circadian(weights,BP,Temperatures)
2.	(T+1) Hours	Preparing Experiments & Breakfast.	
3.	(T+2) Hours	Circadian,Breakfast and briefing from MCC.	Circadian to be conducted every 2 hours(BP,Heart rate,weight,respiration and mood).
4.	(T+3) Hours	Performing Experiments	Conducting individual experiments.

5.	(T+4) Hours	Circadian + Gym(A1)	1st Astronaut's workout time(Rajshekhar) would perform in the same order and time slot everyday.
6.	(T+5) Hours	Circadian + Gym(A2) + preparing lunch.	Anybody could cook for all of us.
7.	(T+6) Hours	Circadian + Lunch time	After circadian proceed to lunch.
8.	(T+7) Hours	Moron test + Experiments+Photo session.	Moron test is a test conducted to check the mental abilities of the astronaut.Photo session was just on the Day 1.
9.	(T+8) Hours	Circadian + Gym(A3)	Time for 3rd Astronaut cadet to workout.
10.	(T+9) Hours	Experiment Reporting,Gym(A4)+Educational Video	
11.	(T+10) Hours	Circadian + Supper	
12.	(T+11) Hours	Habitat Maintenance+Space Dragon	Space dragon is an activity to keep mind relaxed and active(mentally)
13.	(T+12) Hours	Circadian + Group Activity	Group Activity included (yoga,meditation,Dance etc).
14.	(T+13) Hours	Water Report + Sport Report + Daily report.	Water report = Amount of water intake in the body and also amount of water gone out of the body(intake+urine+stool)
15.	(T+14) Hours	Circadian+Chimp test,STP,Urine analysis,Hoff test and Sleep	Chimp test is usually conducted online to check the memorising abilities of the candidate(Usually you have to surpass chimpanzee which is considered to be very smart in memorising the things)

The above-mentioned activities were included to keep astronaut cadets active in all aspects of their lifestyle throughout the day. Activities like Chimp test was conducted to check the astronaut's memorizing abilities and reproducing them in the same manner and pattern.

Likewise, Moron test was carried out to check how astronauts perform while they just sense and touch things without actually watching them in a time restricted environment.

My Observations and Conclusion

My experience in the habitat during the mission was very defined and I could easily and stably survive in the habitat for all the days of the mission without any issues. I could adjust to the conditions, and also get along properly with all my other crew members. My duty as a space engineer and Data officer was also to monitor the data collection, and reports of each member from time to time. Also to take care of any technical issues if occurred. Usually, a lot of people get either uncomfortable or anxious and thus they abort their missions abruptly.

My non-technical experiment in the habitat of observing how things change psychologically between normal and isolated conditions (under supervision).

My technical experiment was to find out the dirt-holding capacity of three different materials that were available to me in the habitat. The three materials were PLA, Silk and ABS, all these filaments were available and with the help of Mission Commander Nicolas I was able to 3D print them in considerably small pieces and conducted my experiments on different dirts substances (Regolith – A Mars soil simulant was not available), so I had to experiment with Organic soil and some baking powder. I considered three different temperature conditions :

1. Normal/Standard conditions which was a standard room temperature condition in the habitat that was recorded to be approximately 24.5 degrees Celsius. It was a bit higher than overall temperature conditions in the Poland Country because of the heating and Air-conditioning systems inside the habitat. Our duty was also to balance them as well.

2. Cold condition: This was the condition where the temperature were around 4.4 degree Celsius.The dirt particles Soil & Baking powder were stored in the same conditions for around 36 hours

3. Freezing conditions: This condition was the one where the temperature recorded was nearly -8.5 degree Celsius.This was the frozen condition where the dirt particles were stored and kept.

Then the 3D printed pieces of the materials were tested and checked accordingly.The results and findings are discussed in more detail and deeper way in other technical report that is prepared exclusively from the technical and scientific point of view. Dr.Agata and team had instructed us to keep the findings and results with us and also to make effort to start writing the report so that it can be further modified and made eligible for a possible publication.

Other than the above-mentioned points there was a brief discussion I had with my fellow crew members about what they actually felt about themselves being isolated in habitat for the mission.They also shared a few points and I also have my own experiences that I felt are worth sharing.These experiences are tabulated below:

S.No	Activity Name	Regular Conditions	Habitat Conditions
1	Sleep	less duration	Sound sleep majorly
2	Mood	Lots of variations	Balanced mostly
3	Eating Pattern	Better and organized	Organized but lot more unwanted eating
4	Atmosphere	Fresh and Awesome	Artificial and controlled
5	Physical Work	Balanced and achieved anyhow	Scheduled
6	Overall Experience	Some deviations and distractions	A lot organized and disciplined lifestyle

As mentioned in the above tabular format, the observations for the major activities of daily life were recorded and tabulated.

1. Sleep plays a very important role in the human life.It is said that a person can survive even a month and six months without proper eating as well but cant survive more than 10 days without sleep. Sleep has a lot more to do in our lives.If sleep cycle is maintained properly then body functions properly and a lot of parameters like weight, mood, clarity of thoughts and appetite is all under check and control.Sleep quality in regular conditions used to vary a lot from day to day.Some day I slept for around 5 hours whereas the other day I could only hit the bed for 1.5 hours as well.While in the habitat it was mandatory for all the crew members to maintain a constant sleep for 6-7 hours at least. So sleep quality in the habitat was perfect majorly in all the days which was enough to keep us motivated.

2. Mood patterns: The mood patterns of person also depends on mostly sleep and well being conditions both physically and mentally.One can get disturbed mentally instead of having a sound sleep and sometimes it can happen because of the underlying stress and other reasons that may disturb the sleep cycle instead of having healthy appetite.In order to maintain a balanced mood it is very important to keep yourself in check physically and mentally.In regular conditions moods with varying frequencies were a lot more.Whereas in the habitat conditions, moods were balanced in all almost all the days.

3. Eating Patterns: The human body needs to intake a variety of stuff either in the form of good thought and food so that it can function to the fullest.A balanced diet is much needed for the body to perform all the functions in best possible manner.Any small disturbance in the food intake may create abnormalities in the body.For instance, if you have more salt intake in the body, chances of bloating is very high in the body.Excessive sugar can cause issues like sleeplessness etc.My observations in eating patterns in the regular conditions was bit better than that of habitat because in regular conditions we are prone to lot of activities and movements and even diversion that prove to keep you away from false hunger alarms.Whereas in the habitat although there was controlled diets and portion sizes that were provided and followed, the urge to overeat some sugar stuff and snack items beyond the eating windows was a bit more

which sometimes created some acidity issues and also more dehydration in the form of stool.That increased water output percentage.

4. Atmosphere: The Atmosphere and surrounding play a vital role in human life. We human beings are designed and engineered to be mobile or able to move from one point to another. In regular conditions we humans make a lot of movements in daily routine like even if we are at home or in the office (workspace) etc. So a variance in atmosphere in regular conditions is observed which is not the same in case of habitat and controlled atmosphere because our mind is only restricted to being in those given 3 compartments where all activities set to take place. Since the habitat also had crew members and MCC which made my stay more beautiful and balanced.

5. Physical Work: Physical work is one such underrate aspect which majority of the people other than fitness freaks tend to ignore. It is one such part in our lives which can either break or make the life. If you are physically active then the chances of you getting sick or prone to some diseases will be very less likely when compared to another individual with almost sedentary lifestyle. Here in regular conditions even though we do not want to hit gyms or we may opt to go for simple morning walk or evening walk as per our convenience.Still most of the times, we tend to skip workout sessions which makes us less disciplined and not fit. Whereas, in the habitat everything was planned and scheduled which made me more inclined towards physical work and fitness. It proved a lot to be beneficial.

6. Overall Experience: My overall experience was awesome. I felt proud of myself from dreaming of becoming an analog astronaut till making my first ever successful Analog Astronaut mission training. Representing myself (Parents, Sibling and even my country there) was one of best experience I could have. Staying for all the 2 weeks in the habitat without getting suffocated to the restrictions was something I felt so happy. My body BMI and circadian parameters were mostly on par alongside my crew members. There are certainly parameters

like weight etc where I am supposed to work. I am making my sincere efforts to keep physical parameters of body under control and also I am planning to learn life surviving skills like skydiving, basic flying, SCUBA diving etc. to make myself more accessible to upcoming missions and also to apply for further real-time mission in ESA (European Space Agency) or ISRO Indian Space Research Organization.

My Tip to upcoming aspirants – If you want to achieve something, then first and foremost is to start. Making an initial move is very important. Being an astronaut aspirant is the most difficult but not impossible. Astronaut aspirants come from various backgrounds not only restricted to Engineering and applied sciences, rather anyone from basic sciences, medical, research in various fields etc can always be part of the mission depending on the organization's requirements as well. Have lots of patience and pursue your goal by maintaining a positive attitude towards life, experiences and learning that you get. A lot of people fail to achieve not because of lack of intelligence or anything but just patience and their attitude. Please keep that in mind and plan you journey accordingly.

Lastly, I would like to wholeheartedly thank my Father Mr. Sreeram Peri, Mother Mrs. Annapurna Peri, younger brother Mr. Anil Kumar Peri for always having my back and loving me unconditionally. My teachers, professors and friends who always motivated me to choose something different and extraordinary in life.
Also, my amazing crew members in the Analog Astronaut Lunar mission – Nicolas, Bartek and Aneta who were equally supportive and balanced and made my stay a pleasant one.

Expedition 74, Salvadore Moreno, Venezuela

Decimus
03/12/2023 - 13/12/2023

Firstly, thank you for this great opportunity, it has been a unforgettable experience which I am 100% sure it will help me to get where I want to be, An Astronaut. It has been a lot of learning, from Seeds growing in a Microgravity environment, to making water out of urine through distillation.

I have found myself very productive and been able to work almost the whole 16 hours of the Lunar Day, and working in isolation was a great experience too. There are some measures taken here that I

will implement in my daily life. I wish I could stay longer but I am also excited to see the outside world.

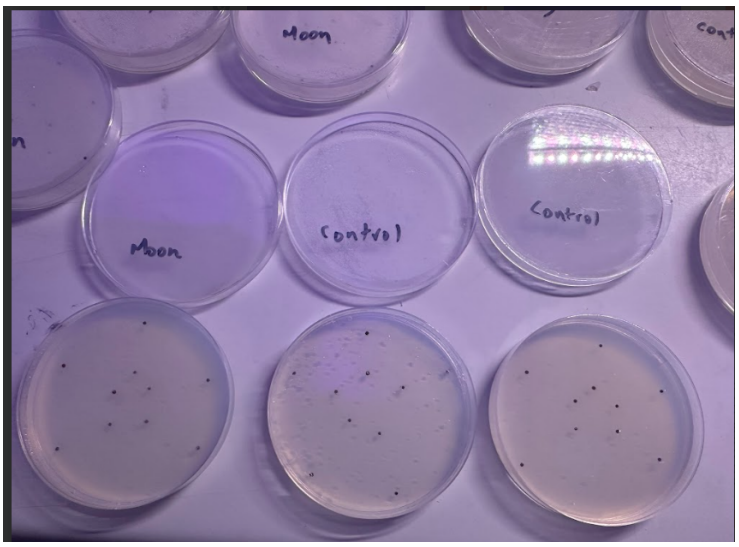
Again….Dziękuję!

Day 1

- Woke up motivated, energetic and ready for action.
- Confused and thoughtful in the first tests in the morning.
- Excited and interested in the Microgravity Seeds Experiment.
- Calm after Microgravity Experiment and Lunch.
- Bored with exercise but I felt that I could have done more.
- Annoyed at the end but a mixture of tiredness with disagreements.
- ENG and I decided to do the Microgravity experiment whilst MED and DAT were fixing and setting up the 3D Printer.
- We had some time to look for all the correct setup but eventually we found it all.
- We had 12 cleaned Petri dishes and we filled them with a 4% Solution of H20 with Agar (5 mm Height and 9 cm diameter), we had a total of 400 ml (H20) and 16 g (Agar)

    - We cooked the mixture previously in a pot to mix very well and make a homogenous mix.

    - After it solidified we labelled them (4 Lunar Setup [Outer Ring 1RPM, Inner Ring -1RPM, Switch Time 4sec], 4 Control and 4 Flipped Upside down or 180 degrees), all under the same temperature, light and different conditions.



- We planted 10 seeds in each pot, distributed into 5 inner and 5 outer stars.
- Then the samples were left on Day 1 with all the previous settings.
- The RPM machine will be on and samples will be checked everyday.
- Tests; we took some time in the morning to adjust to these since it is the first day, we hope tomorrow it will be faster.
- Breakfast, lunch and dinner were fulfilling and were easy to make, most of the crew enjoyed everything, ENG and I cooked for the whole day and MED washed the dishes.
- I brushed the floor and cleaned it.
- I tidied up around the lab work.
- We danced a little bit and sang.
- I exercised only for 35 min, of which 12 min were jogging and the rest were bodyweight exercises.

- There are more things that I probably don't remember but I am really looking forward to tomorrow 🙂.
- Used the Oxytocin Lamp and prayed for 15 minutes.

Day 2

- Woke up tired, since I set an alarm at 18:00 which woke me up from my deep sleep and disoriented me all night thinking it was the wrong time.
- Throughout the morning I felt quite tired and sleepy.
- After the Hof Test, it boosted the morale of the whole team and everyone was feeling more rested and energetic.
- Then I was calmed and focused for most of the remaining day.
- Also felt happy and relieved after submitting the PR presentation.
- Very chilled after exercise.
- Tests all day.
- Researching for the setup of the Water recycling system.
- Cleaned the bathroom, swiped the floor and tidied up.
- Helped with the cooking and washing.
- Got the Crew to organize their thoughts and tasks so they could prioritize what was important and assign tasks to each.
- Fill up the data missing (including some Issues)
- Did a longer exercise version today with more variability.
- Looking for a 3D Project.
- Checked the Seeds in Microgravity are going according to plan.
- Took individuals and group photos.
- Finished up the PR Presentation.
- Had 2 email conversations with my Fiancé since she went to the hospital and there were some house issues.
- No clear update in the Microgravity Experiment.
- Did a power nap of 20 minutes after the Hof Test, as recommended which boosted the morale of the whole team.

Day 3

- Woke up rested but with an urgent need to pee, since I had woken up during the night 2 times wanting to pee, but I avoided the situation and went back to sleep.
- In the morning I felt calm and focused on the experiment research, and doing the test the correct way.
- Then during the research and reading I started to feel frustrated because I didn't find a suitable methodology for the experiment for this Lunar Habitat.
- Then after eating Lunch I felt better and more relaxed, especially right after we did the Hof Test as a team and that made me peaceful and calm, even a little bit sleepy.
- I took a Power nap after the Hof Test for 20 mins and woke up peaceful and calm.
- At around 9:00 I started feeling focused and excited since I decided what I was going to do for the Experiment.
- I was feeling hopeful and focused after the test started.
- Felt happy after having dinner and watching a bit of a movie with the crew.
- Felt focused as the night was ending so reports were finished and data was posted correctly.
- The day felt quite productive from the whole crew which made me feel more satisfied with everyone's performance.
- Woke up and did all the required tests (bioimpedance and circadian) plus filled up the required data as the day was passing by.
- Perform the Day 3 tests asking for my mood conditions.
- Assigned and helped the crew to focus on their tasks and priorities.
- Prepared the Dragon Experiment documentation so it was easier to record our feelings/dragons.
- Did the first part of the dragon experiment in the morning.
- Kept researching for an adequate methodology to proceed with the Urine > Drinkable Water Recycling System.
- Cooked Breakfast, cleaned the dishes, tidied up a bit, helped with Lunch and Dinner.
- The whole crew did the Hof Test together for the first time, it was a nice experience.
- Took a power nap after the Hof Test for 20 minutes.

Tried to do an Urine > Drinkable Water Recycling System, but thought of first start with salted water into drinkable Water Test first:

1. Organized the required materials for a distillation (Plastic bag, pan, technical water, salt, scale, cup, weight, scissors, induction stove)

2. Measured the water (200ml) and Salt (8g) to make a 4%NaCl (Salt) in H20 (Water) solution.

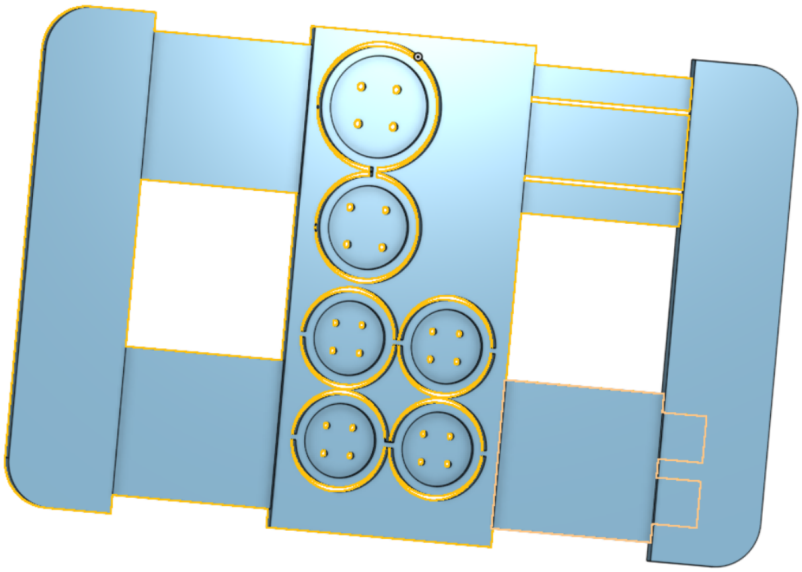
3. Put the pan over the induction stove and put the cup in the centre (making sure the cup is not too tall so the water can go back inside).
4. Poured the 4%NaCl in H20 solution in the stove around the cup (Not inside).
5. Cut the CLEAN plastic bag into a square to cover the top of the pan.
6. Put a weight on top of the plastic bag, making sure that it is above the cup and centered so the water drips into the cup.
7. Cover with the lid and make sure it is sealed correctly so no water escapes through evaporation (you can use tape to make sure a tight seal).
8. Since it is plastic we do not want to heat it up too high for it to melt, and since there is no sunlight to heat up the pan, we put the heat up to 80°C.
9. The evaporation started at 09:15 and waited until the cup had enough water to taste for the whole crew.
10. The cup had some distilled water around 12:20 and the crew waited for it to cool down.
11. We proceeded to drink the water from both sources, the cup with clean water and the 4%NaCl in H20 solution, there was a HUGE difference.

- After the experiment was set I started back again to fill up missing data, and took some photos of the experiment.
- Did some exercise for 34 minutes and it was a mix of cardio & weights.
- Cooked dinner with ENG and ate together whilst watching part of a movie.

- Finished the evening part for the Dragon Experiment.
- Finished the remaining tests for the day.
- No clear update in the Microgravity Experiment.
- We danced a little bit and sang during the cooking and other activities today, morale was definitely the best today.
- Went to sleep around 16:40.

Day 4

- Woke up a little bit sleepy, I overslept for 30 mins.
- Were quite happy and energetic right after the whole crew woke up, during the breakfast and the eyes test laughing a lot, dancing and singing.
- Feeling a little bit sore in my muscles from exercises previously.
- Feeling happy and calm after watching “Encanto” with the crew.
- Feeling focused right after, to get ready and set up the FAST Experiment.
- Feeling a little bit annoyed with some crew members since it feels like they are not taking it seriously, leaving things half way and not helping at all, but nothing I cannot cope with.
- Then I felt very tired, with sore eyes and very very moody, even the crew could tell straight away I was tired.
- I felt lazy too and took the day without exercise as rest.
- Had a recovery and fun session playing UNO today.
- Did the Urine and rest of the morning tests.
- Cooked breakfast with ENG.
- Helped troubleshooting the 3D printer.
- Prepared a 3D file to print (Little Astronauts for the Crew)
- Started working into reporting and missing data.
- There was an update in the Microgravity Experiment, some seeds started to sprout in the “Control” plates.
- Cooked Lunch with ENG.
- Watched a movie whilst having Lunch with the Crew.
- Had some brainstorming some design options to 3D Print with ENG in regards to his personal experiment.
- Did the Hof experiment together with the crew.
- Re-design the 3D printed thread and needle “pocket” version.



- Researched and tried the Ultrasound machine, unfortunately with no luck today, but we will try tomorrow.
- Taking pictures of all the tasks.
- Put some files from the ENG experiment into my laptop to slice in software, but tried to print today with no luck, and will continue tomorrow.
- After doing all the previous tasks, all in the computer mostly, I felt very tired, with sore eyes and very very moody, even the crew could tell straight away I was tired.
- I took a rest day from the gym.
- Had a very fun session playing UNO today.
- Did all the rest of the test together at 16:00 or so and today for the first time since arriving the whole crew went to sleep at the same time. Went to sleep happy.

Day 5

- Felt sleepy when I woke up so I decided to stay another 30 mins, then I felt more rested and calm.
- Feeling a little bit nostalgic, missing my fiancé.
- After feeling focused trying to sort out the 3D printer.
- Feeling calm and a little bit sentimental after having a quick call with my Fiancé, she was taken into the hospital for an infection.
- Focused but a little bit frustrated since the 3D printer plate doesn’t seem to be sticking the ABS/PLA.
- Sleepy after Hof.
- Happy and calm after Lunch since the crew watched a movie.

- Satisfied once the printer could work to print the ADCS mechanism required.
- Very happy and with a lot of laughter before sleeping whilst playing UNO.
- Morning tests like usual.
- First thing was trying to sort out the 3D printer which wasn't printing properly. I tried troubleshooting it, changing some settings, cleaning the heat bed metal sheet, changing filament, and even changing some settings in the slicing software I have.
- It seemed like the bed was maybe off set a little bit on the right hand side.

    - The solution was printing on the left side, and less parts, although it seems it doesn't adhere most of the supports to the plate.
    - There have been more seeds sprouting around the microgravity experiment.

    - Still trying to troubleshoot the 3D printer (almost the whole day trying to fix this!)
    - Some personal reports and presentations for personal purposes.
    - Tidying up the habitat cabinets.

- DAT helped with the 3D printer and finally it seems it worked, we changed the rotation so the extruder wouldn’t move a lot.
- Watched a movie whilst having dinner with the crew.
- Taking some photos with ENG and overall pictures around the lab for Public outreach.
- Did some exercise.

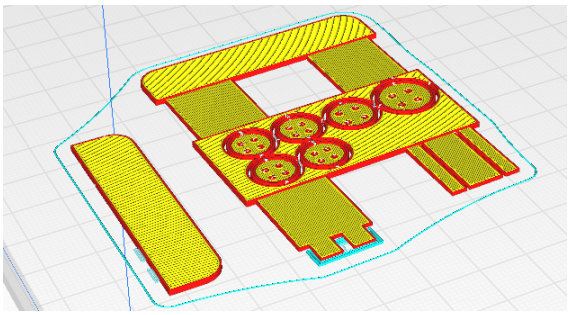
- Cooked dinner and cleaned plates for the team.
- Did dragon test as a team and played uno until late, went to sleep around 18:00

Day 6

- Woke up quite sleepy but then took a nap right after and felt rested.
- Felt quite happy, energetic and active after putting on some uplifting music and eating breakfast.
- Felt focused on writing up reports.
- Felt frustrated during the fixing of the 3D printer.
- Felt quite happy and excited after it finally got fixed, even danced.
- Felt relaxed as the night was coming.

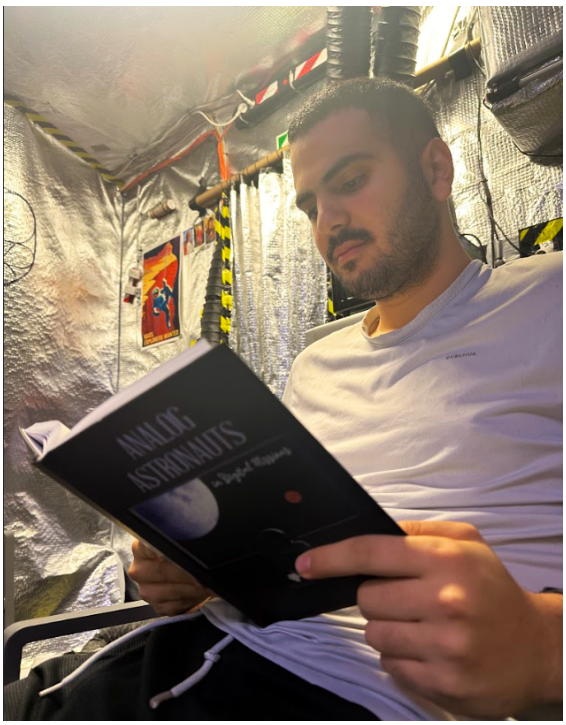
- Woke up at 00:00 and did all the required tests for Day 6 Morning, but then went to have a quick nap again since I was a little bit sleepy.
- I realized there was blood when I sneezed, but this was probably because I hit my nose in the night (it stopped).

- Had the briefing whilst ENG was cooking breakfast and put on some uplifting/happy music because DAT was a little bit moody, then after having breakfast everything went great.
- Made sure all data was up to date and correctly input.
- I sent the Needle and Thread “Pocket” card plus an Arduino case (for ENG), to the DATA officer to print.



- Found a very comfortable spot to work on in the kitchen.

- Did some more reading in the Analog Astronaut Book.

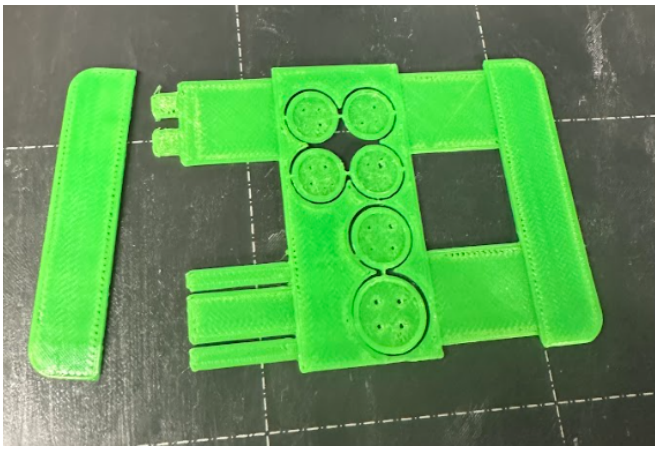


- The 3D printer seemed to have some material stuck and it took some hours to get it out and clean it. We had to open up where the gears were and take the stuck bits, which was a very long process.
-
- Cooked lunch and dinner for the Crew.
- The Microgravity Seeds had some progress with the more sprouts and the 180° seems to be creating cracks in the Agar mixture.
-
- Did the Hof test together and relaxed with the crew.
- Lastly, finish up the remaining tests and write up the reports as a crew.

Day 7

- Woke up quite sleepy but nothing major.
- Had a power nap around since I was feeling sleepy around 4:30, and woke up at around 6:00 feeling cold but much more active.
- Felt very focused throughout the day.
- Had some stressful times as well trying to have everything ready for the Egress tomorrow.
- Feeling excited to come out but I feel I could be longer inside.
- Thank you so much for everything!

- Last morning tests of the mission.
- Checked the 3D printer since it was left running overnight and I am very happy and satisfied that now it prints fine with no trouble.
- Finished 3D printing the Thread and Needle Wallet but since it was too small it didn't fit properly.



- Redesigning the 3D printing the Thread and Needle Wallet.
- Writing my Analog Astronaut experience.
- Doing some work/personal presentations.
- Finishing up the Crew Summary.
- Helped tidying up and cleaning around the habitat.
- Printing some Astronauts for the Mission and adding the EXP74.

- Preparing all the data to be ready for reviewing and making the Summary presentation.

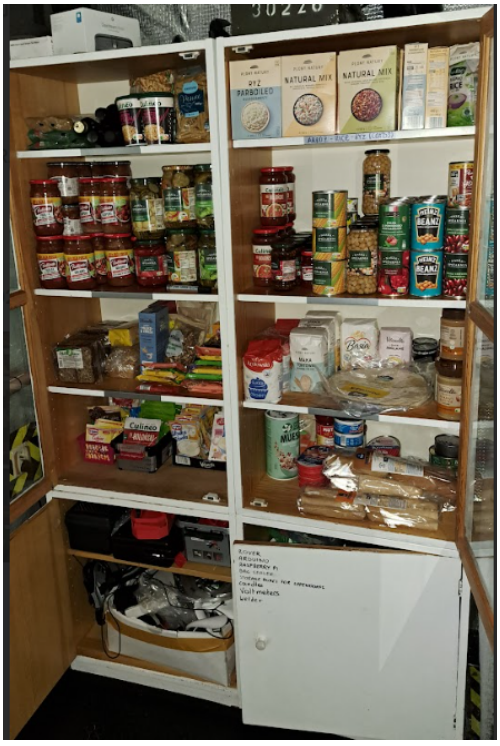
Expedition 74, Brandon Salazar, Mexico

Engineering Officer Report

Decimus
03/12/2023 - 13/12/2023

Day 0

We were exited and happy to start the mission. We found a big disaster in the habitat, I start to clean up the spaces

This:  to: 

We didn’t eat anything inside the habitat this day.

Day 1

Well I feel a little strange, I feel we have a lot of things to do and not so much time. I feel a little with the Impostor syndrome. I'm trying to work well, but I feel I'm not working as well as I can. There are a lot of emotions during the day, but normally I feel happy but there are moments that I felt a little tired or sad. This was a pretty long day, not for the time exactly it was the fist day with lunar time, the first thing we do was change all the clocks to “lunar time” to start with the mission, then we took for first time the bioimpedance measurements, activity who was longer than we thought just because we had a new learning curve. After that, we had the fist briefing, Agata assign Us a few experiments, we start with the breakfast, little late and the we start with the experiments, all the activities took a long time because we found a really big disorganized habitat, before each activity we do, we needs to clean up the area and then start

We had a little problems with the 3D printer and we started to work in the Petrie's experiment, so we divided into two teams to start the mission, Team 1: Salvatore and me to work on the Petrie's experiment, and Team 2: July and Arturo to make the 3D Printer works.

Petrie's experiments:

Step 1: Identify and collect all the things we need, (Petri Dishes, Agar, Water, Alcohol, Paper)

Step 2: Clean the area from the experiment and the Petri dishes,

Step 3: Prepare the Agar
- 3.1 Measure the water 400g
- 3.2 Measure the Agar 16g
- 3.3 Boil and move the Agar with water until makes it transparent

Step 4: test the Microgravity Machine in moon gravity.

Step 5: Prepare the experiment

5.1 Put the mix of Agar and water to the Petri Dishes

5.2 Put the ten seeds in each Petri Dish

5.3 Separate the twelve petri dishes in three groups

5.4 Put in moon microgravity four petri dishes

5.5 Put in the same conditions 3 petri dishes without microgravity

5.6 Put the final petri dishes at 180° (face down)

We organized a cleaning sheet, and continue cleaning up.

Day 2

At the start of day 2, I felt so tired, I haven't thinking about the 16 hours of work yesterday, I woke up late. After the breakfast It took me a lot to start to work, and I feel little better but I was little frustrated because I didn't start my project yet, I felt that there was a lot things to do and no much time. Then, Something makes me happy during a time until I start to work in the project, I get focused and I work until I did exercise.

Finally I'm much better.

Woke up late, and checked the petri dishes from microgravity were okay. Took the weight test, and had breakfast with social integration. Took a break / music since 40 minutes and then start to work. I start with the develop from the ADCS low cost experiment for control for cube sats:

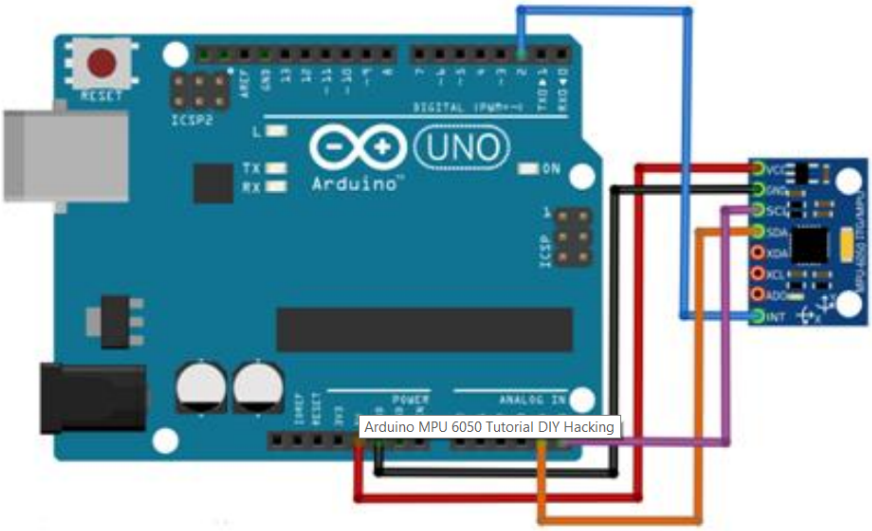
Step 1: Check the Accelerometer and gyroscope sensor

1.1 Solder pins to sensor for tests

1.2 Download data sheet for sensor

1.3 Code on Arduino to get data for sensor

1.4 Make some tests to check the parameters



MPU 6050 GY-521 3 Axis Gyro Accelerometer Sensor Module Arduino Diagram.

Step 2: tests for motor

2.1 Check the battery charge

2.2 The movement for the DC motor with the battery

2.3 Soldier some parts from the H bridge for control the motor direction

2.4 Code and check the H bridge for control directions

2.5 Code the control of velocity with PWM and H bridge

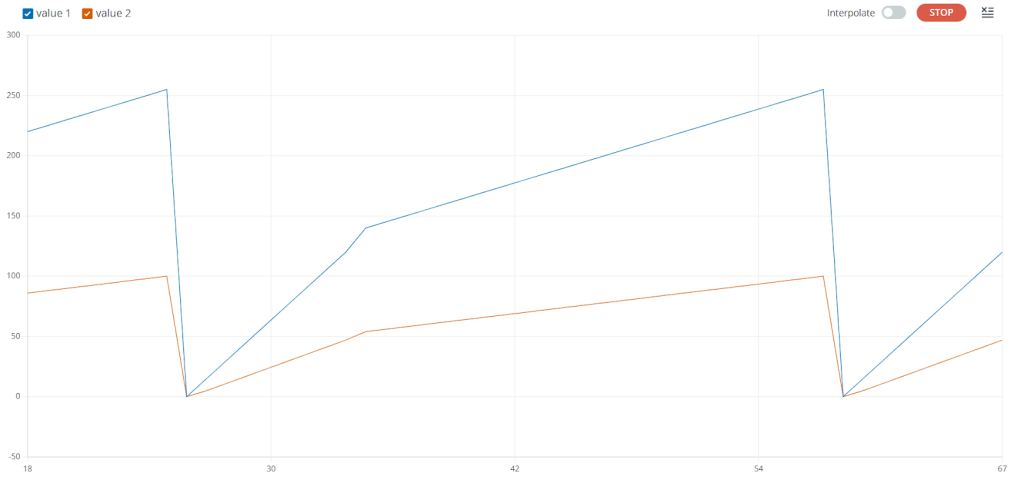
Day 3

First I feel frustration because a woke up at 10 and I thought was pretty late, but I didn't understand why any body woke up yet, same at 11 and I couldn't woke up I was so tired until I understand was 22 an 23 hours and I had time to sleep. Then, I woke up late, like 1 hour more than 00 hours, and I felt sad, I thought that I'm not doing the best. Then I was focused almost all the day working in ADCS project until the Dinner, after that feel good and I did my respective test and go to sleep. Woke up late, and checked the petri dishes from microgravity were okay. Took the weight test, and had breakfast with social integration. Start with the develop from the ADCS low cost experiment for control for cube sats.

Step 3: Check the range from control of motor velocity

3.1 Code an incremental range to check the fist tests

3.2 Check the incremental range to check the motor movement and define Minimum and maximum range of control

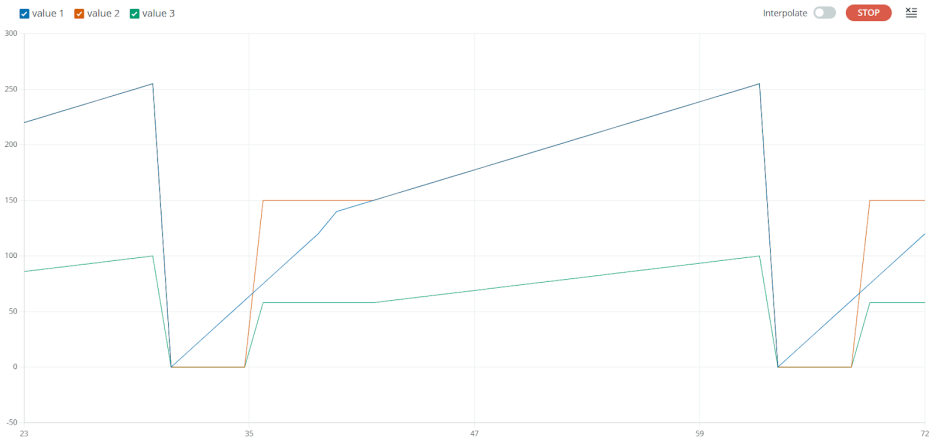


Range of PWM (blue) and percentage (red) of motor control velocity.

Results: The range of control start with 150 PWM to 255 PWM to the motor control velocity (52% to 100% respectively) that could be a little problem with the law control because it doesn't have the complete range.

3.3 Due to the PWM range that spins the motor, (150 - 255) it is necessary implement filters to add to the control that will be develop. There are 3 filters:

1. Turn off motor: To ensure that the motor does not move, place a high pass filter to establish at zero all values less than 60 PWM.
2. Start movement: Due to the motor doesn’t move with values less than 150 PWM and to initiate movement with the control at values from 61 to 150 PWM, place a band pass filter to establish at 150 for all values from 61 to 150 PWM.
3. Limit: To set a limit to the control, place a low-pass filter to set values greater than 255 PWM to 255.

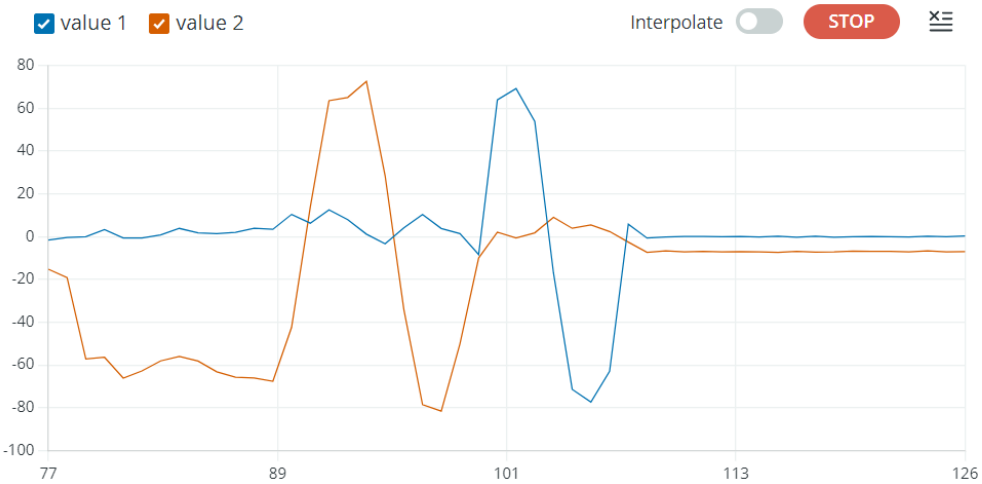


Original control (blue), PWM Control with filters (red) PWM Percentage (green).

Step 4: MPU 6050 Module configuration:

4.1 Calibrate MPU6050 To establish correct lectures from the sensor, it's needed to calibrate it.

4.2 Inclination Angles: The MPU 6050 sensor makes measurements from acceleration and angular velocity, for that reason it is needed to make a code that reads the inclination angles.

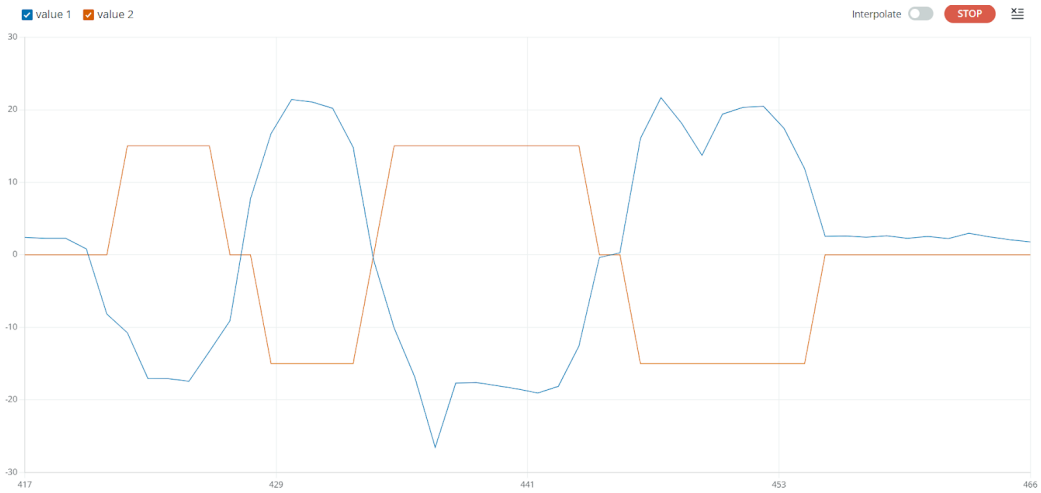


Tests results from measurements of X (blue) and Y (red) Angles.

Step 5: To start to test the control, It needs to put both codes (Motor Velocity Control and Accelerometer lecture) together to test if all the components are working good together.

Step 6: To start test about control between X axis angle value and motor rotation, develop a code where test three statements

6.1 State 1: When the X angle inclination is in the horizontal position, the motor doesn't move.
6.2 State 2: When the inclination has a X angle positive, the motor will rotate in counter-clock wise.
6.3 State 3: When the inclination has a X angle positive, the motor will rotate in clock wise.



States of the control test 1.

Day 4

In the morning Little sad, I didn't understand but I continued feeling I'm not doing my best at all. Before breakfast my humor change radically I felt happy and so energized. Then I felt focused on reports / Photos / and enjoy the habitat. Love music. Woke up, and checked the petri dishes from microgravity were okay.

First plant from petri dishes, Group: Control.

Took the weight test, Urine test and had breakfast with social integration. Start with the development of reports / Photos and put in order our information. Continue with ADCS project:

Step 7: Electronic Diagram for complete electronic system

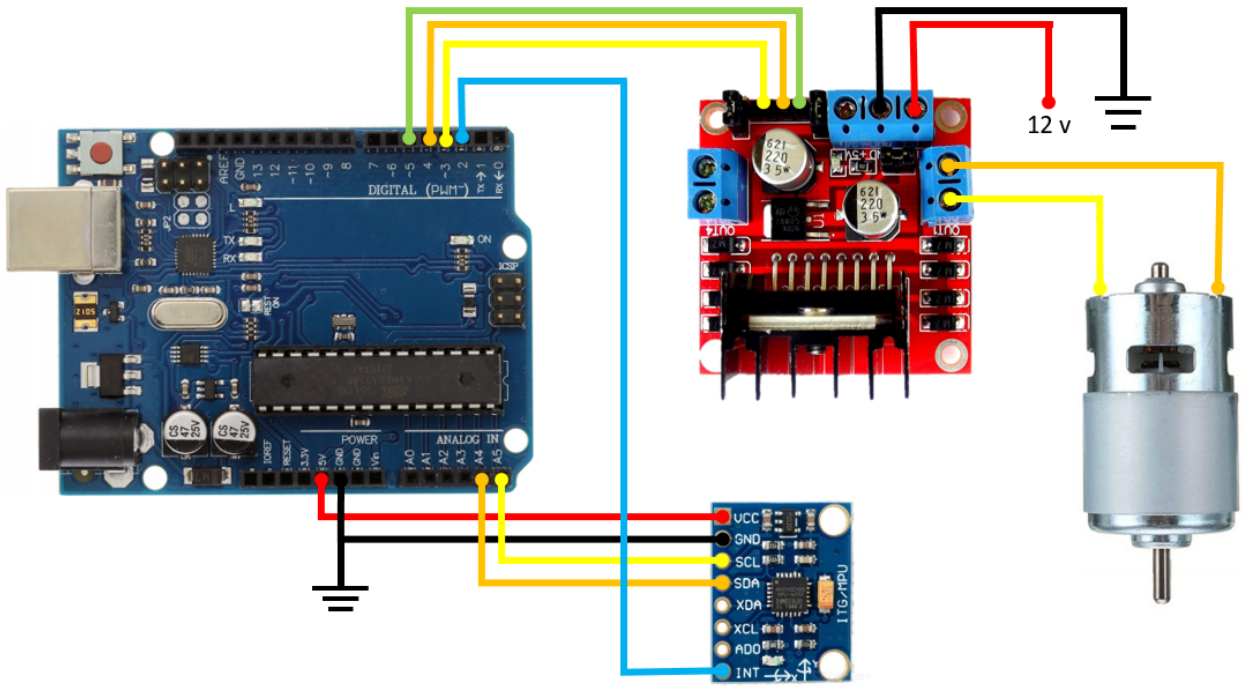


Diagram for electronic system ADCS prototype.

Works almost all the day designing the prototype to put the electronic together

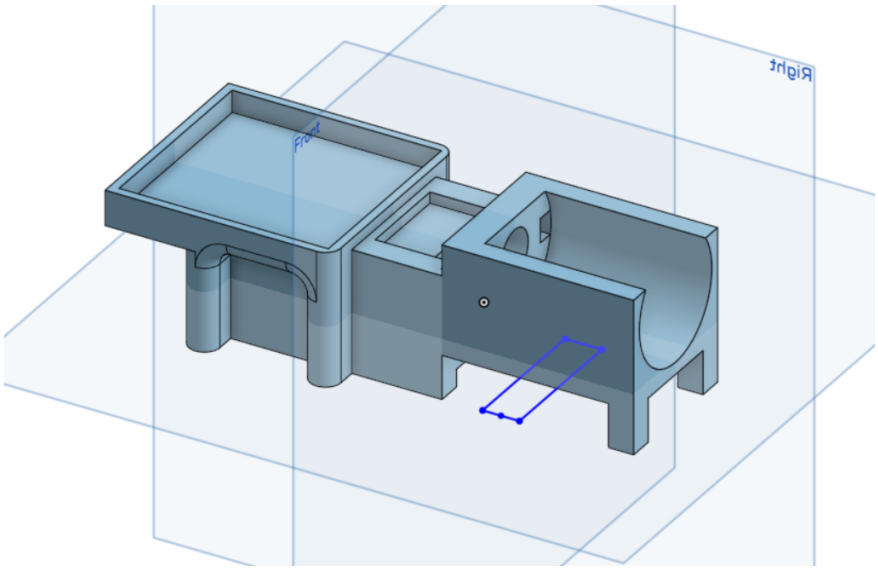
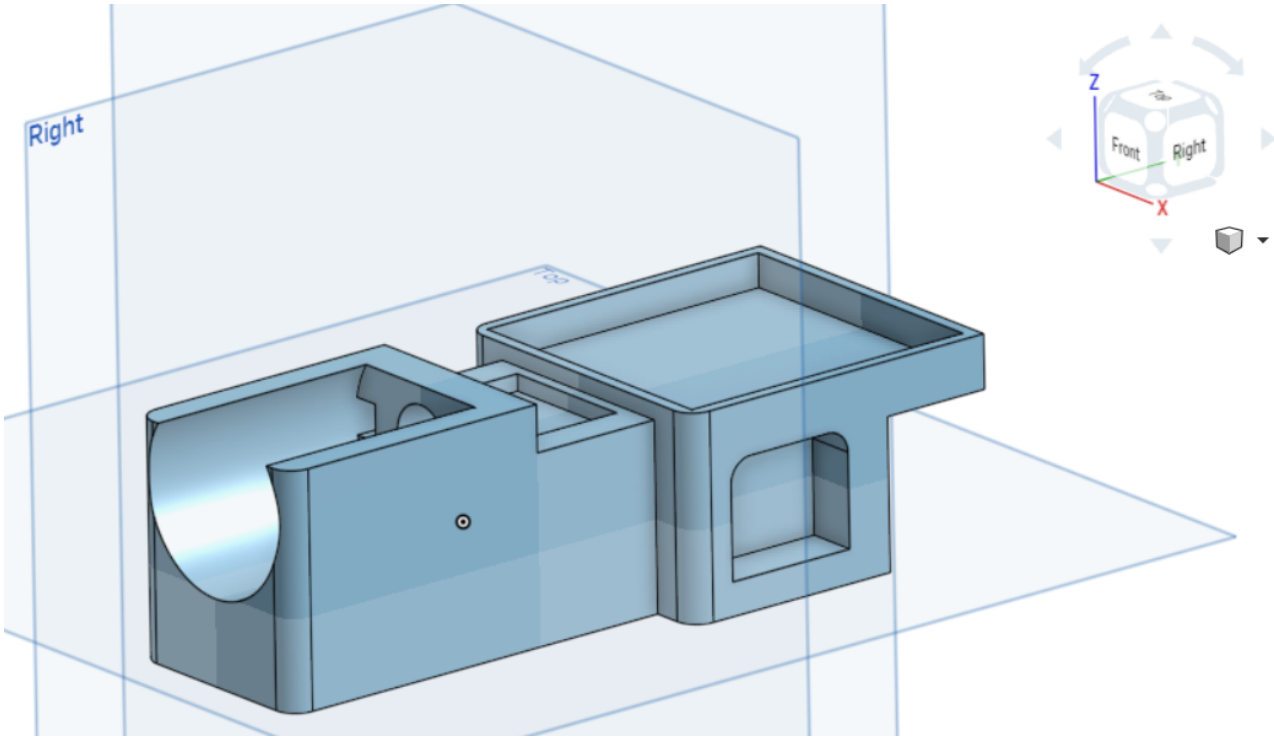


Figure: Mechanic system for ADCS prototype.

Try to print the mechanic system, and it doesn't works as It have to do, so I will try tomorrow. We try to realize the test from ultrasonic machine. I took a coffee of 250 ml outside the control diet. I eat the control diet.

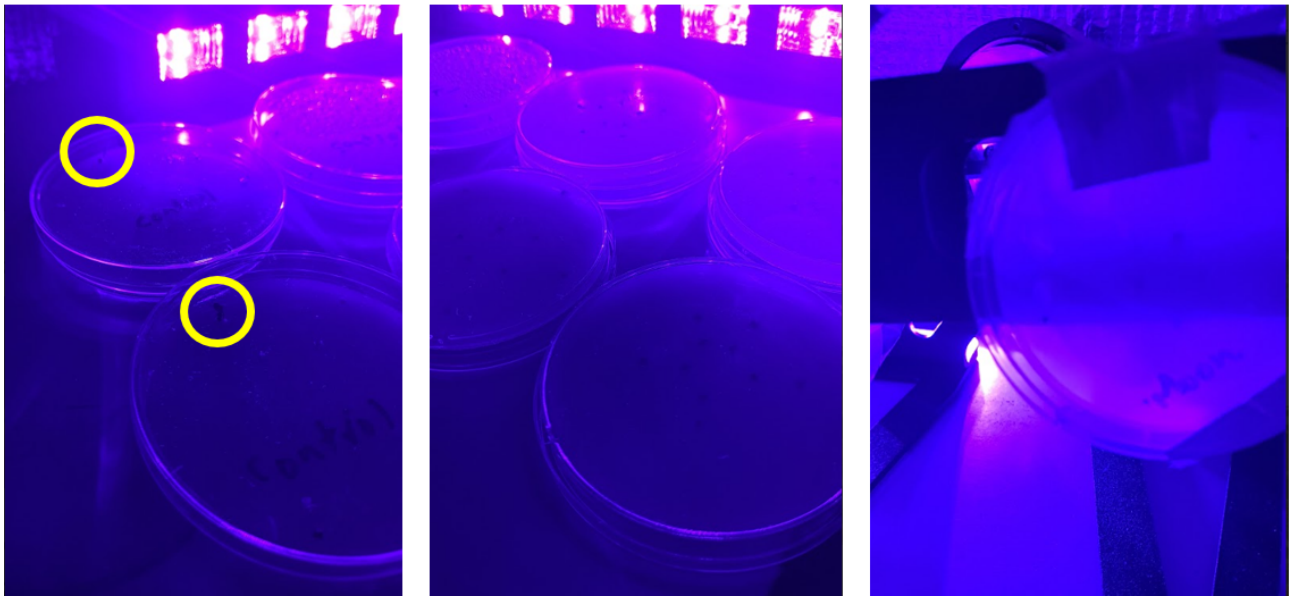
Day 5

I woke up little thoughtful for this experience, there is obviously that in real space mission there are. To make easier the printing in the mechanical design, It was little changes in the form to avoid supports and make a surface more stable.



Doe to the design was optimized for have a center of mass in Y axis, the lecture of MPU5060 that needs will be theY angle, for that reason I change the code to control the system with Y angle. Code form PID control added to the main code form ADCS control probes. In another way, the seed microgravity experiment.

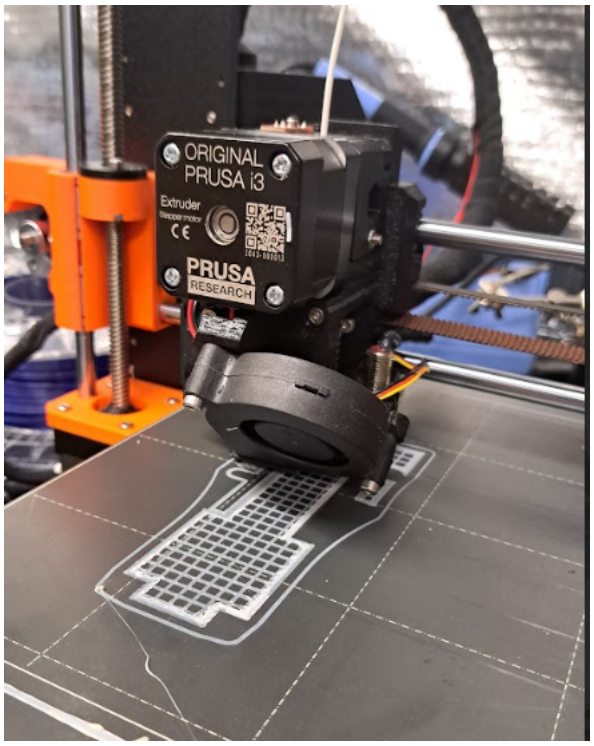
Control 180° Microgravity



Results from seed microgravity experiment.

In the view for today, we saw more seeds germinating in control petri dishes, not in the case for microgravity seeds

We tried to print the model for the ACDS prototype several times without good results because the material wasn't sticking in the bed.



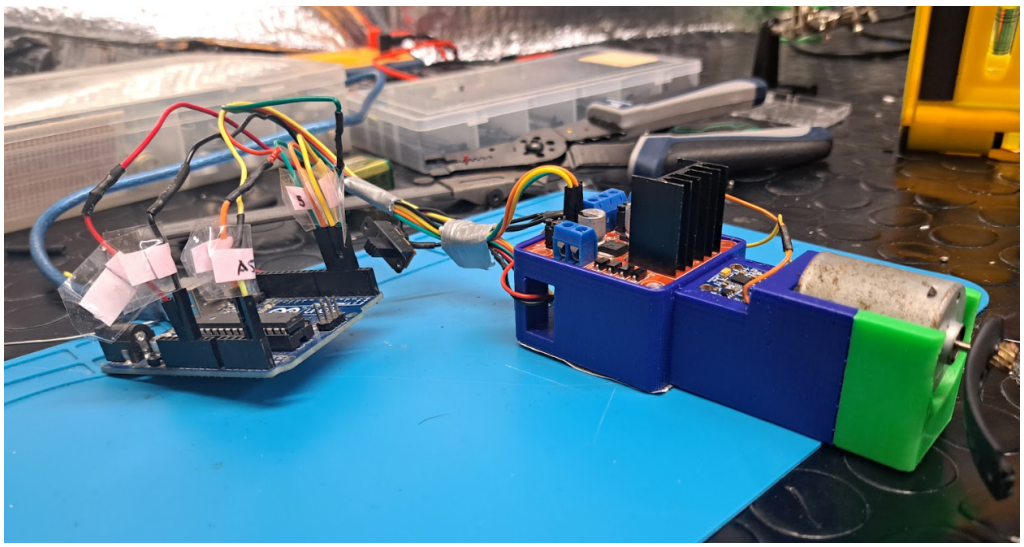
I tidied up the cabinet for all the cable stuffs, PLEASE keep it tidy up.

Cabinet tidied up.

I did exercise for 20 minutes before debriefing. I ate the Control diet plus 4 cookies.

Day 6

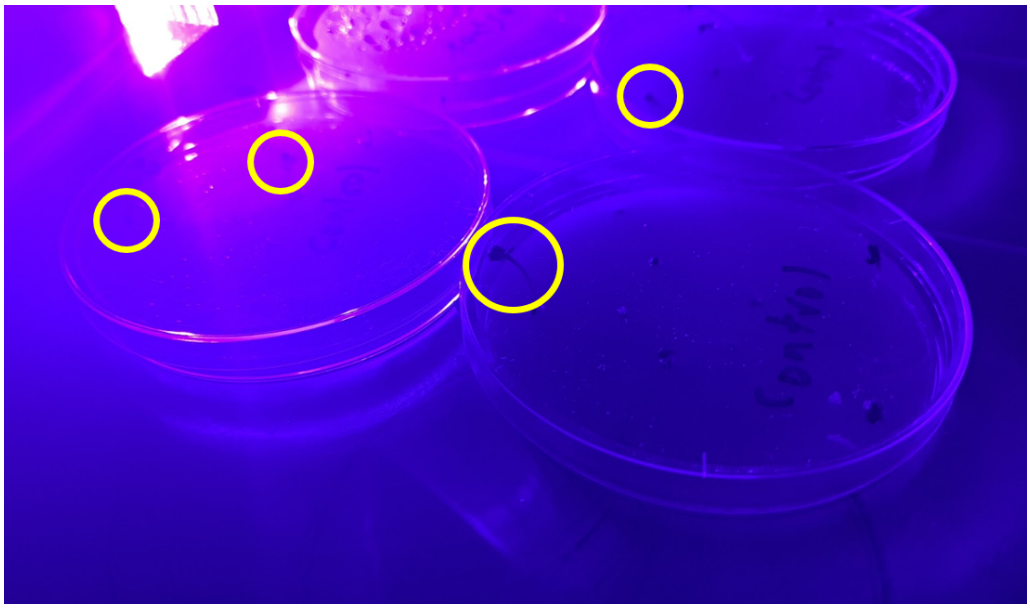
I woke up little tired and sleepy because yesterday we went to sleep little late, then I feel the same anergy like always. For today I did all the test from day 6. About ADCS prototype project, I spent almost all the day soldering, and preparing the ADCS prototype.



ADCS with mechanical system.

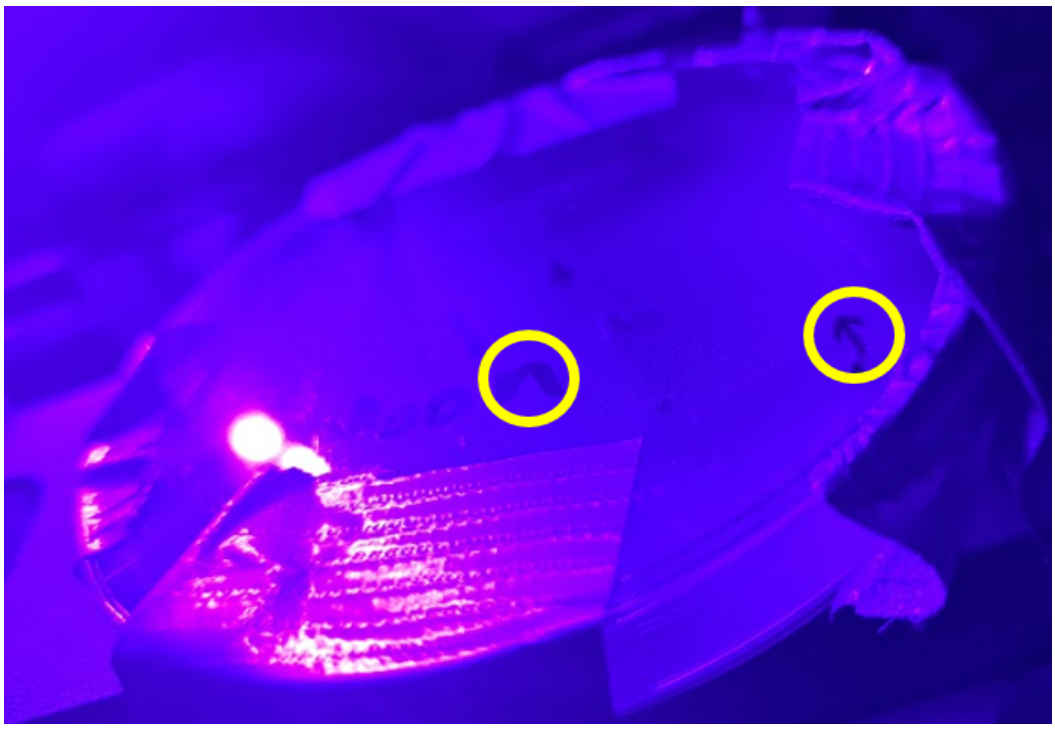
About the seed microgravity experiment, it shows some results

1. For the petri dishes of control group there are more plants form yesterday, one of them its with humidity.



2. In the group of the 180° it doesn't have plants growing up, but it have some fissures. Finally we had a lot of problems with 3D printer and we fixed it.

3. Finally in the microgravity samples there are the fist plants



Finally, we fix the 3D printer.

Day 7

I woke up little nostalgic, I had a dream been in house, it was some neutral but I felt a little strange.

Dos weyes, un pana y la Patrona, Brandon Salazar, Mexico

Decimus
03/12/2023 - 13/12/2023

You're on the Moon or you're not, that's up to you to decide.

Well, let me introduce myself, it's important to understand where I've been to see where I'm going. When I was a child, something like 4 - 5 years old, my mother took me to a planetarium in México City, there was a video explaining how the scientists could search for life in Europa (moon of Jupiter). At that moment my mind flew out, I was very impressed how people can fly outside the Earth, then my mother explained to me that we have already been to the Moon, that was my first step.

But I didn't grow up in Mexico City, I grew up in a small town called San Cristobal in Chiapas, the poorest state in México, so space technology was not common in my environment. I used to think that I would be an architect or something common for my town, but the HighSchool was the point where I decided that the technology will be my way, when a teacher ask us to do an invention, I was terrified, how can I do an invention when we already have everything? Well, one night with a can of soda, two wheels, a small lamb, a switch and a pair of batteries I build my first robot, I said that it was a small prototype because take it to the moon will be easier by the dimensions, little big spoiler when some years later I worked in the design and manual of the CanSat to the Mexican Space Agency. Now with a Bachelor in Mechatronics Engineer and a Master Degree in Aerial and Submarine Autonomous Systems, working for satellite technology development, I'm looking to meet my most ambitious dream, to be an astronaut and my big first step starts here in Analogue Astronaut Training Center (ATTC) in Kraków, Poland.

Travel to the Moon.

As I said, I'm not from Poland, I'm from the other side of the world, México. The first task to arrive to the Moon was to arrive to Poland, so I had to take a long travel, passing in Frankfurt, Germany; It could seem quite easy, but this travel took from 16:00 (México time) of the 1st December until the 3rd December at 23:45 (Poland time), because of complications caused by weather conditions.

Mission Day 0

Arrive to AATC was awesome, the mission crew was integrated by Salvatore Bellinghieri, Arturo Martiñon, July Ángeles and Me: two Mexican guys, one Venezuelan guy and one Mexican girl or how we say “Dos Weyes, un Pana y la Patrona” - very latín lunar mission in AATC.

After an introduction of each one and the mission assigned by Agata's team, we had to start and the first task was to get the mission food according to a list meticulously planned, a simple task to fulfil but not easy when the shop is in a language completely different than yours and even isn't English, that tested us to show the different skills of each crew member, at least to assign the mission roles, COM (Communication Officer) for Bellinghieri, MED (Medical Officer) for Martiñon, DAT (Data Officer) for Ángeles and ENG (Technical Engineer) for me.

Landing to the Moon

The weather conditions in Poland were tough. We had to land at the habitat walking through a mountain covered with white snow, three... two... one... landing on the moon and going inside to the lunar habitat, a tiny place, little home for 4 young astronauts to this mission, a bedroom, a kitchen, several places to work, a tiny gym to keep us healthy and the most important thing a toilet, all this inside walls with thermal and radiation protection that make the place seem inside a lunch box. The place was very disorderly, cables, cables and more cables everywhere, a lot of food in a small cabinet with a big disaster too, it seems like a tornado was there, so was the moment to start the mission and the first titanic task was to tidy up, DAT and I tidy up this cabinet, COM and MED clean

up other places and work together to make this mission comfortable for us.

Mission Day 1: Lunar time

Our clocks rang at 9:00 Polish time, the first task of the day: set everyone to 00:00, there is no more Earth, here is the Moon, the schedule will be easy, 16 hours to work and 8 to sleep, it's time to start... The first briefing is coming and we haven't finished the bioimpedance/circadian/sleep tests, there are a lot, going from zero to one hundred was a bit complicated, we need to be faster...

Earth to Moon - Lunar conditions registered, temperature outside, temperature inside - Me thinking 《it seems that this thermal lunchbox works. Another data was sent from the Control Center at the Earth.

Moon to Earth - COM sending information about our first night, reporting bioimpedance results and plans for each one to this day - for me, ADCS prototype.

Earth to Moon - Detailed experiments to start, first “microgravity seeds experiment” second “Iris test”.

Too much information to take in, too many measurements, too many experiments, I feel worn out, it's a lot. I'm here and I have to start, COM and I are working on the microgravity seed experiment, MED is planning the iris test, DAT? I don't know...

Mission Day 2: Tests and more tests

Hour 04:00 - totally strange. 04:00 is usually for sleep, but we are already after breakfast, working on experiments. Hour 10:00 and we feel already tired... so strange. When on the Earth day begins, here is "afternoon". Circadian measurements became a little stressful, taking vitals every 2 hours it's new, I feel it is too much time for this activity, astronaut life is pretty busy.

I started prototyping ADCS, made electronics test, and the motor is working as planned beside a little problem: maybe the motor is too small. 16:28 time to bioimpedance and sleep.

Mission Day 3:

A hard morning said to me "Hi". I woke up and saw the time. Ten o'clock, too late, no alarms, no sound, no one awake yet, why? Should I wake them up? I feel so tired and I can't wake up. Come on, it's late, but I lost feeling of being active versus sleep... 11:00: same feelings, too late, what's happening? I can't wake up, but, why?... 00:00 clock sounded, wait... what? It wasn't 10:00 or 11:00 there were 22:00 and 23:00, I need to change the smart watch to a 24 hours format.

Today work was much better, play with electronics makes me feel comfortable and more confident, in Earth I was in a job with a lot of documents to fill but little experiments left behind, so this mission bring me to technical and funny things.

Not all it's the best in this mission. COM and Me are working pretty hard to successfully complete this mission, But some crew members are too busy with Earth activities. Well, You are on the moon or you are not, that’s your choice. Did you try the treadmill? Unfortunately this habitat doesn't have windows, could be pretty cool se outside and see the lunar ambient at real time, but run seeing the lunchbox wall permit you fly pretty far, in my case imagining Jupiter outside, at really, Jupiter is like a star since here (moon) but my imagination says I can see it in all its splendor, as well, see the Earth from here could be nice too.

Mission Day 4:

Have you felt that life has no meaning? The psychological tests were a bit rough, in one of them I found this question, well, maybe, it's to detect a depressed person or something like that, but We are astronauts and science have a point of view, think in time could be a little relative, if you think about the comparison between a child from 5 years and an old man from 70-80 years, the age from this old person could be an eternity, but what about talking about universe? It is almost 14 million years old, in this case 80 years are only an instant. Now We are on the moon, working to carry the people to Mars, 2 planets, one satellite, but What's this for the millions of stars of the universe? What's our meaning? I don't know, but as Assimov has written some time, Maybe We are here

to carry the knowledge and expand it, of course the test is not for that and I just put “not”. 16:50 time to sleep.

Mission Day 5:

Working 16 hour per day it's pretty hard, at this time We have to meet some objectives, but that is not reason to take apart the rest and funny time, Maybe We aren't the closest team to work, but the hands works so good when all want play UNO cards, this game could be a very good psychological test, you can see how the people get fun around a table, some Ones only want win, Another Ones are focused in avoid that the first one doesn't win, and I really don't understand what's the MED technic.

We already complete more than the middle of the misión and We feel more exhausted each time. It's our first time as Astronauts and the tests ritms are hard. We already do the test a lot faster than the first days but it's still hard. I don't know how it will be when I go to the ISS and I have to stay in this ritm for 6 months, not only 7 days.

Zero contact: We have Internet, “thanks God for space Internet” but isn't it for personal things it is for research and work, that makes the communication with Earth not so accessible, COM carry all the communication with control center, and that makes I don't have Communication with my close people, that makes me feel missing them.

Mission Day 6:

Have you ever felt some days that seem as long as short? A lot of work and things to do makes me feel that. ADCS prototype has its first results but at this ritm I will have to finish it on Earth. We had to fix the 3D printer and that take Us a lot of time. Maybe is because the mission is finishing, but We have had many times to get fun without leave the work, of course.

Mission Day 7:

Morning: Last day to work, last day in lunar habitat, rocket is near of Us and We are almost ready to leave this big lunchbox that became our home for 7 days, confidence in myself is bigger than when I arrive here, plans for today: Prepare to take of from here,

report everything of this mission and tidy up to leave the space ready for the next crew.

Yellow lights blinking, control center sending messages to COM, it's obviously We have an emergency, What's happening? It seems like a little problem with electricity, sensors and sirens not working,

Control Center- EMERGENCY SITUATION, 2 minutes to seal all modules, turn off fuse 1 and 2 and hide in the shelter. -Electricity failure... -Decompression in bedroom module T-20s. -Let 's do it. Crew Suited up and ready to continue... -T-10s to be in the shelter... three.... Two... One... -Everybody in the shelter.

COM- Status: no damage, waiting instructions...

Control Center- The Geolab module is secured. -MED is making the medical checkup... -We lost signals from Mesa and bedroom modules, DON'T take off EVA suits..

Control Center- Measurements from Alpha and Beta radiations are needed, doble check at everybody and every experiment, DAT set times to 20m from now, limit time to send measurements in Mesa and Bedroom, you need to crawl below 70cm and make sake and slow moves.

COM- Permission to go in Mesa.

Control Center- Affirmative, T-8m20s to extreme conditions.... T-5m ... T-2m47s... there are an option, someone have to go to the shelter to avoid air consumption for additional 2 minutes.

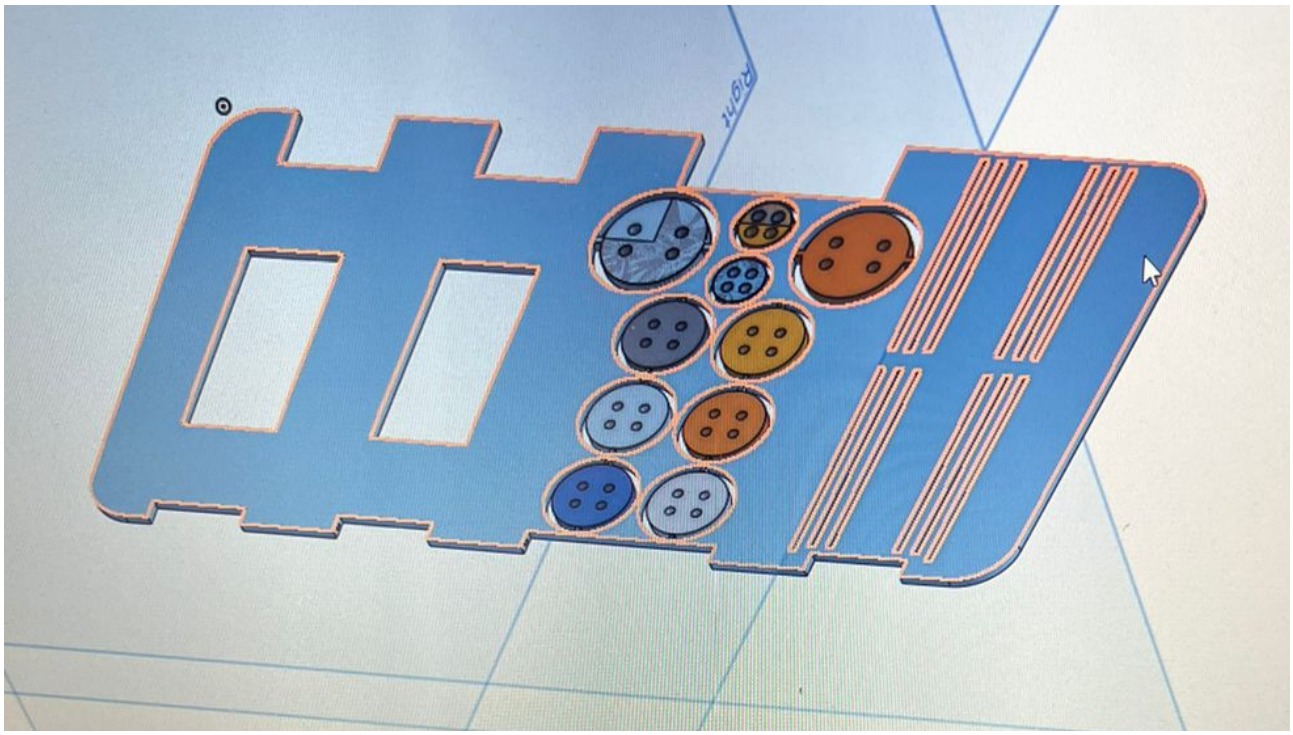
ENG- DAT is your turn.
Emergency alarms sounding, Red lights blinking.

Communication with Earth lost.

Times updated at 3m37s, crew members working together, dosimeter not working... T-2m, it starts to feel pretty hot, EVA suit getting hot... T-1m, alarms in EVA suit getting crazy... T-26s We saw each other,

Three... Two... One

Fortunately, Analog Astronaut Mission was a simulation, We died but We survived, the misión was concluded with the last debriefing, sending the last report and leaving the habitat in a pretty cool lunar lander “Agata’s Tesla”, to finish this I want to say Thanks AATC, It was a beautiful experience, I learned a lot in this short time and of course I'll give double check to emergency procedures next time, Thanks Agata, Matt, Krystian and all AATC team that makes this possible.



Expedition 74, Judith Ángeles, Mexico

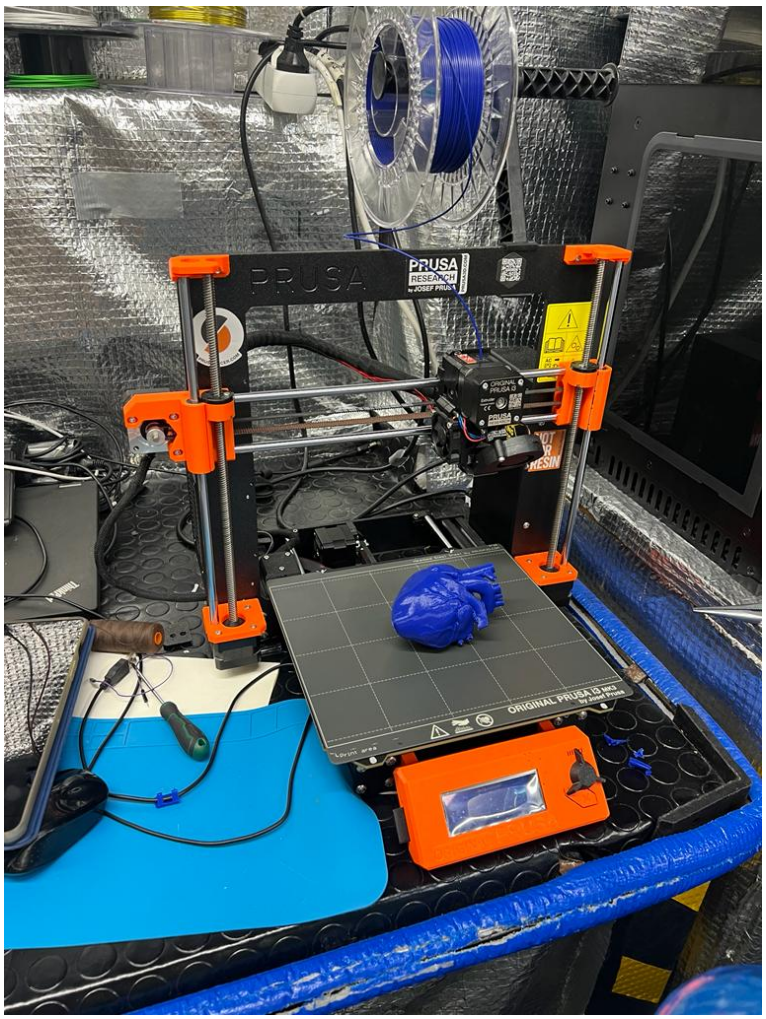
Data Officer Report

Decimus
03/12/2023 - 13/12/2023

Day 1

When I woke up I was really tired and I was stressed because I had a lot of things to do and how to figure out all the things and tasks to do. One remarkable event was that I fixed the 3d printer with Arturo and sent one piece to the printer to make it work. My general thoughts are that have one mission with external extra responsibilities generate me much stress because i have a lot of activities and exams to realize at the day.

The things that i do was to checked the filament to put the correct material in the 3d printer and put one piece in a SD memory to upload it in the printer and make it work



Day 2

My general feelings that i have when i woke up was all the things that i have to be done and also i can appreciate that the crew feel very sleepy as me so i enjoy the snap because i feel like new when i take it and also i work in the presentation and with the photos i enjoy this day. The things that I made was to check missing information to generate a strategy to make sure everybody doesn't miss in one data so we can have more precise data. I did some training and did functional exercises and work.

Day 3

I woke up so tired that it was difficult to wake up. I felt motivated. One remarkable event I made during my day was that I helped to

take documentation in the experiment that we made from the filter of the urine. My day was a little bit heavy because i slept late. The things that i made on my experiment task was to record the reaction of my mates to see if the experiment was good to can proceed to the next steps and approach to the goal.

Day 4

My first thoughts that i had when i woke up was that i felt with a lot of energy and had no problem waking up and also i was very motivated. One remarkable event that happen to me was that i send one design in the 3d printer and help my crew mates with the data and search the missing important data to have all the control and also i did external task. First i saw the excel that was all good and have no problem then i search one model to make and send the design to the 3d printer the designed that i used was based in something special to have like something significant to have all the members of the crew and the piece was an astronaut with the mission name. We play uno and that really makes me happy and laughing.

Day 5

I woke up very tired and with headache because the last night i didn't slept well because the room was so hot. I change the patch with all the members' family names and I start to create a design in CAD for which we can print an astronaut with our name as a memory. We try to print like 6 times a design but we couldn't because the filament lift, we try to put some tape but it doesn't work so i change the position of the part and add some supports and then it was printing but at the end the part the filament finish and we change to green. We play uno and that really makes me happy and laughing.

Day 6

I woke up kind of mad because I didn't sleep too much.

Day 7

When I woke up I felt tired because I can't sleep very well but it was nice overall because today we enjoy the last day here and also I learn how to work in a isolated room for seven days. I help to send to print the final 3D models and helped in little task to the crew and as we do an emergency mission and we get confused we used the wrong tool but it was okay because it was a new learning that we have from overall it was fun and have a good time.

Expedition 74, Arturo Martiñon, Mexico

Decimus
03/12/2023 - 13/12/2023

Day 1

When i wake up i was a little bit tired figuring out how does all it works and what were the task we are supposed to do. One remarkable event was that July and i was trying to calibrate the 3d printer my general thoughts were that i was sure that we can calibrate the printer despite it have a lot of errors and i was very happy when the printer start to work up. The things i do was to checked that 3d printer does not have broken parts and making really quick checks in the calibration and finds errors the printer throw me and working on the messages that the 3d printer give me

Day 2

I was really motivated when I woke up but felt a little bit sleepy and couldn't concentrate at all. The remarkable event was that I learned more about the systems PID.

Day 3

My general feelings when i woke up where motivated and thoughtful and excited, also my remarkable events on day 3 where that i do a design sketch for the needle card and think about how can optimize the model and to make this possible i ask to the crew what they think and have ideas and feedback to start to make my sketch. I started to moderate the the needle card to know all the measures and give me a idea to how optimized the the needle card. And how can edit add or change based on the recommendation and feedback i have of my crew mates.

Day 4

My general feelings that i have when i woke up was that i feel energetic and motivated because i feel that i rest very well. One remarkable event was that i finish my prototype design of my sketch. The things that i made in the day was to modeling the prototype of the needle card first we put all the measurements that correspond and then put some corresponding details. Then I added some details for carry on the needles in the right sight of the card.

Day 5

When I woke up I felt very motivated ready for doing tasks first I help de data officer because she felt ver bad because she have headache and also I sweep the floor to maintain our area clean. On this day the day was relax because all the crew was on time with his tasks so we played a table game called Uno.

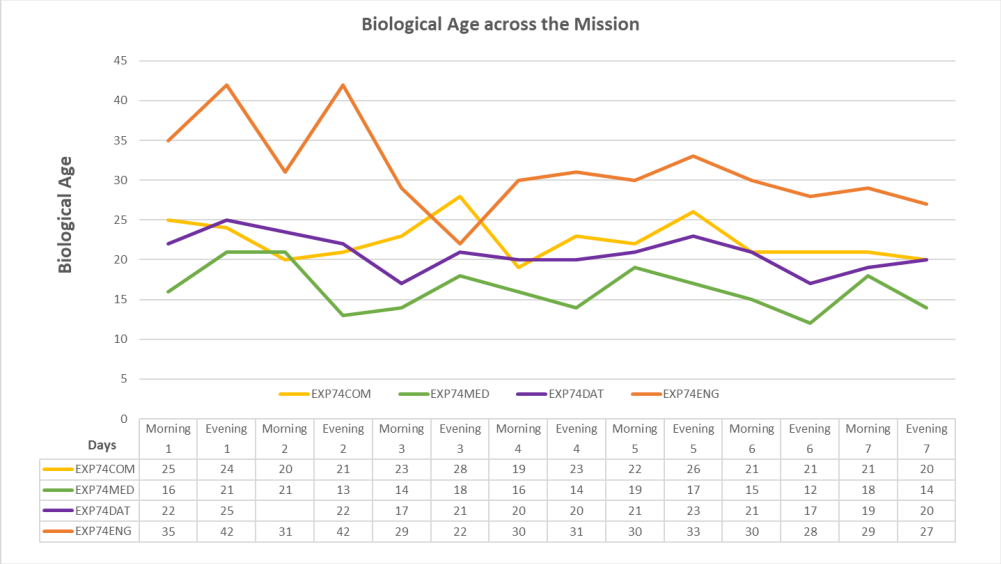
Day 6

When I woke up the first feelings that I have was that all the crew know what to do it was all automatically so it was much easier compared to other days. The remarkable event i made was that i send my 3d sketch to the 3d printer but it failed the 3d printer and we tried to fix it. When we send it to print it doesn't stick very well to the filament to the plate so we were trying different methods to

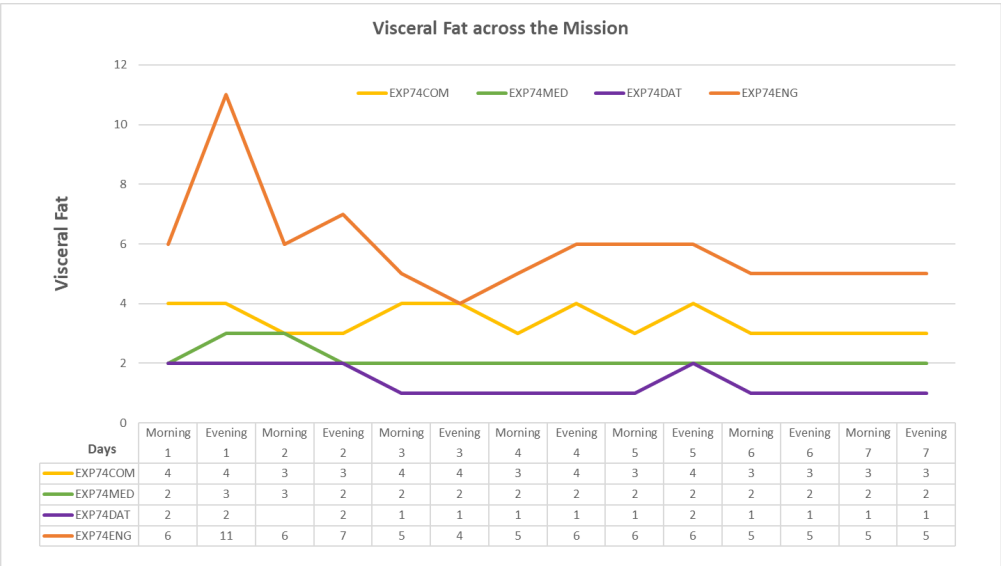
attach the filament to the printer so we can easily send it without any problems. And also we calibrate and dismount the extruder because we find out that something inside was making the failure.

Day 7

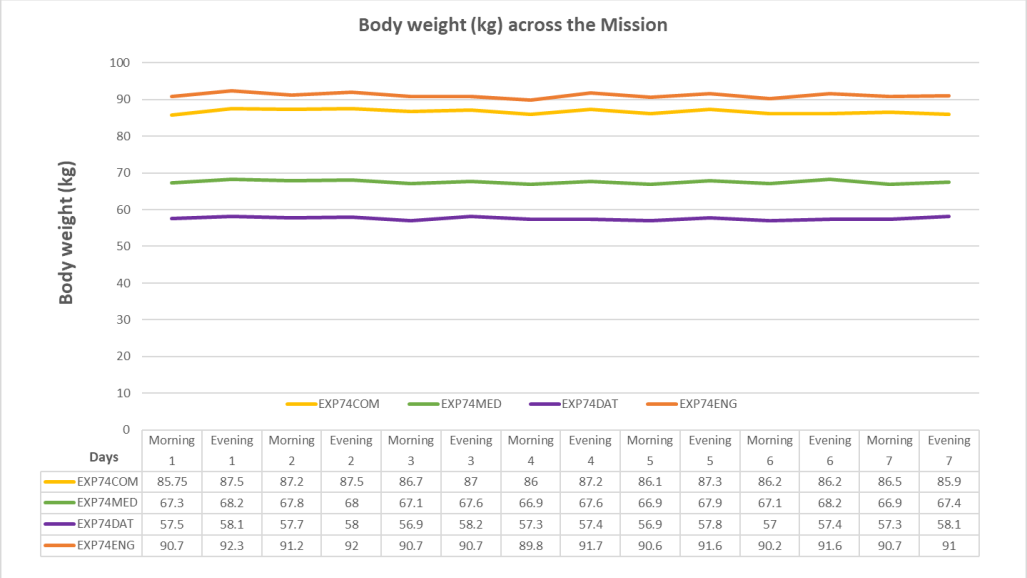
I feel calm with much energy ready for new things and with very eager to speak with my crew and also in that day we figure out that this day is the last day that we conclude with all the test so the task that we have is to make a summary of all the reports that we were registering since the day zero. One thing that we did was to make run the 3d printer after we fix it at the moment it sees that is doing his job very well also i have same steps when the 3d printer throw the calibration failure message.



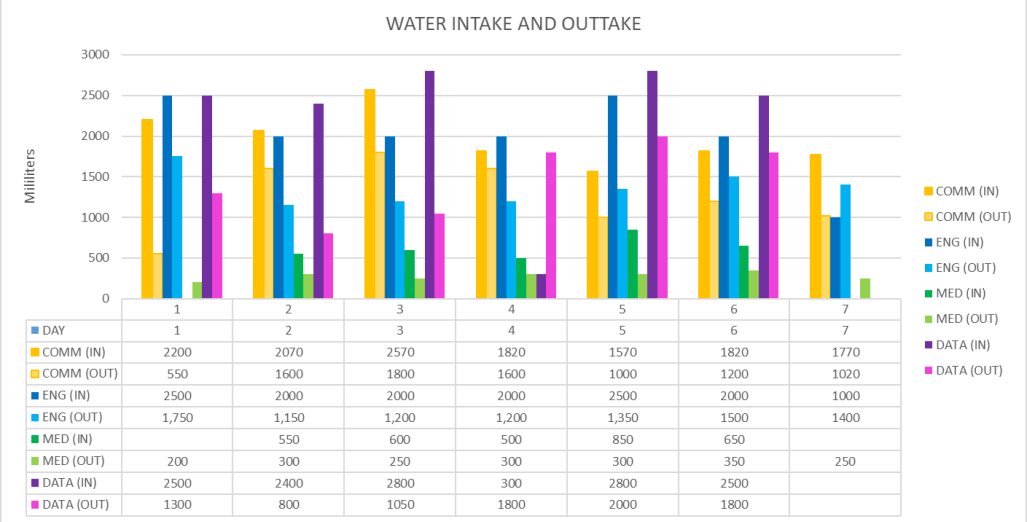
Days	Morning 1	Evening 1	Morning 2	Evening 2	Morning 3	Evening 3	Morning 4	Evening 4	Morning 5	Evening 5	Morning 6	Evening 6	Morning 7	Evening 7
EXP74COM	25	24	20	21	23	28	19	23	22	26	21	21	21	20
EXP74MED	16	21	21	13	14	18	16	14	19	17	15	12	18	14
EXP74DAT	22	25		22	17	21	20	20	21	23	21	17	19	20
EXP74ENG	35	42	31	42	29	22	30	31	30	33	30	28	29	27



Days	Morning 1	Evening 1	Morning 2	Evening 2	Morning 3	Evening 3	Morning 4	Evening 4	Morning 5	Evening 5	Morning 6	Evening 6	Morning 7	Evening 7
EXP74COM	4	4	3	3	4	4	3	4	3	4	3	3	3	3
EXP74MED	2	3	3	2	2	2	2	2	2	2	2	2	2	2
EXP74DAT	2	2		2	1	1	1	1	1	2	1	1	1	1
EXP74ENG	6	11	6	7	5	4	5	6	6	6	5	5	5	5



Days	Morning 1	Evening 1	Morning 2	Evening 2	Morning 3	Evening 3	Morning 4	Evening 4	Morning 5	Evening 5	Morning 6	Evening 6	Morning 7	Evening 7
EXP74COM	85.75	87.5	87.2	87.5	86.7	87	86	87.2	86.1	87.3	86.2	86.2	86.5	85.9
EXP74MED	67.3	68.2	67.8	68	67.1	67.6	66.9	67.6	66.9	67.9	67.1	68.2	66.9	67.4
EXP74DAT	57.5	58.1	57.7	58	56.9	58.2	57.3	57.4	56.9	57.8	57	57.4	57.3	58.1
EXP74ENG	90.7	92.3	91.2	92	90.7	90.7	89.8	91.7	90.6	91.6	90.2	91.6	90.7	91



	1	2	3	4	5	6	7
DAY	1	2	3	4	5	6	7
COMM (IN)	2200	2070	2570	1820	1570	1820	1770
COMM (OUT)	550	1600	1800	1600	1000	1200	1020
ENG (IN)	2500	2000	2000	2000	2500	2000	1000
ENG (OUT)	1,750	1,150	1,200	1,200	1,350	1500	1400
MED (IN)		550	600	500	850	650	
MED (OUT)	200	300	250	300	300	350	250
DATA (IN)	2500	2400	2800	300	2800	2500	
DATA (OUT)	1300	800	1050	1800	2000	1800	

End for this year...
Kraków, 2024

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