WE ARE ETH – Episode 31

With Mariko Burgin, ETH Alumna and NASA JPL engineer

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[00:00:00] **Mariko Burgin:** **So we have forward planetary protection, which means when we go to Mars, we want to make sure we don't bring things from Earth with us that we then inadvertently observe and think we have found life and yet we're actually looking at something that we brought. And backward planetary protection is what I'm in is when you bring something back, making sure that you contain it, you bring it back safely and you want to break the chain of contact with Mars.**

[00:00:29] **Susan Kish:** In this episode, I'm talking with ETH alumna and NASA JPL engineer, Mariko Burgin, who is also the current president of IEEE Geoscience and Remote Sensing Society. This is the We Are ETH podcast, and I'm Susan Kish, your host.

I have to say, you're the only person in LinkedIn I've seen where the first line of your description is Earth, Mars, and beyond. It's just like the best, right? What do you mean when you say Earth, Mars, and beyond? What is that?

[00:01:06] **Mariko Burgin:** It's a little bit of a play on words. And when I started off in space, I really worked a lot on Earth missions.

And this is still my core and my main interest, but these days I work also on Mars and other missions. And I'm fortunate to work in a place where Earth, Mars, and beyond is actually possible.

[00:01:22] **Susan Kish:** Of course, for any Star Trek fan, it's like the coolest ever, exactly. I see also that in your bio you're the IEEE GRSS, which is the initials for that geoscience group. Can you tell us what is this organization and what does it really do?

[00:01:42] **Mariko Burgin:** So the Geoscience and Remote Sensing Society is one of 39 technical societies of IEEE. And IEEE is really the overarching umbrella society for engineers all around the world. And then underneath you have these technical societies that have their focus point.

And my home society is geoscience and remote sensing. And as the name says, geoscience has to do with earth observation and remote sensing is remotely sensing the earth. And that really falls into what I do or what my speciality is. And I'm fortunate right now. I'm for two years, I'm a president.

[00:02:18] **Susan Kish:** When you say remote sensing. I have this vague remembrance, then I'm going to age myself, in the 60s and 70s, where this was a controversial practice, right? It was, um, not necessarily considered a good thing. I'm sure the world has regressed since in the last 50 years. But does remote sensing mean like a yard off the earth and little drones flying? Or does it mean like satellites circulating the world? What? How remote is remote sensing?

[00:02:48] **Mariko Burgin:** So basically it's all of it. But I think the definition remote sensing means anything that is not contact. So if you're away from it, you're remotely sensing something that can be, as you say, from a drone. It can be from an airplane.

It can be from a satellite. And remotely sensing is also for telescopes in some sense, right? Because you're looking really far away. It's fascinating what you can actually observe from a distance. Our eyes are the perfect remote sensors, too. That's what we do, right?

[00:03:17] **Susan Kish:** I never thought of that.

[00:03:18] **Mariko Burgin:** Right.

[00:03:18] **Susan Kish:** And to what extent has the world of remote sensing really changed in the last few years?

You mentioned you were president for these two years, but you've been in this field for quite a while, right?

[00:03:29] **Mariko Burgin:** Technology has changed quite a bit, right? Um, remote sensing technologies used to be like, let's just take one example, radars. Um, that's a very old technology. It used to be for military applications.

Nowadays it's also used widely in earth observation because it's amazing what you can see with radars. You can see weather patterns, you can see rain, you can see all sorts of things. So it's essential. But nowadays you also have radars in cars for autonomous driving. So I think these remote sensors are now everywhere.

They really are in our day to day lives. You could even say your iPhone is remotely sensing where you are and gives you added information based on that.

[00:04:10] **Susan Kish:** So your day job, though, is at the Jet Propulsion Library, laboratory, sorry, and NASA. And it includes this wonderful expression that I had not heard, that you were the break the chain leader.

And I have no idea, but that sounds radical. And, but I, can you explain what break the chain means in this context and what it is you actually do?

[00:04:32] **Mariko Burgin:** It does deserve a little bit of explanation. So it's called the break the chain domain. And it's part of the Mars Sample Return Mission. So Mars Sample Return, as the name signifies, means returning samples from Mars.

It's a very simple name for a task. And then breaking the chain means breaking the chain of contact with Mars. So I actually am in a field called planetary protection. And it's a really fascinating field. So, we have forward planetary protection, which means when we go to Mars, we want to make sure we don't bring things from Earth with us that we then inadvertently observe and think we have found life, and yet we're actually looking at something that we brought.

And backward planetary protection is what I'm in, is when you bring something back, making sure that you contain it, you bring it back safely, and you want to break the chain of contact with Mars. That's a whole domain. I'm currently the domain lead for that.

[00:05:28] **Susan Kish:** So, in other words, if you bring something from Mars back, then all of a sudden we don't have a life form that does something rather scary.

[00:05:36] **Mariko Burgin:** Well, uh, you could say it like that, but it, it's also, how do you say, you want to make sure that what you bring back is contained. It's sort of safety measures that, that you want to do. Breaking the chain of contact is something that you also do for other planets, not just Mars. It's just best practice.

[00:05:52] **Susan Kish:** One of the other things you list is around mission formulation. Can you explain what mission formulation means and to where?

[00:05:59] **Mariko Burgin:** Mission formulation really means coming up with the next ideas, the next missions that NASA could launch or that NASA could build. And mission formulation really starts at the very beginning, like that idea of we should do this.

Or we sometimes say from the random idea you have in the shower to actually having something where you think, I think that could work. And so mission formulation at JPL actually has its own process. So we have, we call them concept maturity levels, where we can quickly determine how mature a concept is and then figuring out once you have an idea, what is the idea?

Sometimes the idea centers around the science, right? You want to observe snow. But then how do you do it the best way so that it fits within a certain cost cap or it's the instrument is not too heavy and then you work in that space and in the end you we call it a point design you have one design that you think that actually could work for this particular call or opportunity and then you say okay let's do it and then you build a team you make a proposal and you submit it, and that's the beginning of the mission formulation, and then, of course, once you win, you have to build it up, and you have to really come up with the architecture. It's a fascinating process, I have to say.

[00:07:13] **Susan Kish:** I have to say, when you describe the process that way, Mariko, it sounds like being an entrepreneur and starting a company.

[00:07:20] **Mariko Burgin:** It is a little bit like that. That's the thing that I really think is also attracting me because it really, everybody has sometimes good ideas, but then it's finding the right idea or finding the idea that works perhaps in five years, right? That trade space is really interesting. Yeah. And it's wonderful to work with such enthusiastic and passionate people who are all in it because they want to come up with that next really cool mission that could work and explore something truly new.

[00:07:50] **Susan Kish:** I don't know if these are confidential or could you tell us the story of a, of one of your journeys along this mission formulation.

How did you go from an idea in the shower to something that allowed you to write a paper and get it published?

[00:08:03] **Mariko Burgin:** Yeah, it's hard sometimes. So for me, I've been doing this for, let's say, perhaps 5, 10 years. So sometimes mission take a little bit longer, right from the idea to actually getting somewhere. So perhaps I can just give you ideas of where I saw them.

And, and the funny thing is, the ideas come back, right? Because sometimes you have a good idea, but it's not quite developed yet. For example, you have a rover that wants to drive very long distances on the moon. That's a fascinating idea. What science can you do with it? And then you run into questions of, do you have solar panels?

Like what's the power situation? How will they deal with the day and night? And then the team goes off and does something else and comes back again. And then they have a solution for that problem. And then you are on the next step of the journey. So it's fascinating. It's not just one idea that usually gets curated is a whole pool of them.

And so that's the fascinating part too, because it really takes time to mature a good idea until you're like, okay, I think we have it. This is it.

[00:09:05] **Susan Kish:** And most of the ones you're describing are these ones that happen on earth, on the moon, on Mars, on beyond, as you called it.

[00:09:14] **Mariko Burgin:** All of it. Yeah. All of it. One of the guiding principles or basically documents that we use are the decadal surveys, as we call them.

NASA, every 10 years, and that's why they're called decadal, basically asks the community, what do you think are the next big things that we need to address to bring our science forward, collects all this information. And then you get a book of all the things that we think we as a community, like all scientists around the world think could be

important for NASA to fund and to go forward. That's sort of your starting point to see like, yes, we should go to Mars. Yes, we should do Earth observation for these particular fields. And that's a guideline to, to for mission formulation.

[00:09:58] **Susan Kish:** So NASA basically crowdsources its priorities. Very cool. One of the papers I was reading through, I have to confess many of the titles were beyond me, but I was reading through your list of extensive list of papers, but there seem to be several around.

Martian groundwater. Can you talk about that and what, I know this question of, is there life on Mars and is there water on Mars is top of mind for those who are interested in Mars. So can you talk a little bit about that?

[00:10:27] **Mariko Burgin:** Yeah. So I was involved in a study and I think those are the papers that you're referring to where we were working on a new technology to, to sound for water on Mars and it's this really cool idea of basically shooting this large ring out and laying it out and then basically using that to sound very deep into the earth because one of the difficulties is water usually we expect is deep in the surface and how do you penetrate all the way down and really observe it? But I agree the search for water is something that is being pursued and especially on Mars I think that's always something in mind.

There's one right now we have the perseverance rover that is looking for ancient life. So that's one aspect ,but then of course water would be also fantastic to to know more about it where it is located and how deep is it? Is it accessible or not?

[00:11:20] **Susan Kish:** When you say ancient life, you mean like fossils or ancient life assumes that it's not living today. So it's evidence of past life.

[00:11:29] **Mariko Burgin:** Exactly. Yeah. And that's the purpose of, of perseverance right now, looking for ancient life because it landed in a Delta. And they're based on just how it looks. And I highly encourage everybody to take a look at the photos that the rover is taking because they're all online.

NASA all puts all of them out there. And just look at the Delta. It looks like a place that could have been teeming with life at some point. Right now it's dry. It is completely like it's like a desert. And so the purpose of Perseverance is really looking for these signs of past life. Fossils and so on.

[00:12:07] **Susan Kish:** What is the time frame you work in? You mentioned offhand that the projects sometimes have a long time frame. You drop them, you come back, etc. What would you consider a best case timeline. Is it six months? Is it 10 years?

[00:12:23] **Mariko Burgin:** It really depends with mission formulation how big the mission is. So we have flagship missions which are really big and take a decade or more to prepare.

By the time the public hears about it, it's probably already been in planning and preparation for a while. I think there you could say five to 10 years is appropriate because it takes a lot of effort to build this huge, not just build, but think up, architect, and then build and test and launch and execute this whole big mission.

But when you talk about smaller things, smaller missions who have perhaps a lifetime of only two years, those are much quicker because you usually don't build a huge spacecraft and turnaround times are faster.

[00:13:07] **Susan Kish:** So, let's go to how you went from the ETH to other institutions, but let's go backwards. Before you were in California, if I understand, you were in Ann Arbor, which is where I grew up, so I resonate with that.

How did you make that switch from doing graduate studies in your postdoc there to working in NASA.

[00:13:27] **Mariko Burgin:** I was a grad student doing my PhD in Michigan and actually at that time my advisor moved to USC here in Southern California and I hitched a ride with her, basically came over here and then I always had the desire, I call it my North Star.

I always wanted to work in space, something space related and then of course being in the vicinity of JPL, Caltech and so on really encouraged me to try to go for a postdoc and that's how I came over .But yeah, the transition from Michigan to L. A. was difficult. Ann Arbor is amazing. It's very, it's a wonderful college town. So it took me a long time to get accustomed to the traffic and the noise, but now I love it.

[00:14:11] **Susan Kish:** I understand. But do you miss Zingerman's? That's really my question.

[00:14:14] **Mariko Burgin:** I do. We still sometimes order from Zingerman's.

[00:14:18] **Susan Kish:** We do too.

That's the best. So let's go one more step back. How did you get from the ETH and your studies there to working in Michigan?

[00:14:28] **Mariko Burgin:** I think for me there, the stepping stone was I had to do an internship as part of my master's thesis. And I somehow convinced myself that I wanted to do it outside of Switzerland. And I think I applied to so many places, I can't even remember anymore. But in the end, I did a, about a 10 month internship at ESTEC, so at the European Space Agency in the Netherlands.

And that really shaped my trajectory, because for some reason that gave me the confidence to say, hey, if that worked out, why not do something else? And so I decided to do my master's thesis. My six month master thesis abroad as well. And being very lucky, I managed to get connected to a professor in Michigan.

And that's basically how I went over. With the sole intention of doing a master's thesis, coming back to Switzerland and then working. I did this research. I really loved it. And then basically I decided to continue on with a PhD. So that was the jump over the ocean that I did.

[00:15:31] **Susan Kish:** Now today, the ETH, it sounds like, is starting a space program or pulling together all the threads.

And I think next summer, in fact, they're starting a master's in space. But at the time you were at the ETH, was there such a thing? Or, because I, from what I read, I think you just, you, not just, you studied electrical engineering.

[00:15:50] **Mariko Burgin:** No, I think at the time when I was there, there wasn't such a thing. Perhaps if the class or coursework would have been there, I probably would have been very interested.

[00:15:58] **Susan Kish:** How did your years at the ETH prepare you for this journey and for what you're doing now?

[00:16:04] **Mariko Burgin:** I think looking back, my time at ETH in Zurich, it was really great. The education was really good, coursework and everything. Let's be honest, it was also tough. It was, the education was good, but the first two years I remember were, you learn a lot, you have to really prove yourself.

But I think that was part of it too, really getting to that level where I could feel like, okay, I think I, I have my knowledge. What I also appreciated is the curriculum that we could lay out was very diverse. So I was able to take many different courses. I remember from wearable computing to mobile technology to information theory.

So I was in a department where you could really do different things. Some people were really focused already at that point. In the masters, I wasn't. I was more, how do you say, going and trying out different things, which I really appreciated. Control theory and so on.

[00:16:57] **Susan Kish:** Did you have to do a lot of programming and data science while you were there?

[00:17:01] **Mariko Burgin:** Programming, yes. That is something that really at ETH was when, where I really got my fundamentals in. Data science, not so much. Interestingly enough, when I was at ETH, it wasn't that hot topic yet.

[00:17:14] **Susan Kish:** Along your career it sounds like you've won a bunch of awards in JPL, NASA and, uh, and an IEEE award. Can you tell us a bit about some of those awards and what they meant?

[00:17:27] **Mariko Burgin:** I mean, many of these awards, I have to say, are team awards, and I think that's the reason why I'm most proud of them, because I am a strong believer that in the end awards. are not just for a single person. They're for a team. And yeah, I, I think some of these awards are for extraordinary efforts where the team had short turnaround times or we had to do something and we just, the team came together and we made it happen.

And I think this kind of camaraderie is, is really nice that then they also give out an award to recognize the whole team. You mentioned the Tripoli award. That one I'm also happy about because it has to do with promoting women in STEM. And that's another thing that I feel very passionate about. Being a woman in STEM and representing and encouraging the next generation of scientists and engineers to really do it and just go for it, for their dreams and what they want to do.

[00:18:21] **Susan Kish:** I understand you also do a lot of mentoring, and that's been important. Can you talk about that? And especially, to the extent that it works with folks at ETH, that would be, I'd be interested in how those dots connect.

[00:18:32] **Mariko Burgin:** Yeah. I've been reflecting a little bit on this. Why am I actually so interested in mentoring?

And I think it goes back to my high school times. I'm the first one in my family to go to college, and I think the role models, the role modeling at that early age, or even earlier than high school even, is really important. And then mentoring should not be misunderstood by someone advising you. It's more giving perspective, right?

And having someone who you can sometimes run ideas and thoughts by, and they provide you their own perspective. And you have to have different mentors because everybody has different opinions. But it's something I think if someone has all the facts, it's much easier to make decisions. Right. I'm really a strong believer of now.

Everybody should pay it forward to the next generation. Have that conversation over coffee and share your you know, failures or your successes and show it what it takes. Not just like the resumes and LinkedIn are always nice. It makes it look like it was all very well planned, but sharing the story with someone who's trying to figure out how to do it, I think is really impactful for their career.

Right. As a mentor, I think it's also. You always learn something because things change so quickly. You learn from the next generation of like data science, for example, right? Or machine learning or AI and what careers they are now aspiring to. So yeah, I think it's really a give and take. Yeah.

[00:20:00] **Susan Kish:** I'm going to go back to this question about the ETH, because when I read about their space program, I was fascinated by all the different parts that were touching it, right?

They had everything from life studies and robots and chemistry and their research, right? Yeah. Yeah. space and there were like 10 different departments that were pulling together for the space programs. Can you give me some context for that? Why would it be so complicated? Why would they need so many different areas to be coming together for this?

[00:20:30] **Mariko Burgin:** It's interesting. Like when you say you want to study some, I have a career in space. There are many different aspects of it. Right. And For example, what you just mentioned, usually you have engineers or you have scientists. It depends a bit of how you want to shape your curriculum, but you can't just be an engineer.

Um, being, for example, a systems engineer who knows the technology very well without knowing what the thing does, what it observes, what it, for example, if you are developing a sensor that measures the composition of the air, yes, as an engineer, you're responsible for that sensor and for building it. But you should also understand how it measures it because that, that kind of, that interaction with the, with the scientists who are standing on that side is very important.

So I think when someone builds a curriculum like this to build a wholesome individual who can then work in industry or in academia or in, in government jobs, it's really important to give them these different perspectives, not just the single thing. And I think once you have that appreciation, you naturally start learning and talking to people and asking them about, hey, why are you doing it like this?

And it makes you, I think it makes you a better engineer and scientist because you're starting to get curious about what other people do and how they look at it from the other side.

[00:21:48] **Susan Kish:** Fascinating.

So it sounds like you support that way that they've structured that holistic perspective as you describe it.

[00:21:54] **Mariko Burgin:** Granted,

I am biased, right? I have to say I have a science background, but also now I'm an engineer. So I really love living at that intersection between science and engineering. So the first few years at JPL, I was really a scientist writing my own proposals and really living on the publication side on science.

And now I work on the engineering side. So I, I, I really liked that intersection. I know some people. I prefer one over the other, but that's my personal opinion.

[00:22:24] **Susan Kish:** How are you active with ETH today? I think I read that you often work with the ETH Foundation, but I'd just be interested in understanding how you work with the institution.

[00:22:34] **Mariko Burgin:** I just recently became an ETH Circle member, so I'm really happy about that. And I'm still trying to figure out exactly how I can best contribute. For me, ETH was a major stepping stone, like, in my path on education, right? I've told you a little bit of how my path of going west has gone so far. And I would like to find a way to, again, pay it forward, pay it back for the students in the future.

And right now, I'm thinking mostly, for example, at JPL, we have, uh, some people who come from ETH for internships or postdocs. We have a Swiss club, so to speak, so there's some mentoring and socializing going on there. Um, so I'm still trying to find my place a little bit of what I can do, but ready to go.

[00:23:21] **Susan Kish:** Did I understand correctly then, you grew up in Switzerland, when you were young, what did you want to be when you grew up? Did you always want to be active in space or was there some other path?

[00:23:32] **Mariko Burgin:** I always had this fascination for space. I always thought that would be something to do. And I remember I grew up in Uri.

I remember, yeah, I remember heart of switzerland and I remember growing up and thinking space, that would be fantastic to work in. I had no idea how to get there. And so it was really a discovery on the way.

[00:23:53] **Susan Kish:** You know, when you were in school, you were curious about all these different areas in your studies. What are you curious about today?

What is it that has captured your interest?

[00:24:03] **Mariko Burgin:** There's one particular topic that keeps coming back to me, which is marine debris. That is, pollution of the oceans through plastic. It's not really related to my research work at all.

[00:24:14] **Susan Kish:** Right.

[00:24:14] **Mariko Burgin:** But for some reason it's a topic that I find very interesting and I've been also thinking about.

Like, how can you detect where the debris is? How would you mitigate it? How would you clean it? And I know there's now, there's companies who are working on this, trying to remove the plastic out of the ocean, recycle it, and so on. It's just something, how do you say, that has caught my attention. Perhaps because it's not like in a country's responsibility because as oceans are international waters.

[00:24:44] **Susan Kish:** I understand. Although remote sensing plays a huge role in measuring a lot of the impact of climate change. What are the books or podcasts that you're listening to and reading these days?

[00:24:56] **Mariko Burgin:** Honestly, these days, reading and listening to podcasts is a bit less on my list. I have a one and a half year old, so much of my free time is taken up by her.

[00:25:06] **Susan Kish:** I can only imagine.

[00:25:07] **Mariko Burgin:** But there, there are some podcasts that I really like, like Planet Money and Code Switch, mostly NPR and things like that, that I really appreciate.

[00:25:16] **Susan Kish:** And were you a science fiction reader when you were growing up?

[00:25:19] **Mariko Burgin:** I, I was very much so.

[00:25:20] **Susan Kish:** Any particular authors you really liked,

[00:25:22] **Mariko Burgin:** um,

[00:25:23] **Susan Kish:** or books?

[00:25:24] **Mariko Burgin:** Don't recall. I was just basically consuming everything I could get my hands on.

[00:25:31] **Susan Kish:** That sounds like a good approach for this. Mariko, thank you so much. Really enjoyed the conversation. And thank you for explaining things like breaking the chain. Now I understand.

[00:25:41] **Mariko Burgin:** My pleasure.

[00:25:42] **Susan Kish:** I'm Susan Kish, host of the We Are ETH series, telling the This is the story of the alumni and friends of the ETH Zurich, the Swiss Federal Institute of Technology.

ETH regularly ranks amongst the top universities of the world with cutting edge research, science, and people. The people who were there, the people who are there, and the people who will be there. Please subscribe to this podcast on whatever platform you listen, and give us a good rating on Spotify or Apple if you enjoyed today's conversation.

I'd like to thank our producers at Ellie Media and the ETH Circle, and especially to thank you, our listeners, for joining us.

Links of topics mentioned in the episode:

Planet Money: https://www.npr.org/sections/money/

Code Switch: https://www.npr.org/podcasts/510312/codeswitch

Image Gallery from NASA Perseverance:
https://mars.nasa.gov/mars2020/multimedia/images/

NASA Decadal Survey: https://science.nasa.gov/earth-science/decadal-surveys/