Episode 18: What Do Astronauts Do? With Dottie Metcalf-Lindenburger

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(Jessica) So hello everybody and welcome to What Do Scientists Do? It's a show where I

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talk to a different science guest each episode and they teach us all about their favourite

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science topics as well as what it's like to work as a scientist and I'm super excited for

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today's episode because I am joined by former US astronaut Dottie Metcalf-Lindenberger.

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Hi Dottie! Would you give us how you like to be

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addressed with your name and your pronouns?
(Dottie) Yes hi I'm Dottie Metcalf-Lindenburger

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and my pronouns are she and her.
(Jessica) So Dottie what kind

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of scientist are you?
(Dottie) By training I am

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a geologist and uh I also though- like to just say I am a STEM advocate because I was a science

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teacher and I taught everything from meteorology to astronomy and of course all the Earth sciences

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and specifically geology too.
(Jessica) Cool! So what do
you study right now as a geologist?
(Dottie) Yeah! Right now as a geologist

I like to say I work for spaceship earth. So I do soil sediment and groundwater remediation

which means I help clean up chemicals or metals or different things that have been left behind in the

Earth's surface that could cause contamination to our water and make it just harder for us to

live the - the lives that we want to live. So I help clean up and that's been really important to

me as a retired astronaut because again we live on a spaceship and I want to make sure that it

is ready for the next generation.
(Jessica) I love that. So what

are some ways that you clean it up?
(Dottie) Yeah um well one of the interesting

ways that I was surprised when I first came into the field is that we can actually inject through

tools that go down into the Earth you know maybe to depths of 50 60 feet is a maximum -

vegetable

oil and we use this vegetable oil for bacteria to live off of and specific types of bacteria that

help break down whatever we're trying to clean up. That's one way of cleaning up plumes especially of
groundwater with specific contaminants. But in other ways you know sometimes it's like

just pumping out the water and then treating it at the Earth's surface um so that it can then

be injected back in but when it's injected it's now clean. It's had whatever was in it

removed. So there's like lots of different ways to remediate but the vegetable oil one surprised

me when I first came into the the occupation. (Jessica) Yeah that is surprising because you

think of just oil in general as this bad thing for the environment. It's surprising that you

would be putting something there that doesn't seem like it quite belongs there but in order

to help out so that's really interesting to me as well. So how did you get into this kind of

work? What was it about your experience as an astronaut that led to you becoming a geologist

and helping take care of spaceship earth? (Dottie) Yeah so I was a geologist by

training and I really loved thinking about the applications. Again, even before I went to space,

this was when I was an undergrad, I wanted to be able to apply the science. I think it's a

fascinating science, I love being outdoors, so some of those things were attractive to

me. I got to be outdoors but also that I was applying it to make the place I live
better. So when I came back from being an astronaut and decided to retire from the
agency and move back to Washington State I went actually back to school to get more
um specifics in the remediation and how we - what type of tools like I said that we use
and and how we work on teams with engineers and all the different types of equipment,
so I went back to school for that because I have a daughter - at that time when she was much younger,
now she’s in high school - but I want to make sure that the planet that we leave behind is in a
good place for her and the next generations and so I felt was so important to help be a part of
the solution and not just talk about it.
(Jessica) I love that! So was it your perspective - was being able to see the Earth from space very impactful for you in this way?
Would you say that that was a part of it?
(Dottie) That is definitely part of it when you first see the thin atmosphere and then you think about ocean water versus fresh water and
then you think about the land and the land that I saw from space I I had not seen some of these vast deserts. You know I grew up in Colorado so I've - I've always lived in places where water is
um of a shortage but never like seen places where there just really isn't fresh water so definitely
looking back at our planet and thinking about it in that way that it really is our spaceship

um and literally that thin atmosphere is what we all share and need. And I wasn't an atmospheric

scientist so what I knew that I could contribute to is then working with the the soils and the surface of the Earth, the geology portion, and I took classes in hydrology so then I could also work for the freshwater piece too. So definitely it was very impactful to see our planet from a different perspective and to see places I'd never been to and think about the criticality of all of these things: air, clean water, and clean land.

That makes sense! I imagine that anybody looking back at the Earth would be thinking of at least some of those things even if they're not already an earth scientist. So when did you go to space and what was your job for NASA? What was your job both before you went up and while you were up there?

Yeah so I went to space in April of 2010 uh specifically I was there from April 5th to April 20th of 2010 and um I had lots of jobs so when an astronaut comes into the corps whether it's for the NASA astronaut Corps or the Canadian Space Agency, European Space Agency,
Japanese Space Agency, they go through a lot of training and basically we have to become kind of a

person that can do multiple jobs, not just the job that we originally did. And so um my job though

specifically on this space shuttle flight was to be a flight engineer which means I didn't help fly

the vehicle but I sat behind the commander and pilot and helped make sure and monitor

that everything was going right on launch and landing and once I was in space I was a robotic

arm operator and that's significant because the Canadian space agency built our robotic arm.

And then I also was a um I like to say a mover. We had six tons of equipment and Science and like

literally a bedroom for astronauts to live on - live in on the International Space Station.

So we had to move all of this equipment back back into the space station or into the space

station for the first time. But in space you can't just move without removing something right?
Like

things float and they don't set down so you have to be able to put something into a place

but that requires usually removing something too. So I was a very specific space mover,

so iike - a lot of logistics. And then I was part of the spacewalk team. So even though I

didn't go outside and do the actual spacewalk, I helped support our space walkers. So I got to
wear multiple hats in space and that's really what astronauts do that are coming from one of our government agencies to go to space. They wear multiple hats, so even if they've been engineers, scientists, doctors, pilots, you know they're gonna have to do a lot of different jobs and we go through this training to prepare for that. So it was really fun and interesting, sometimes hard um but definitely rewarding.

That's so cool so you really did a little bit of everything there and I'd imagine that everybody's probably prepared to also take over other people's jobs in case something happens and there must be so much training that goes into it. How long was your training?

Yeah specifically for our class when we come in initially as astronauts it was a year and a half and we start out with things like doing survival training because we'll be in vehicles some of those vehicles are airplanes as we train regularly here on Earth but of course we'll be in a space vehicle and so understanding like what you need to survive and how you can make do with little things.

Um so we start out with that and of course flight training is really important um so we get to start in a slower aircraft which in our case was the t-34 now they
use a t-6 which is used by our Pilots back here that are training for the military. And then we move into the t-38 trainer which is a plane that can go faster than the speed of sound um and it's just a really versatile aircraft. It's also really good in helping train teamwork and in um learning like what really is important in the moment. So like learning how to focus with the teamwork, with the checklist, with all the systems you have, and then after we do that training we move into the vehicle training and in our case we learned both the space shuttle and the space station. Now astronauts would be of course like really involved in the space station and then these new commercial vehicles that they might fly on. So we did that training and robotic arm training and spacewalk training which is in a huge pool we call the neutral buoyancy lab and this swimming pool is 40 feet deep and 100 feet by 200 feet so it's a giant pool and we use water to kind of simulate floating because of course we have to build and operate things in space and so it's a good way to train us. So all of that took you know a year and a half and then as a crew we did another year and a half of training. So by the time I flew in space I'd had three specific
focused years of training. But then while I was waiting, I waited for six years before I actually took off in the vehicle, and so in addition those other three years that add up to the six we continue training but we also support in different jobs in the office. So those jobs can be like maybe talking to astronauts on a daily basis as a Capsule Communicator, maybe working with teams to help you know fly the right equipment to space, make sure that that equipment is checked out, supporting checklists, there's just a lot of different jobs that you can do while you're also kind of keeping and maintaining your training.

Wow yeah that sounds like the kind of job for people who love doing a little bit of everything. What would you say is your favourite thing that you got to do as an astronaut?

Oh yeah so even though like I said I didn't go outside for an actual Space Walk, I loved being on that team. Both the training on Earth because I loved being in the neutral buoyancy lab and actually working in the spacesuit underwater and thinking through the problem solving and the teamwork that's needed, but then when we were actually in space executing these spacewalks I was the person talking to our
space walkers for the six to eight hours that they were outside and I loved it. It just felt like you know you're on top of everything, you're watching, you're thinking through the checklists with them, you're problem solving, you're working with the ground team. We also had to have some support from the robotic arm operators that were in space too with us so it's just a great teamwork and I would say that's some of my favourite work that I did as an astronaut.

(Jessica) Wow I didn't realize that spacewalks took that long, you said six to eight hours?

Um and the robotic arm that you keep mentioning is the Canadarm, correct? Or maybe it was the Canadarm II by that point? I'm not sure when they switched it.

(Dottie) There was multiple arms so we had the Canadian-built arm that was then part of the Space Shuttle so we used that robotic arm and that's what I specifically flew in space, and then we used the large which - the SSRMS, the space station robotic manipulation system. Um it's the really big one that's able to able to kind of like work like an inchworm across the space station, and so we had um like Stephanie Wilson and James Dutton and those two were kind of our operators
while we were doing the space walks outside and so they were helping us move equipment and put

things into position or pick up things that we were working with that are too big for us to

move so for example we replaced an ammonia tank. This ammonia tank weighs 2000 pounds on Earth and

so it can't just be moved even though in space things float, you still have to manipulate that

mass which that means you still have to like be able to speed it up and slow it down and it's just

so much bigger than us as a person that it can damage the spacecraft if we couldn't slow it down

so we used the robotic arm to help us with that. I like to kind of think of it as like a crane.

(Jessica) That makes so much more sense when you think of it as a crane too I feel like

something just clicked for me because I always think - well what can it really

pick up if it needs to pick up tiny things? But having humans help it out and using more than

just one tool would definitely help with that.

(Dottie) Yes exactly it has a nice end effector

that works with multiple different types of tools and tools can be plugged into it as well and so

yes it can carry humans, it can carry equipment, it can even move modules so it's pretty awesome.
(Jessica) That's pretty cool. Would you say that that's your favourite science related thing that you've ever done? Helping out with those space walks? Or do you have something else that you would say is your favourite thing?

(Dottie) I would definitely say that that's my favourite thing overall but if I think back down here on Earth there's two things that really stick out back on our spaceship. One was I had the opportunity to live underwater, this again was with NASA and it was at the Aquarius Reef habitat off of the State of Florida and again we were using water to help us think through exploring our solar system. So we lived underwater in this habitat and we simulated spacewalks every day as if we were working at an asteroid. So I really loved this project because as a geologist it made me think about how would we sample an asteroid? What information would we want to be getting communicated back to the scientists and engineers back on Earth and what parts of the asteroid would be important for us to collect and how would we do it? So I really love doing that because it brought back in my geology and then what kicked this all off, why I became a geologist is when I was in undergraduate school my
very first year in college I actually thought I would be studying only math because my mom had been a math major and a math teacher so I thought oh I'll be like my mom and maybe I'll teach math but I took an intro to geology class and that's when I fell in love with it and so I had an opportunity to do an internship outside of our National Park Yellowstone, and that summer just was amazing. I was outdoors every day thinking about how glaciers how specifically an ice sheet had once kind of you know flowed across this landscape and changed it and what evidence we we could now map of where that ice had been and that summer is what made me become a geologist which then allowed me to be able to apply to become an astronaut so it was a really critical summer. (Jessica) That's so cool. Yeah I was just going to say how did you end up going from that into being an astronaut? (Dottie) Yeah well that's an interesting story too because ever since I was um probably a third grader I wanted to fly in space but I also wanted to do a lot of other things like - like I said my mom was a teacher, so was my dad! Um although he also ended up working at Hewlett-Packard as an engineer later but I like loved science, math, technology and engineering are the STEM
fields. So when I was in third grade uh Sally Ride became the first American woman to fly in space and that's about when you're like starting to even just think about like what's possible for me when I'm growing up. So I now believed it was possible for me to become an astronaut and so I was able to attend space camp when I was in ninth grade and I just like really loved learning as much as I could about space whether it was from deep space and thinking about other galaxies or stars, the birth of stars or just our own solar system and thinking about like all these incredible planets and how they're so different or seeing humans fly in Space you know there's I - all of that just was super interesting to me. So um I studied geology, that seemed like a way that I could explore not only our Earth but like think about the solid planets in our solar system and then I uh was gonna take like a gap and serve in the Peace Corps. It ended up that I didn't get to go on that Peace Corps Mission because the country I was assigned to pulled away from Russia. But that sent me back to school to become a teacher and in becoming a teacher I of course taught science and I taught astronomy and when I was teaching an astronomy class one of my
students asked, "how do you go to the bathroom in space?". And I wasn't sure so I looked up you

I also found out how they were hiring teachers as part of the astronaut class of 2004. So they were

hiring teachers I was like, oh they need science teachers! I can now apply. So it just brought

everything back together in a way that I wasn't expecting but that's how I became an astronaut

from being a geologist and a science teacher.

That's so funny that you found the

link from just having to look something up for your students. That is one of the most popular

questions at SuperNova's space camps that we run and I'm sure it's a question that you've

gotten many many times.

(Dottie) Definitely

(Jessica) So we've talked a lot about all the things that you've done and all the different

jobs that you've had but you mentioned to me earlier that you also keep up a lot with

what's happening right now in space and the space industry and you mentioned the Artemis Mission

because you thought it was pretty cool. What is the Artemis Mission and why is it special?
Yeah so Artemis is the mission that is going to return us back to the lunar surface well back to the moon but also it's paving the way for us to be able to go on to Mars. And it's so cool because in this time frame you know we have been to the moon but it was 12 men that were there before I was even born and we haven't been back since then! And so this time we'll be sending women and people of colour and it's going to be an international endeavour so we have over 20 countries that are involved in this. So again to me it's thinking about how do we learn more about our solar system, and as a geologist it's thinking about how do we continue to understand our own orbiting Moon and then Mars is so fascinating and I - I've always been fascinated by it um probably because a lot of the information that was coming back through early spacecraft and probes was about Mars when I was like you know growing up and it continues to be, obviously it's a plan that we can go visit potentially with humans, um but it's going to be hard. And so we really need like everyone and so that's why I'm excited about Artemis because it's - it's going to involve
multiple countries, astronauts that reflect all people across the Earth, and it's going to be different too. I mean we uh are going to try to understand like where there's water, how we can um use the water to sustain life and also prepare for vehicles being able to go further into space, so there's just so much good engineering and science that can be learned from it as well as any time that we're working with our colleagues across the globe, um just the relationships there and just building stronger ties too. (Jessica) I love that! So it really shows how Space is really all about cooperation and international cooperation as well as teamwork within your job. It seems like that's a huge part of it and I love that about it. I have one kind of unrelated question for you. I read that you were or still are a member of an all-astronaut band and I need to know more. What is it and how did it end up happening? (Dottie) Yeah well it's a funny story so um we always joke those of us that have been in the band um it's called Max Q which is like a space term it's the maximum dynamic pressure and it's experienced when a spacecraft is launching through the atmosphere and it's going so fast but it needs to in the case like when we're in the shuttle it needs to throttle back because that air pressure,
the atmosphere, could actually like tear parts of the vehicle apart and so it is a technical term

but the fun part is that it's a band of astronauts or people that work with us as astronauts because

we've had our medical doctors they - our um space doctors have been part of the band and we joke

that it's not our day job. But um it's just a fun way to connect and I was actually asked by Chris

Hadfield to join uh we were on a backpacking trip for the National Outdoor Leadership School. So we

send astronauts on these backpacking trips to kind of think about how you live in an

environment that's not comfortable where you don't have everything that you need immediately at hand

and you can have discussions with people that have already flown in space. So it takes us away from

our office, away from our families, puts us in you know like the mountains or sometimes people go to

the desert or do kayak trips and you have to think through these things so I was on this trip with

Chris Hadfield and a few other astronauts that had already flown in space before I had flown in

space. And so it was a chance to learn from them and we just happened to climb this mountain and


um I don't know we were singing some song and he was like, "Wait, you sing!

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You should be in the band!" and I thought he was just joking I'm like "Oh, you know..." but I had

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always sung in choir uh when I was growing up so I was like oh okay I'll you know I'll come by one

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night when you guys are playing and I'll try. And uh I did and I had a lot of fun, I really liked

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the members. The members rotate and um sometimes there's a hiatus. I'm not sure if the band is

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active right now or not but yeah so I'm not in it anymore but when I was down in Houston it was like

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whoever could play these different instruments right? We needed some guitars, we needed drums

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uh we had singers, pianists, so we we took all folks that were willing to um put themselves out there in a different way I guess.

(Jessica) I - I love that! I love that

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it was Chris Hadfield on a backpacking trip that just was like "yeah join the band".

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(Dottie) *laughing* Yeah

(Jessica) If anybody listening

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doesn't know who Chris Hadfield is because he was a very famous Canadian astronaut when I was a kid

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I feel because he was very well known for playing the guitar on the International Space Station and recording music videos and all sorts of things as well as being one of our Canadian astronauts.

Well thank you so much for joining me today Dottie! It was a pleasure, I know you had to wake up quite early for this because you're currently on the other side - on the other coast.

(Dottie) Oh it's been really nice and I - again I love what you're doing with it so thank you for asking me! And have a great rest of your day too!

(Jessica) Thank you so much Dottie and as always a big big thank you to everybody listening. If you'd like to hear more from Dottie and keep up to date with space news you can follow her on Twitter @astrodot. If you'd like some more science fun you can also follow us on Twitter or Instagram @scientistsdopod or you can head to bit.ly/whatdoscientistsdo to check out all of our past episodes.

Do you have a question that you'd like answered by one of our experts? Send us an email or a voice recording at whatdoscientistsdo@superstaff.ca and we might answer your question on the show.

Thank you so much for listening and I'll see you next episode. Bye for now!

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