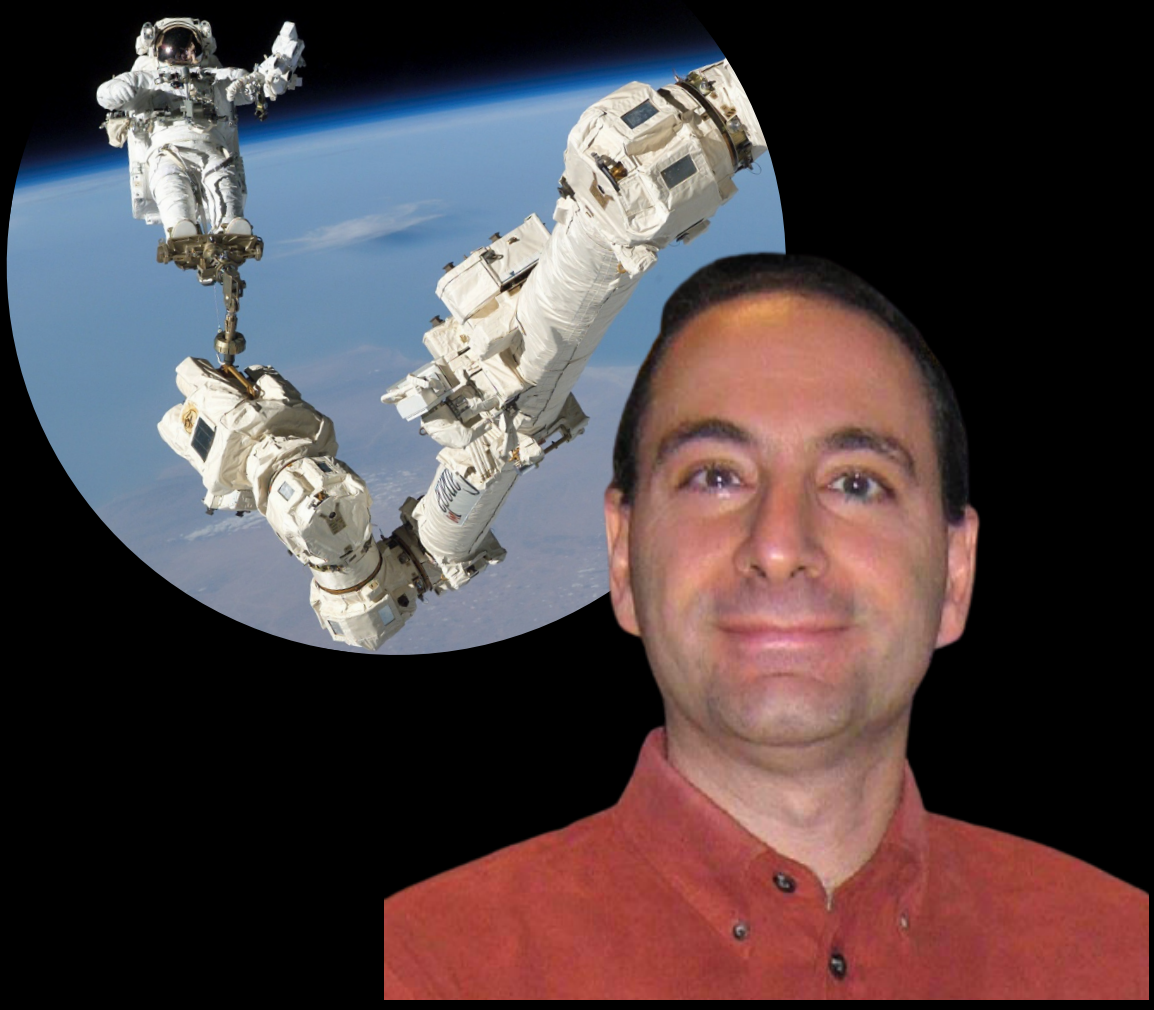
In Dialogue with the Canadian Space Agency



iGEM CONCORDIA

ASTROYEAST 2020

The Canadian Space Agency
With Luchino Cohen, PhD Senior Exploration Scientist; Mathieu Tremblay, Exploration Scientist; Clélia Cothier, Exploration Strategic Planning, Space Exploration
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Interviewed by iGEM Concordia Montreal

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Mathieu Tremblay
I've worked twenty years at agriculture and Agri Food Canada before joining the CSA. Mainly I'e worked 19 years in a plant pathology lab doing molecular epidemiology to detect and quantify various trends in agriculture and then just before joining the CSA, I worked one year at the technology transfer office to help the growers and other stakeholders of the agricultural sector to have a better view and to adopt the technologies and innovations developed by agriculture and Agri Food technological scientists. Then I joined CSA on Nicole's team with Luchino, with the Life Sciences, Astronauts and Medicine Group and I said it the wrong way but you get the idea of the group. And more recently I joined the Space Exploration Strategic Planning Group and more specifically in food production initiative which the CSA is involved.

Luchino Cohen 1:39
I'm a senior exploration scientist at CSA. I've been doing this for 15 years. Before that, I did some research at the University of Montreal on immunology and chemistry using human models. After about 10 years of postdoc and research associate, I was recruited by Nicole at the CSA to work on the Life Science Programs.I've been involved in about 10 ISS investigations in some way or another. Part of my job is to support Canadian scientists in doing experiments on the ISS. We also have some ground research programs, and some I'm involved in. Also the coordination of ISS research with international partners and basically the ISS is my world recently, I got involved in doing that last year. Last summer I worked with students from Sherbrooke University. And we investigated the potential of synthetic biology for space exploration. That's why I'm interested in this conversation. I honestly am convinced that this is something we should support in the context of the space program. I am trying to see if there are some ways for CSA to support some teams in the past in participation in the competition such as a iGEM so we'll see what can be done and how we can help you?

Clélia Cothier 4:09
Hi, I'm Clélia. I am in the same team Mathieu Tremblay, I'm also working on the food production initiative. My background is very different and not so scientific. I have a background in Political Science and International Development and worked for a few years in the Montreal startup innovation slash social impact ecosystem. And as part of that, I worked a lot on open innovation competition, which is what I'm doing now is working on open innovation. So I'm also really interested in what you're doing from the open innovation side. And I think that nurturing competitions and innovation at all stages is really important.

[iGEM Concordia begins to present their project]
Jump to 16:53 to skip the AstroYeast overview

iGEM Concordia 7:30
Okay, excellent. Hello everyone. Today I'm going to be talking to you about our project AstroYeast. The inspiration behind this project came from some exciting news from NASA who's going back to moon in 2024 and also from SpaceX who's planning the first crewed flight to Mars in 2024, as well, and we've asked, How can we fulfill the nutritional needs of a group of astronauts that are 80 million miles on a mission to Mars where there are no resupply vehicles?

Currently astronauts consume dehydrated food packets and supplements on board the International Space Station. The problem is the shelf life of these dehydrated foods and supplements is only 18 months with current efforts to extend it to five years, and the nutrients in them have been shown to degrade substantially over time. Moreover, there's a lack of physical space to produce food by traditional rules. We also have the problems of limited oxygen and water. And if we're going to continue to explore our space, we need our portable, reproducible space compatible factories. Why did we choose yeast? Well, it is reproducible, we can send a small volume, a few milliliters, and make more in space. The genome is already fully sequenced, which is great for us scientists. And it doesn't uptake other DNA like bacteria can so we don't have any horizontal gene transfer. And they're easily bioengineered for nutrient production.

NASA already has a Bionutrients program in place which uses yeast to produce betacarotene for astronauts in space. So the problem is microgravity, which is very small gravity, produces these unpredictable cellular responses. We see things like random budding, changes in cell polarity movement of the nucleus, changes in cellular membranes and also changes in the cytoskeleton. And these are poorly understood and this ultimately makes for unpredictable growth and affects the nutrient yield.

iGEM Concordia 9:44
Our solution at iGEM Concordia this year is to design space compatible yeast strains with tolerance to microgravity induced stress, so that they can then be used to biomanufacture, more predictably, the vitamins and nutrients that our astronauts need when they go on long duration missions. To inform the design of our project, we're consulting with a number of stakeholders. We've consulted with researchers from CUBES, they're affiliated with NASA. We're also consulted with industry leader, Ice Cube Application Services. We also consulted with bioethicists to make sure that our project is actually in line with the bioethics. And we talked to Karen A. Mcdonald about the biomanufacturing processes, as well as Dr. Corey Nislow, who has been sending payloads with NASA to study yeast responses to microgravity. We're actually collaborating with him. I'll get into that in a second.

And finally, we're also talking to bioinformaticians for the development of our database that I will explain briefly. As for a timeline of the project, we're proposing a two year project. This year, we developed our astrobiology database, which is a database that compiles gene expression changes. Not only yeast, also other microorganisms based on findings from the literature. And it is open source. Using this database, we've selected a few genes that we're going to use to design microgravity resistant strains. We're also designing a hardware to simulate microgravity that we're going to start building and testing next year. And then after that, we're going to do our genetic lab experiments and then analyze and report to detail in the fall of 2021.

Here's a look at the database. This is what we have so far. So a researcher can go in and type a gene name. And then they can pull up the results of studies that looked at this gene with the up or down regulation status. They can also get a lot more information on that gene, they can look at the chromosome annotation, so whereas the gene location, the study overview, study information, as well as which pathway does this chain belong to to understand what is being affected and in the cell, you can look at different organisms. As I mentioned earlier, we can also look at specific species study type. Is it a study that was conducted here on Earth? And if so, which kind of study? And or is it a study that was conducted during spaceflight?

What's interesting that I should mention about our database is that it is open source, but it is also something that we constructed to be evolving over time, it will be accessible to the community and researchers in the future can submit their data to our database. Simulation microgravity is what we're doing at the moment. We are looking into making a rotating cell culture system to test our yeast strain. If you look here in the middle, you could imagine a sort of a culture dish where you have cells and liquid media. You'd have sedimentation because of gravity, but because the system is rotating, the cells will experience microgravity as they would in space. So once we've selected our genes, what we're going to do is we're going to

label them so that when we test them in microgravity and simulated microgravity, they're going to give off a signal, a light signal. So imagine like a light switch that turns on when they experience microgravity.

iGEM Concordia 13:29
Now knowing the signal in our yeast strains, we're going to induce mutations, let the cells adapt. We're going to screen and then we're going to test again and we're going to repeat this process over and over again until we get yeast strains that are resistant to microgravity induced stress. Then they can be used to biomanufacturing nutrients, more predictably. Some considerations... well, before going to simulate microgravity, we wanted to standardize this process. For that we're going to follow the Bonn Criteria, for simulated microgravity studies to make sure that other researchers in the future can compare our findings to theirs. We're also considering heat shock, proteotoxic stress. We're fortunate that Dr. Kachroo's lab, who is our principle investigator, has a student who's designing a proteotoxic reporter in yeast and we're hoping to be collaborating with her to study that in our strains as well.

We're also looking at other stressors, controls and testing, how do we respond in heat and pH changes and how does that compare to their responses to microgravity. And finally, we're taking radiation into consideration by testing our new strains using RAD25, in the lab, and seeing how they would be affected by radiation. Following our discussions with the stakeholders that are in the space industry, we have implemented a few considerations. So first, we are collaborating with iGEM teams from University of Calgary to design a bioreactor that would be suitable for us to be able to produce the nutrients. And also we're going to implement a freeze dried protocol from Dr. Nislow, that I mentioned earlier from UBC, who's collaborating with NASA so we can replicate what he has already done. And we're also going to do fixative testing, RNAlater testing that he's also sharing with us.

Finally, we want to have a design that is small and automated, so that we can minimize space and the need for personnel in terms of running our experiments. We're also collaborating with Space Concordia, which has a planned flight payload in 2022. We're hoping to send our east trains on that payload. What are we accomplishing with AstroYeast? An important thing is to standardize the microgravity research field and we're doing it by designing our database which is specialized for microgravity and it is open source. It helps researchers compare across studies and it accelerates the research field overall. We're also designing our reporter strains that other researchers can use in future. And we also help researchers understand the effects of microgravity induced stress on yeast. Ultimately, what we want to do is contribute to biomanufacturing in space, whether it be nutrients or pharmaceuticals, and much

more, there are much more applications. So this is kind of an overview of our team and our different fields of study. And if you have any questions, we would like to take them and have any feedback that you guys have for us.

Luchino Cohen 17:36
Thank you for your presentation, a few questions. Do you have evidence or do you know about evidence that yeast are stressed in simulated microgravity?

iGEM Concordia 17:48
Yeah, we do have some papers. Similar stresses are seen.

Luchino Cohen 18:04
Okay. And has it been already shown that the distresses observed in simulated microgravity are the same as the ones observed in real microgravity?

iGEM Concordia 18:18
It's still a little bit of a point of contention. A lot of the simulators matchup but not always with the studies, which is something a lot of people are looking into now and trying to determine how accurate simulating microgravity on Earth is. There are a lot of papers that also defend it that say it is a good contribution. And we have asked a lot of our stakeholders about this including Dr. Nislow, who does run simulated experiments as well as experiments in space, and definitely says it's a value. This is something that we can do. It's cheaper. It's accessible to us as undergraduate students. And then as we get better results, we hope to send something to space.

Luchino Cohen 19:04
Okay, because this is I think the evidence has to be solid and robust, because this is the basis of your approach basically. I'm convinced that you've done your homework and that you consulted the experts. I just wanted to be sure that this was something that you have investigated.

iGEM Concordia 19:31
I should also mention that when we created our database, we have done a comprehensive review of the literature on yeast in microgravity, to pull all that data. So this is for studies where researchers have submitted their data to an NCBI and we're able to collect that and we've done our own analysis and based on our own analysis, and comparing different studies, we've picked a certain set of genes that are important in regulating this stress response in microgravity.
So it wasn't just from one study, we looked at different studies.

Luchino Cohen 20:04 What about the response to radiation?

iGEM Concordia 20:26
It seems to not be an issue in Low Earth Orbit.

Luchino Cohen 20:29
I'm surprised that you're going to look at this response because basically the yeast will be cultivated or used in an environment where there are astronauts and you can be sure that the astronauts will be protected against radiation. It's with what's happening on the ISS. We send humans there because we know that there'll be at least protected reasonably against radiation. Is it really important to look at the impact of radiation in these projects?

iGEM Concordia 21:02
Experimentally, micro organisms that are genetically modified, from what we understand, aren't allowed inside the ISS, they're put outside of the ISS, they can be sealed. Again, we can bring Dr. Nislow back. He's flown full genome wide deletions up to the ISS more than once. So he has replicates as well. And he stated that at Low Earth Orbit, radiation isn't such a huge factor. We can also do some testing with this RAD5 here on Earth to make sure that the changes that we're seeing aren't from radiation. We can see what we would expect from radiation, just as kind of a control.

Luchino Cohen 22:03
One last thing that came up in my mind, while I was listening was there was initially a rationale based on the return to the moon and potentially hinting to application on the lunar gateway. I think that that's maybe a bit delicate to use this rationale, because there will be very low resources on the lunar gateway to do any kind of activities there. Especially scientific activities, even less culturing yeast. I don't think there will be any hardware available to do that, but maybe I'm mistaken. So basically, my message was the long deep space travel to Mars makes sense to justify this project. The moon a little bit less, you may have some better argument.

iGEM Concordia 23:17
I think we were aiming for Mars. It is the biggest inspiration. It started out by looking at the Moon because Dr. Nislow is going to be studying yeast on Artemis One, he's going to send the payload looking only at the defects of radiation. He's not going to look at microgravity this time. But definitely, this is something that we're going to focus on Mars.

Mathieu Tremblay 26:00
I'm very curious. Thanks for this very great overview of the project. This is really interesting, I'm very curious about what form will take those yeast for the astronauts. Will it be a pill, a slurry, yogurt, what is it?

iGEM Concordia 26:27
I wanted to mention that what we're doing, is something that NASA is already doing through their Bionutrients program.They started this recently in 2019. I don't know if anybody here is familiar with it. Okay, so they have these packets, and inside the packets is a food microbe growth media and everything is dehydrated. I don't think they have consumed them yet. They're just running tests. They hydrate them. And then the contents are deactivated. And then ideally afterwards, they want to consume it. It's kind of what I showed here in the beginning. This is what it looks like.

What you see here is they are hydrating it. And then the microbes comes back to life, and they're actually using yeast, and then it will grow and then eventually, everything's deactivated. And then they can consume it. In terms of the like, the texture, I'm not personally sure. I mean, we're trying to reach out to them and find that out. But it looks like it's powdery. From what I can see in the images.

[time signature resets]

Mathieu Tremblay 0:00
So it is really a supplement that the astronauts will take?

iGEM Concordia 0:06
Yes, I've seen that David's Jacques actually run the experiment, but I don't think anybody has consumed it.

Mathieu Tremblay 0:21
Another question is which nutrient will be provided? I know the list might be long, but maybe I'll change my question a little bit. What other complements would be needed in order to complete all the specific requirements that the human body will need in long space flight durations?

iGEM Concordia 0:46
That isn't the focus of our project. What we really want to do is create microorganisms that are compatible so we can produce different nutrients and then they could be bio engineered. To produce those nutrients, we want to tackle the growth issue, the yield issue. Personally, we are collaborating with the University of Toulouse iGEM team, who is also making Vitamin A in space. And we're going to use that as a proof of concept for our yeast strains. Also, the University of Calgary iGEM team is doing the same thing as well. We're collaborating with both of them. But we ourselves aren't going to produce other vitamins. We haven't gotten into the research of what astronauts need. I know that they take vitamin D. That's something I was reading a lot about. I know that NASA Bionutrient program is making a precursor to vitamin A. And there was another one. I don't remember the name. I can look it up right now.

Mathieu Tremblay 1:51
Think about that for Vitamin C. Thanks. So now I better understand The goal of this project thanks, do you know besides the little device that is right there and in the picture, do you know if there's any other technology that will be needed to implement this, in the long duration flight?

iGEM Concordia 2:20
You would need a bioreactor - yeast has been cultured in space. I believe it was a 2002 paper. They did eight days. And you saw the Rotary Cell Culture System, which can feed nutrients so that the yeast can live longer, and which we're gonna have to work out for our experiments. But there's a lot of research and a lot of bioreactors that have been made. And this is something we're hoping to collaborate with University of Calgary on as well because one of their teammates is kind of excited about it, and something we'll be focusing on more next year.

Mathieu Tremblay 2:59
Thanks. My last question would be, do you have any specific benefits on Earth that could come out of this project?

iGEM Concordia 3:11
There is a foundational aspect to our project. The AstroBio database this year for the iGEM competition is the focus. And we're hoping to bring together a lot of this microgravity community because it's a little scattered, there aren't really that many places where they come together. So hopefully through the database we can build a little bit of community, providing a point of access, and then with our strains, understanding how they act in microgravity. If we can sequence them, we can contribute hopefully to yeast research as well. It's kind of a long shot, but we hope that it could also contribute to bioproduction of nutrients here on Earth. Morgan Irons who works with Deep Space Ecology, she does solutions in space and on Earth, so a lot of the applications are in harsher environments. So if she finds solutions for Mars, they're usually applicable somewhere on Earth as well. That's kind of where we are at. It's definitely something we would like to expand on if we find it. But if we're staying true to our project at the moment, it's very much space related.

Mathieu Tremblay 4:23
Okay, thanks. For the moment. I don't have any other questions.

Clélia Cothier 4:34
Mine are not very technical, I'm mostly curious about the way that you imagine if you had for example, a magic wand, what would you need from the CSA and what would be most useful? Is it in terms of speaking to people? Is it exposure? Just so you understand I'm

more on the system side of innovation, rather than the actual experiments. I'm very curious to know what your needs are and what would be most useful for you.

iGEM Concordia 5:07
I would start with a few things that just came to mind on introductions. I know Matt, you'd spoken that you work with food production. So we'd definitely be interested, if there's any people that like related to vitamin A, which was said astronauts need in space, definitely interviewing and talking to people. And Luchino talked about ground research. So we are building our own microgravity simulator, but it would be amazing to compare those results to a more reliable machine. We're hoping that we simulate really great microgravity, but it would be if we could do a duplicate experiment to see how it was checking out. And yeah, Clélia talked about nurturing innovation. We're always looking to connect with people for fundraising. Meeting people, expanding and growing.

We also are looking for yeast researchers in microgravity, if you know any, there aren't a ton of those. For software, server space to run RNA sequence analysis maybe. And, in the dream magic wand world, we'd like to send this to space. That would be cool. Really amazing. Because we've been connecting with a lot of people and industry and corporate NASA, but connecting with people in Canada would be great, like Canadians basically researchers and people in the industry in Canada that would be awesome, because we are Canadian iGEM team. And we'd like to have representation from Canada.

I guess a little tiny detail. We are doing a Mini Jamboree. It's a conference kind of in the same style of the iGEM Jamboree. Canadian iGEM teams come and we do an introduction. And then we have workshops, and then everybody presents and are judged. But we're hoping to have someone from the Canadian Space Agency, that was related to space and synthetic biology at some point to do an introduction and we wanted to extend that invitation.

Clélia Cothier
And also sent you there's been a request for information. NASA is thinking about launching a challenge on space food. Looking at that can give you a lot of information on our Canadian side. I can already send you the public link from NASA and would be happy to have a full on conversation with you if that's something of interest. And so I'll try to have the link and paste it here. But on my end that's sort of like the extent of what I can look into but it's it's really interesting and it's great to see the university scene in Montreal, so proactive and doing so many things. I was there not too long ago. So it's always happy to reconnect with the students working on a lot of cool projects.

Mathieu Tremblay 9:41
If I can add something I forgot. I promised to explain what's behind me. One of the initiatives that CSA participate, it's it's called Naurvik , you can look at this on social media or in the news. It's located in the far north in Gjoa Haven. It's a joint initiative between the Arctic Research Foundation, CSA, Agriculture Canada and NRC (National Research Council). The goal is to provide fresh food for remote communities that live in very harsh environments. And of course, for CSA this is a great test bed to test space technologies to help and to yet somehow understand how we could grow food on the Moon or on Mars.

The vision of CSA is that, by the mid 2030s, Canada will have sought after food production capabilities for long duration human spaceflight, and provide one or several critical systems to an international partner, lunar surface food system. And of course, this is a discount also for Mars. And so yeah, so we are now looking at Canadian capabilities for now to see what do we have over there to help to pursue this objective and goal and yeah, so it also implicates non plant food sources. So I see a link with your initiative here with your project.

iGEM Concordia 12:41
What are the CSA doing as long term goals for outer space exploration?

Luchino Cohen 12:52
We certainly are committed to support and in this program, especially, we're talking about human exploration here. Most of our activities currently are targeted to the ISS. We also are expanding a new ground research program through some specific funding announcements.Then we are trying to see what kind of contribution Canada could do to the lunar gateway in terms of infrastructure, robotics, and potentially science. Some of some of the people working with Mathieu have been actively involved in groups like ISECG (International Space Exploration Coordination Group). I don't know if you heard about this group of space agencies. So this group of representatives from space agencies that are brainstorming over space exploration towards Mars.

We are mostly supporting technology development and science investigations in order to allow humans to live and work in space, wherever that be. This is usually through announcement of opportunities, whether it's for technology development through the science technology, Space Technology Development Program or through announcement of opportunity from the group of space exploration. And we have an ongoing research program currently on the ISS, but focusing mostly on human health. I am one of these, the way we approach this is going through addressing some risks for human health. One of these risks is the nutrition risk. That's where I think the kind of project you're involved in is well-aligned with our priorities.

Clélia Cothier 15:42
If I can add a second, no quick note on ISECG, so the International Space Exploration Coordination Group, and that's the link I posted globalspaceexploration.org. They posted three global exploration roadmaps. The last one was out in February 2018. And there should be a supplement on lunar exploration by the end of 2020. And what's interesting to know is that CSA will become the chair during the fall of this group. We'll be actively involved in the planning and in the coordination of that group. So those documents are definitely a good idea if you want to have more of an idea of a roadmap of coordinated action from different space agencies. It's a reference.

And, the other thing that I might say, and that's very much in the brainstorming realm, but we were thinking at some point if there would be ways to leverage the fact that CSA will be chaired to engage youth to make links with some of the youth programs. So it's all very up in the air right now.

iGEM Concordia 19:37
You're saying you're looking to create food independence? What are the main initiatives that you're pursuing right now for that?

Mathieu Tremblay 19:52
Now, the main goal is to acquire knowledge on what's the Canadian culture. In order to achieve this goal. Right now, what's behind me is one of the things because we gradually want to build this testbed. And there will be some other initiative in the future but CSA is back in the food production initiative, since one year so it's totally new now. So we still have to, to define the initiative, the activities that we will do.

iGEM Concordia 20:45
Perfect. And you had mentioned it seems like you're knowledgeable about, what are the nutrients that astronauts need vitamin A, D, C? Are there other nutrients that are the primary focuses?

Mathieu Tremblay 21:01
Oh, I don't know exactly. I just heard about vitamin C, that the shelf life might not be very long, but I heard this. I don't know if it's good information. I just assumed that C might be on the list, but I guess every vitamin that doesn't endure long shelf life in the form of dehydrated food is something that a human being will need, especially for a long duration flight to Mars.

Luchino Cohen
But during my research on the synthetic biology field, I talked to [a researcher] from Ontario in Toronto. Anyway, one of the applications that would be of interest for space would not only be nutrition but also drug production. So let's say that if there was

any way to engineer a microorganism to produce specific drugs, that could also be a potential application.

iGEM Concordia 22:14
I think it's already been done. Yeast are used to produce insulin. I haven't delved into the different applications, but that is one I know of at least. So it'd be interesting. If we worked if we made the yeast more compatible in space for insulin production, that's actually a really great proof of concept as well.

Luchino Cohen 22:44
In terms of your project, you mentioned a marker to indicate stress response in yeast.

iGEM Concordia 23:24
What we are working with is a design more focused around spectrometers right now and using that.

Luchino Cohen 23:43
So, if you think ahead and consider potential space experiments, then you need to maybe choose a gene marker that or a marker that can be easily detected without too much specific equipment that may not be available in a rocket or or a suborbital flight or on the ISS. So there are a variety of approaches that were used previously but it's important to think about some markers that can be easily detected.

iGEM Concordia 24:30
Those are some other things we're also picking up was setting up the strain and then freezing it once it's up there and then sequencing it when it comes back to kind of like, see what kind of the big differences were or using the chromoprotein.

Luchino Cohen 24:48
So some can yeast be maintained on the solid medium.

iGEM Concordia 24:56 Yes.

Luchino Cohen
So then you may just about a colorimetric method, if there were some, I don't know, my experience in microbiology is very, very weak, I managed to cultivate some equally in the past in a long, long past. But if you can have a plate with some colonies in there and some of them turn red, that's very convenient. So an astronaut can take photos of the plate and send back information.

iGEM Concordia 25:33
That's a good idea.
But then also they know exactly what you're saying. Now you don't need a bunch of specialized equipment for it because not every rocket or ship is going to have a spectrometer. Even if we do manage to get a small spectrometer or custom machine. It would probably be more weights to send up there. So if we have a colour basis method it would be much better.

Luchino Cohen
Say whether it's liquid or solid medium. If you have something that can be captured with an iPhone, that's perfect.

Mathieu Tremblay 26:12
Although I think there's a MinION up there.

Luchino Cohen 26:16
It has this. It has been tested on the station. And it works. Real Time sequencing on ISS. We're getting there. We knew in Canada, we're working also on instrumentation to do some blood analysis. But this is another problem.Any other questions?

iGEM Concordia 26:52
What are you most excited about in your position at the CSA right now?

Luchino Cohen 27:03
I'll go first maybe because I already have a good idea about that. My job is to open the way to space, to humanity. That's what key motivates me, that's what allows me to accept some constraints like working in a government organization, which is very slow and can be sometimes painful. But it's what excites me the most about my job is to open the way to space to humanity.

Mathieu Tremblay 27:49
That's a good answer. I'm not going to answer better than this. For me space exploration there's the word exploration. This is an amazing playground to be curious about everything because you can go over any subject's technology. Working in the Canadian Space Agency, curiosity goes to what Canada can do? This is very amazing. But I think the thing that drives me more is the amazing health, human health and human problem solving that can come up from space research to the Earth.

Clélia Cothier 28:48
In the short term, I would say it's learning from a lot of passionate people and knowing that even if sometimes I feel completely lost on technical topics,I know that I have value by bringing in a totally different perspective. That's super valuable and, and fun every day and I can actually be super excited getting up every morning, since starting with the agency. And the other thing I would say, related to that idea of bringing a new perspective is getting inspired- like space is super inspiring and brings a lot of innovation- I think bringing that innovation to a very concrete, solid and terrestrial social impact is what I'm really interested in.

That's why, for example, the link with food production. One of the reasons why I'm really happy to be in the team is that there's actually a lot of connections to be made to food security and to certain populations that are in remote or harsh environments, that don't currently have good Food Security. Being able to connect with terrestrial impact and at the same time learn from people. I haven't met one person so far that is not super passionate about what they're doing at the agency. So I feel very lucky to be in an environment like that to do my job.

[End]