AirSpace Season 5, Ep. 5: Even Better Than the Real Thing

Theme music up and under

Emily: Welcome to AirSpace from the Smithsonian's National Air and Space Museum. I'm Emily.

Nick: I'm Nick.

Matt: And I'm Matt.

Nick: A little over 550 people have been to outer space, but a lot more people have participated in space analogs, places on earth where space missions are simulated.

Emily: These space analogs are pretty fun and cool for analog astronauts, but they're also key to testing equipment, techniques, and the human element on the ground before launching them into space.

Matt: We talk to two analog astronauts, one who runs analogs and another who spent a career in fake space, but recently got the chance to visit the real thing. That's just ahead on AirSpace, presented by Olay.

theme music up and out

Nick: People have been pretending to go to space for a lot longer than they've actually been flying in space, and not all of it is kids in pretend cardboard boxes like Calvin and Hobbes.

Matt: Yeah, *laughs,* I mean, before you can fly a successful mission to space, you have to do a lot of training. And that training, a lot of the time, involves a great deal of simulation, right? We know that the first humans who went into space had simulated space flights many times before they actually flew. To the point where, when they actually did fly, they noted that it was just like the simulation, right? Although I'm sure there was a difference. I'm sure it feels much different to be strapped on top of a rocket and blasted off into space than to sit and be jostled around inside of a little tin can amusement park machine inside of a test facility.

Emily: Well and I think it's important to address what we mean by analog because analog can mean a lot of things, but it's also a really big term. I think anything from the Neutral Buoyancy Lab in Houston, which is a giant pool with the space station inside of it, that astronauts use to train for their space walks, all the way to things that kids get to use at space camp. That qualifies as a space analog. Even some of the early testing that was done with people who weren't even astronauts yet, they hadn't flown yet. Pretty much anything that simulates an aspect of traveling to space is an analog.

Nick: In the Apollo era, they took astronauts and literally sealed them into the command module inside of a giant vacuum chamber and let them live in there for a few days, just to see how it was going to work in real life. But what we're talking about today is more akin to analogs for whole missions, where we're kind of, soup to nuts, simulating what a mission would be like, but here on the ground.

Matt: Right. And there's a long history of that type of activity as well, right? We know that all of the Apollo astronauts trained at different sites on earth for, how would they actually go and find rocks and pick up rocks and operate the equipment on rocky surfaces on the moon. And so one of my favorite locations in Arizona is Meteor Crater, Arizona, where they actually did some astronaut training, understanding how to operate the vehicle around the crater and understanding how to look for rocks, pick up rocks, identify where they came from, what situation they were found in. So there is this history that goes back to the first operations on the surface of another world, where we were coming up with ways of finding analog sites for that on earth, and then enacting aspects of the mission there.

Emily: But I think what most people think about when they hear analog astronaut or analog space mission, they're thinking about these really, sort-of, self-contained or self-sustaining habitats that are oftentimes in really isolated locations. So that essentially, you're getting locked inside a giant house somewhere, with a bunch of other astronauts, sort of fulfilling whatever your mission is. And some of them can be really short-term and others can be really long term. And a lot of these habitats exist in the United States, but they're a little bit everywhere. And we've talked about some of them in a previous episode on AirSpace called Under Pressure, where we talked about a lot of the underwater laboratories, specifically off the coast of Key Largo, Florida, but there's also analogs at the Mars Desert Research Station in Utah, the LunAres in Poland, and there's also a ship in the Arctic. They're everywhere. A lot of people are doing this because there's not just value for space science and astronaut training, but there's a lot of scientific value too.

Matt: So one of my favorite analogs is the HI-SEAS or the Hawaii Space Exploration Analog and Simulation. So HI-SEAS is a dome that's located high up on a mountain on Hawaii's Big Island. It's surrounded by rocky volcanic terrain that's not too hard to imagine is the surface of another planet. And in fact, it's the same rock type that we find on both the moon and on Mars, it's volcanic basalt.

Nick: HI-SEAS has been running simulated Mars missions since 2013 and they recently added simulated moon missions to their docket. The analog center is run by Dr. Michaela Musilova.

Dr. Michaela Musilova: Well, hi there and aloha, from Hawaii. My name is Dr. Michaela Musilova and I'm the director of the HI-SEAS research station in Hawaii, located on the volcano Mauna Loa, where we do simulated missions to the moon and Mars.

Emily: And what I think is really cool about Michaela, is that she was an analog astronaut before she became the director of HI-SEAS.

Dr. Michaela Musilova: I'm an astrobiologist, as my profession or let's say as my area of expertise. I've been working in astrobiology for over a decade now. And during my PhD, I first heard of these analog missions and I was selected as part of the first British crew to do a simulated Mars mission at the Mars Desert Research Station in Utah. And that was my foot in the door. I realized the potential of analog missions, I got to do a lot of really great research and that really motivated me to continue being involved.

Emily: So what I think is cool about Michaela's story is that she was participating in a mission in 2018, that was supposed to last for eight months. And it ended up getting stopped after just a couple of days, because there had been an accident. And this kind of gave her this idea that there was no need to necessarily be doing these kinds of analog missions for months and months and months at a time. There's value to those kinds of missions, but doing shorter missions also had a lot of value. And it was this idea to run shorter term missions that helped elevate her to the point where she was eventually named director of HI-SEAS.

Dr. Michaela Musilova: So they don't necessarily, you know, need to be, quote unquote, locked up there for long periods of time because they just need to test that a rover works or that we can grow certain types of food under the simulated lunar or Martian conditions. Whereas it's the human-related research that usually takes several months in order to get meaningful data.

Nick: And the shorter missions are good when you're testing out an equipment or a procedure or an experiment where you don't necessarily need to put people through the rigors and isolation and communication delays and such, that you will find on a real long-term mission, but those are really important too. And those go on at HI-SEAS and elsewhere.

Emily: Yeah, you need to really know how people work together. You need to know what the psychological effects are of people being together and being really isolated for a really long time. To get to Mars, astronauts are going to be on an eight-month-long journey just to get to Mars. Then they have to implement their mission, and then they need to spend eight months in a small space together, coming home. That has to have a mental and physical impact on the human body and the human mental state. And this is the safest way to understand how people are going to engage with one another and engage with their environment and work through this kind of long-term isolation.

Nick: So when we say human testing, in this sense, we don't mean whether or not the analog astronaut has the right stuff. Like, we're talking about such extreme scenarios, like what you were describing on a Mars mission, Emily, that we just need the data of what happens to a person, not necessarily the astronauts themselves. They're going to be tested later, where we're going to cover that,

but how people interact, how people live, and relax, and work over those long durations in such confined spaces. There's really only one way to find out.

Emily: Right. So Michaela's run about 30 missions since she's become director, and a lot of that has happened during the pandemic. So talk about isolation on top of isolation. But a big part of those missions was testing equipment and systems that could actually be used for these kinds of future space missions.

Matt: One of the most interesting experiments that I've read about, that happened at HI-SEAS, or at least interesting to me, was an experiment that had to do with boredom and how boredom affects your, sort of, cognitive abilities, your ability to react to things happening around you, because we know that this is something that happens in space environments. You're in a confined space for days on end with the same people. You tend to kind of give in to the routine and become bored. Now, astronauts never like to talk about being bored in space. They don't really like to admit that they ever experience boredom, but if you're spending months in a habitat with the same people, doing the same things day after day, boredom does set in. And so HI-SEAS, one of the experiments that they performed there was to try to figure out, well, just how much does it impair your ability to react to a sudden change?

If something suddenly goes wrong in your environment, how will you react to that? How will you respond to it if you're so used to the same thing happening day after day? And so, you know, I think that's a really important and interesting question that they're trying to get at there at HI-SEAS, but it's not something that you'd necessarily would think of as one of the biggest problems facing a exciting space mission to Mars is, well, they're going to get bored and they're not going to know what to do if something suddenly happens. They're not going to be as aware of changes in their environment, because they're just sort of going to fall into that routine.

Nick: Yeah, that was one of the bits of debrief from one of the Apollo astronauts, Pete Conrad, on Apollo 12. He said, "You guys, you got to give us something. We can't just float there for two weeks."

Emily: I think some of the most important science that's going to come out of these analog experiments in these analog habitats is allowing researchers to study how these groups interact and function in these really long-term isolated environments.

Dr. Michaela Musilova: Since I've become director, I found that the more diverse the crew, the better the dynamics and the more successful the mission is. And so I strive to recruit crews that are diverse in gender or in ethnicity. So especially, I'm hoping to encourage more people of color to join our missions because there was definitely a gap in that in the past. But I also like to encourage people who are from a different field of expertise to join missions. So not just your classic scientists, engineers, maybe doctors who would typically get selected for such

missions, but I like to have at least one person that's, let's say, different from the rest. That's a journalist, an artist, a teacher. Someone that's different, who can really think out of the box. So we're not all thinking the same square way, if you will. And really adding those different perspectives of different backgrounds, and different nationalities and cultures to the missions makes it so that everyone really becomes, in a way, more creative themselves because they're starting to see things differently. They learn a lot of new things. They become more accepting of others. And most importantly, empathy increases within all of us.

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Emily: I think one of my favorite experiments has to do with the microbiome in your digestive system. I think that's something that we don't understand very well among humans anyways. I think it's a really interesting area of research, but when you consider putting a bunch of humans together in a small confined space for long periods of time, there's a lot of really important questions that need to be answered about how that changes your microbiome. How that changes across the mission. What you can do nutritionally, to help mitigate any negative impact and what the long-term consequences might be. And these are the kinds of environments that allow you to run these kinds of experiments. I think my other favorite one is, umm, getting to test out various rovers or various other transportation mechanisms.

Dr. Michaela Musilova: That's one of the advantages of the HI-SEAS facilities, that it's located on an actual active volcano, at approximately 8,200 feet in altitude. And similar geological materials and features can be found on the moon and Mars, so they can do directly relevant research in terms of planetary science. The terrain is also a good challenge to test rovers and robots, again, as if they were preparing them to use them on the moon and Mars. So that's the other type of research we do there.

Emily: And so these are the kinds of things that you can do at HI-SEAS or other analog experiments, because you have to practice. Leaving the habitat means you have to get your suit on and you have to get into these vehicles and you have to work with these vehicles and test out their technologies over, in some cases, really long drives. So I think that's some of the really cool stuff that these kinds of habitats can do.

Matt: Can I tell you about one more favorite? So this is my favorite because the little robot that they used was this cute little robot that looks like a little dinosaur. It's like a little plushy dinosaur, but it's also a robot that walks around and interacts with you and, sort of, tries to cheer you up and stuff. So they were trying to figure out if having a little robot companion with you on board would actually help you to feel more engaged, like you were caring for something like a little pet. And during the pandemic, my dogs, who you may have heard barking in the background during one of these recording sessions, have been a real comfort to

have around, but the idea that, you know, we want our astronauts to be happy, so we give them these little robotic pets to take care of and remind them that, hey, there are cute plushy things in the world. Even if everything outside of this habitat wants to kill you, there's still something to be cheerful about.

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Nick: A day in the life of a analog astronaut is designed to be as close to a day in the life of a real astronaut as is practically possible, but that can still vary. However, if you're in an enclosed space and you're there with a few people, you're going to do a lot of cleaning. You're going to do a lot of repair work. You're going to do a surprising amount of paperwork. And while that might feel like the downside of a space simulation, those are all things that actually go on on real space missions as well.

Matt: Yeah. And you're also going to get to spend time with your crew mates, doing things that are a little bit more enjoyable, like having meals together and maybe even preparing foods and sharing foods with each other. You're going to have time to do your science experiments and other things that I think you might find a little more rewarding than the paperwork. But yeah, life in a space station or in a habitat is going to be incredibly regimented with a timetable that you pretty much have to stick to each day.

Emily: So we had the opportunity to talk to a real life analog astronaut, because some people sign up to do these analog astronaut experiments as a way to achieve their goals of maybe gaining additional training and skills that help them get to the real space someday. And so we had an opportunity to talk to Dr. Sian Proctor, who's doing just that.

Dr. Sian Proctor: Hello everyone. I'm Dr. Sian Proctor. I'm a geoscientist. I'm an explorer. I'm an analog astronaut who has recently turned into an astronaut.

Matt: Many of the people who participate in these analog missions actually have applied to be astronauts and just, for whatever reason, didn't make that incredibly difficult cut to be one of the actual NASA astronauts. And that was the case for Sian.

Dr. Sian Proctor: I was a finalist for the 2009 NASA astronaut selection process. So all my friends knew that I had a thing for space, but my friends also knew that I had a thing for food. And so when the HI-SEAS habitat announced that it was looking for people to live in this new analog for four months, to investigate food strategies for long duration space flight, one of my friends immediately thought of me and sent it to me. And I was like, yes, I do love food, and I do love space. So I'm going to apply. And I was lucky to get selected as one of the very first crew members to live in the HI-SEAS. And it was four months, investigating food.

Emily: So while Sian was working on her first assignment as an analog astronaut, she served as an education outreach officer and that involved a lot of different things, which included creating a cooking contest and a cookbook while on the station, called Meals for Mars. And I think that's a really cool part about what Sian worked on because we have already, even though it's not the focus of this podcast, we have done episodes on space food. It is one of the biggest questions people ask when you talk about astronauts, what's the food like? What was it like for Apollo? What is it like for astronauts now? So I think it's really relevant that there was this work that Sian was doing towards really trying to amplify the importance of food in these kinds of isolated spaces, because I think it's an important part of that emotional connection that people have.

Matt: Well, and one of the cool things is you can still go on YouTube and find some of the videos that Sian made at HI-SEAS of cooking the recipes from the recipe contest.

Dr. Sian Proctor: (From YouTube) Hello and welcome to the HI-SEAS kitchen. I'm Sian, one of the crew members, and we had a food recipe contest that we ran before the mission started. And so what I'm going to do is, over the next four months, I'm going to cook some of these recipes with other crew members. *fades out*

Matt: And so you can see someone preparing a meal, sharing it with her crewmates, pretending that they are on a mission on another world.

Emily: Right. So for Sian and a lot of people who are these analog astronauts who are participating in these simulations, it's not just a chance to contribute to exploration and advancing human space flight, but the research that goes into these habitats and the research that's done inside the habitats is a chance to help create solutions and gather data that aren't just for space, but they really have the ability to help solve problems here on earth.

Dr. Sian Proctor: And when you go into one of these analog habitats, you may be looking at microbial growth in the habitat and on the people's bodies because you're living in close proximity and monitoring how that changes. Now, that's definitely relevant for going to space and spacecraft and living in close environments, but it's also applicable here on earth. When you're talking about all the data that's coming up on how microbes really rule the roost when it comes to human health. And when you think about living in submarines or on ships or even in people's households. So there's so much crossover between space research for humans and just everyday thriving on earth and how we can improve ourselves through understanding human space flight.

Nick: Like Michaela, Sian believes that analog missions provide space to test what people other than historically conventional astronaut candidates bring to a space mission. Artists, for instance.

Emily: Right? So what you're talking about, Nick, is we're not talking test pilots with a military background. We're talking about broadening that perspective towards, sort of, opening space exploration up to people of many different kinds of backgrounds and how those backgrounds are all really important and have their own strengths when it comes to long duration space flight.

Dr. Sian Proctor: When we're thinking about going to the moon and staying there, or going on to Mars, we're talking about this new space of long duration space flight and ISS, the International Space Station, they typically go up for six months. But when we're going to Mars, we're talking about three years, and when you're talking about really small spacecraft to get there, and a little habitat to live in, and every time you go outside, you're in a space suit. And that has psychological implications.

Nick: Astronauts don't look as much alike as they used to, but by and large, people who travel into space have a lot of things in common. And if we're at the dawn of a new space age, then more and more people are going to be traveling up, and it's important to figure out whether you need a guitar player on the International Space Station. Turns out that was some pretty great film we got back.

Emily: Yeah. And what I think is really great about Sian's story is that she started off with this intense interest to go to space and made it as a finalist, right? She became a finalist for the Astronaut Corps in 2009, but didn't make the cut. It's incredibly competitive, as you just mentioned, the people who become astronauts have incredible skill sets, that when you actually look at the skills that finalists have, it's still an incredibly impressive group of folks.

Nick: So after getting so far in the extremely rigorous astronaut selection process, and then by performing all of this wonderful and important work in space analogs here on earth, she landed a seat on the Inspiration4 mission, which took her into orbit, aboard a SpaceX capsule.

Dr. Sian Proctor: What I've learned about crew cohesion, what I've learned about myself, all of those things kind of come into play. One of the things that we did in our mission was we talked about strengths, and I had each crew member take a strength finder test so that you knew what your top five strengths were, and we know each others so that we can use those strengths to our advantage. So things like that, that might not have been on a normal astronaut training schedule, I picked up from being an analog astronaut, and was able to bring that in and share that with the crew.

Matt: We talked about how analogs make a space for, perhaps, artists and poets to go into these missions and see how they fare. Sian was actually chosen for Inspiration4 as an artist and a poet, but in fact, in addition to that, her sort of side hustle is she piloted the spacecraft.

Emily: What's cool, Matt, too, is in addition to piloting this spacecraft, and I really enjoyed watching her Twitter account and watching her learn how to fly all these ridiculously cool jets, piloting this mission made her the first black woman to pilot a spacecraft, which is a really special achievement as we think about continuing to diversify the pool of folks going to space.

Matt: So, you know, with all the developments going on in commercial space flight with space tourism, with commercial crews, with potentially having private commercial space stations in orbit, one of the things that seems to be on the horizon is more people are going to be going into space more often. And even so, though, and even if we do end up sending missions to the moon and missions to Mars, none of that is going to put an end to analog experimentation with life in space. This has become a really central part of the way that we prepare for new missions and ask new questions about what we should do next in space and how we should operate in space. So I don't think that I see this sort of thing ever going away.

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Nick: AirSpace is from the Smithsonian's National Air and Space Museum. It is produced by Katie Moyer and Jennifer Weingart, mixed by Tarek Fouda. AirSpace is presented by Olay and distributed by PRX.

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