

Ask A Biologist Vol 097 (Guest: Arvind Varsani)

Virus Quest

One of the benefits of being a biologist can be travel. There are some researchers who travel the globe as part of their work. **Arvind Varsani** is a molecular virologist who studies viruses found around the world. Dr. Biology was able to catch Arvind between trips to talk about his work, including his research in the Antarctic and some penguins that are missing their feathers. A mystery that might be close to being solved.

Transcript

Dr. Biology: This is Ask A Biologist, a program about the living world and I'm Dr. Biology.

Dr. Biology: Let me ask you, do you like to travel? Maybe you are you the type of person who is always planning the next trip - maybe to some exotic place? Perhaps you're the type of person who considers adventure and exploring to be part of the very nature. Well just maybe, you might be a future biologist or say a closet biologist ready take on your next career.

Dr. Biology: While we imagine biologists in white lab coats standing at some bench in the laboratory, this is not always the life of someone who studies the living world. Quite a lot of them break out of the laboratory and travel to places that are so exotic they make, well, most of our trips seem a bit dull.

Dr. Biology: My guest on today's show is virologist Arvind Varsani. He is a world traveler. He's also a professor in the School of Life Sciences and a researcher in the Biodesign Center for Fundamental and Applied Microbiomics as well as the Center for Mechanisms of Evolution. His work with viruses has taken him around the world, including his primary research area, which is a far away as the Antarctic. This is where he's studying the plants and animals of the Ross Sea.

Dr. Biology: Arvind, I really want to thank you for joining me on Ask A Biologist.

Arvind: You're welcome. Thank you for bringing me in.

Dr. Biology: You are a virologist and to be a bit more precise, you are in molecular virologist. Let's talk a little bit about what molecular virologists do.

Arvind: Molecular virologist. The term molecular is actually quite a fancy title. It's nothing more than just a virologist who studies the RNA and DNA of viruses. Basically, we study their genomes and those genomes can allow us to actually identify viral traits in these viruses and some sort of evolution about them.

Dr. Biology: Ah, you're talking about genomes. We have a genome ourselves and they're basically our instruction set for how to make us and how to, you know, how to work.

- Arvind: That is correct. And if you think about the human genome itself, we've got lots of viral like genome elements in our genome.
- Dr. Biology: Ah, you know, it's interesting because lately I've had a string of scientists who work in the world of microbes, right? And this is filled with bacteria and viruses. And what's surfacing from those conversations is that we've missed or not discovered very much about these tiny organisms. In fact, we usually only talk about bacteria and viruses when they're doing bad things to plants and animals. But this isn't really the entire story.
- Arvind: No, that is correct. It isn't the entire story. And I think we as a society have looked at these elements from a completely different angle. And the angle we've primary looked at is from the angle that they cause disease. Because you know, disease is a problem in things that we dearly care about. And to be honest, if we think about viruses and the global planet, we start realizing they're probably the most abundant entity on the planet. And if there is so abundant, they shouldn't be all causing disease, right? And at some point some of them do. But what about the rest? The rest probably are extremely beneficial in our ecosystems. In the marine ecosystems, they're modulating population level of different marine organisms.
- Dr. Biology: Oh, controlling how many there are.
- Arvind: That is correct. And so to try and keep a balance in the system, in other systems, there are known to be actually beneficial because the either allow certain bacteria, for example, to survive an attack from another virus. So the viruses are actually friends of some of the bacteria and prevent them from getting infected by someone else. Isn't that kind of a cool concept?
- Dr. Biology: Right.
- Arvind: So there are all these elements of viruses or bacteria that have integrated into the chromosomes of these larger organisms and they have caught evolved with that. And in some cases those genetic elements are really beneficial to the survival of that host. Without that, some of the hosts wouldn't actually exist to be honest.
- Dr. Biology: Right? Like our gut biome, without our gut biome, we're not here.
- Arvind: Exactly. If you think about the gut biome, if we were to distill it down, it's 90% them 10% us.
- Dr. Biology: [Laughter] Well, and in this case it's important that we have that 90%. So let's talk a little bit about your research. And the reason I say that is at the beginning of the show we talk about, you know, exotic travels and you're really one of these biologists that's really out there. And when I say out there, your primary research study site, is in Antarctica. It's the Ross Sea. What do you need to do to get to that remote location?
- Arvind: I think you need to know the right people to get to the remote location. That is one important thing. Or at least you need to encounter them at some point so that you

can convince them that your research is important enough so they can take you out there,

Dr. Biology: But you're not just hopping on a plane and the next day or down at the Ross Sea.

Arvind: No, not at all. So it is actually quite a long journey and there are a couple of ways to get out there. One of them is on a boat and that is a very long journey and that you'd have to sail out from New Zealand or Australia to get out to the Ross Sea. But the slightly easier one in our modern system is airplanes. And so for example, from the United States, I would have to fly to New Zealand to Christchurch and in Christchurch, which is on the South Island of New Zealand, the United States Antarctic program have a little base there. And from there we are flown down by the New York guard. So they actually fly the Lockheed Martin LC-130 and they're only 10 planes in the world that have skis on them. And that's why they're called LCs not just to C-130 and so these then land on an ice runway on the McMurdo Shelf and it's pretty amazing that there is a runway that is just made out of ice and they're tractors that groom it everyday. So the logistics are fascinating. However, there are no lights there, so it's all line of sight landing. So that means if the visibility's really bad, then something called the boomerang happens. So you could be in the air from Christchurch on these planes and at point of no return, which is roughly about four hours into the flight. If the weather is really bad, you boomeranged back to Christchurch. And for example, the last season I was there, I was stuck in Christchurch for more than a week because we boomeranged three times.

Dr. Biology: Whoa. All right. I'm not booking my flight just yet. So you have the boomerang to get there - if you're lucky, you don't have to boomerang, I should say. So why studies such a remote location?

Arvind: These remote locations are amazing from the perspective that they're probably the least altered from human activities and these human activities could be anything from fisheries to mining to anything else along those lines. And so the ecosystems are actually normally existing with very little external influence and for us to actually figure out what are the consequences. For example, the big overarching theme at the moment is climate change and are these animals being impacted by climate change? The best place to study it are going to be these kinds of areas where there are remote and extreme conditions which are actually facing some of the most changes,

Dr. Biology: Right. Typically when you set up an experiment, you want to make sure, that if you can, you want only one variable to change. If you have multiple variables, multiple things changing, it's hard to tell which one is having the most impact. So on this remote location you've kind of minimized the different things that humans have caused or other outside problems that could have occurred. And now we're just focusing on the climate that is changing.

Arvind: That is correct, yes.

Dr. Biology: And when you're there, what is that ecosystem like?

Arvind: The ecosystem is unique and there are different colors. The color green is very rare other than little algae and moss that you see on some of the rocks. But the main colors that you see there is black, white, gray and blue. The blue, the ocean, everything else has just the color of rock, ice and the sky.

Dr. Biology: Hmm. Interesting. So, uh, one of the animals that you've studied quite a bit, our penguins. And if I think about penguins, I think black and white,

Arvind: That is correct. And so the black and white is unique because in one way the white patch at the front is important because for predators they can't see it from the bottom because it's looking up towards the sky where it's from the top. They blend in really well as well.

Dr. Biology: I love the penguin and I love them as a bird because one of the questions we get on Ask A Biologist is can penguins fly? And uh, our answer is probably a little bit, you know, playful in the sense because we say yes, they can fly. The only difference is they don't fly in the air, they fly in water. And quite frankly, uh, they use the same motions that a typical bird in flight does and they can do it up to 20 miles an hour.

Arvind: And it is amazing how far they can go. So we've done some work on some of the animals where we've actually attached loggers to them to see how far they go to get food for the young ones during the breeding season. And in a three day journey they would have traveled roughly about 250 kilometers. And that equates to roughly about, I would say 120 miles or more or less, something like that. And that is amazing in a three day journey for a small bird that is just over a foot and a half tall. Don't you think that's amazing?

Dr. Biology: Absolutely. Not only that, uh, there's a reason why they have to do this, right?

Arvind: Yes. They have to, you know, in some cases forage far out, because during the breeding season, some of the currents actually takes some of the food away with nutrient fluxes change the water system. But also if there are too many birds, there is competition, right? So the food resources get limited and so you have to go further and further to look for food.

Dr. Biology: Now let's get back to your main passion and that's viruses. So what do penguins and viruses - what's the connection?

Arvind: The connection is unique in the sense that about eight years ago David Ainley, he is a rock star of penguin biology, came to visit me while I was based in Christchurch in New Zealand and he came to me and said, listen, some of the birds this season, they're chicks did not have feathers. They were naked. And he thought I would be able to figure out why they did not have feathers because I studied parrots that succumb to feather loss once they have this one particular virus in them. And so through that journey and his team, I've ended up in the Antarctic studying viruses and penguins and we knew very little about viruses and penguins. And now we're beginning to unravel exactly what is happening in these animals and we're still to actually figure out what was causing the feather loss. I think we're very close but it's to be proven.

Dr. Biology: Okay, so you're not going to give us a sneak peek?

Arvind: I can give you a sneak peek. And the last season we saw a naked penguin. Unfortunately we weren't able to sample it. When I say naked penguins. So imagine a penguin without its fur coat. Would you want to survive in the Antarctic without a fur coat? I wouldn't. And there was this poor little chick. The mother was actually brooding two chicks and one was seemingly healthy. The other one did not have any feathers on its back. The only feathers it had were pretty much on its feet. So it's like was wearing a pair of socks and a little bit of feathers on its head, so to, we're wearing a beanie and that was about it and it was struggling to thermoregulate. We could see that. And we monitored it for three days, but the third day we went to have a look at it. It wasn't there anymore and its sibling was there. So either it died overnight or at some point, and it was actually eaten by some of the scavengers in that area. So we sampled some of the nest material, we scraped the nest material, and in there I've discovered a new virus that is most closely related to the viruses that we've seen in parrots that caused feather loss.

Dr. Biology: Okay, so it is a virus. Yeah,

Arvind: So we think it is a virus. We do know that these viruses do this and other birds don't, just parrots. And so it is highly likely. So now the question comes in is how frequently are these episodes? Because we're working in a rookery, a colony of penguins that is roughly 300,000 breeding pairs. We can't monitor each and every breeding pair. So we're just looking at a subset. So how frequently does this occur in nature? And this is one colony, there are lots and lots more other colonies. So this is one of the things that we want to embark on and actually try figure out.

Dr. Biology: When you're doing these travels, do you do the lab work while you're in the field or do you bring the samples back?

Arvind: So we bring all the samples back primarily because it's easier to do the lab work here. However, the United States Antarctic program has an excellent laboratory already set up at McMurdo base. It's called a Crary Lab. And there are some instruments there. You can do some crude lab work there, but it's not a solid full molecular lab.

Dr. Biology: And this also, I'll let you continue doing a lot of these studies year round. So even if you're not there, people can send you samples.

Arvind: That is correct. Yeah. So this, this means that primarily most of the work in the Antarctic is done in the Austral summer. So it's pretty much the flip side of the summer up here in the northern hemisphere. And, and so that is usually between November and February to March. And this is the time when most of the animals come to breed other than the emperor penguins, which actually breed in the winter in the Antarctic.

Dr. Biology: Oh yes. How many times have we seen the March of the Penguins? That's quite an amazing story in itself.

Arvind: So if anyone of you is interested in figuring out what [the] Antarctic looks like from a penguin perspective, Walt Disney have just released a movie called Penguins and the movie was shot primarily at Cape Crozier where we work in the rookery where we work. And you can go and see Steve, the penguin who has come out to breed.

Dr. Biology: Hey, if you had to be a penguin, there are a lot of different penguins out there. What kind of a penguin would you be?

Arvind: I would probably be an Adelie. Penguin, I think an Adelie Penguin is like the Jack Russell of dogs. It is very, very curious. It has got a lot of energy and it's just comical.

Dr. Biology: [Laughter] Oh, I believe it. I believe it. You know, I was amazed that when I went to the Galapagos, the Galapagos Penguins as well. I got to swim with them. I say I swam with them, but basically they were like little torpedo's going by awfully fast.

Arvind: But that's interesting because did you know that the Galapagos penguins are the only penguin north of the equator? All the penguins that are on the planet are old south of the equator. So whenever someone asks, you are the polar bears in the Antarctic? Simple answer is no. They're in the Arctic in the north.

Dr. Biology: Now you are a global traveler. And as I mentioned at the beginning of the show, a lot of people think of scientists sitting in a laboratory with their white lab coat at some bench researching their particular topic all by themselves. But in fact science is very collaborative. Can you talk about some of your collaborations?

Arvind: Yeah, I think the way I look at science is from a different set of lenses. And that is that to excel in science, to move forward in science. You need to team up and you work quickly to get the answer out there rather than to sit on the answer and get the glory for it. So I like collaborating because it enables me to learn new things. So I work with ecologist. I work with biochemists, geologists, um, psychologists, pretty much everyone out there because I'm actually interested in science. I'm actually a naturalist even though I am a molecular virologist with that fancy molecular term. Um, I'm actually, deep inside, I'm actually a naturalist. I'm interested in everything science and for me to actually exercise that passion, one of the ways I can do it is by running projects that are very collaborative and that are interdisciplinary cross bridges that we never would imagine would cross and actually gives us a lot of really, really good insight into the functioning of ecosystems.

Dr. Biology: So globally, I was thinking of describing you as a virus hunter, but uh, I saw that you weren't exactly excited about virus hunter. So let's come up with another term.

Arvind: Yeah. I'm not a big fan of the term virus hunter because it kind of conjures this idea of Indiana Jones in a hat and with a couple of guns and knives going out there hunting for these renegade viruses. I actually think about viruses from a different perspective because as I said earlier, I don't think we've seen them primarily from a disease causing agent, but I think there are beneficial entities. I would term myself more a virus ecologist or a virologists with the molecular tinge to it because I'm interested just in their functioning in the ecosystems.

Dr. Biology: Oh, okay. So we're going to say you're on a virus quest.

Arvind: That is actually a very, um, what is the word for it? A nuance of looking at it. Yes. I like the word quest.

Dr. Biology: [Laughter] So let's talk about some of the places in the world that you're doing, some of the collaborations and where your quest is taking you.

Arvind: So we're working across the globe. We've got projects in Brazil, we're working with some of the agricultural units in Brazil, looking at plant viruses and dynamics in those ecosystems. And some of the ecosystems are changing dramatically in Brazil with deforestation and increasing agricultural systems. We've worked quite a lot in the Pacific islands off Tanga. I'm looking at some diseases in plants and animals. We've done a bit of work in New Zealand and Australia. In Africa. We've got quite a lot going on. At the moment we're looking at chemicals in South Africa and these animals are like, there are small cats, wild cats that are coming into urban areas but are interacting with urban cats. And so there are disease dynamics. The die offs are high in these animals. So we're trying to help a team in Cape Town kind of answer a few questions. And this is the same scenario, which we're kind of investigating out in California where we've got the bobcats and mountain lions interacting with domestic animals. So there's a bigger project. So we've kind of embarked on this quest. If may we use the word here, uh, looking at our quest of virology within a whole lot of feline species across the globe.

Dr. Biology: Okay. So on your quest, are there any viruses that you've come across that have really surprised you?

Arvind: Yes and no. The yes is, every virus that I find in my quest always surprises me and no I should know better because at the end of the day, we've only looked at these things from one lens. So as soon as I switch that lens out and put on my other lenses, I realized that we have no concept of 99% of the viruses that exist on this planet. And that's why I say I'm not surprised.

Dr. Biology: So tell me, how do volcanoes and boiling mud come into the picture for viruses

Arvind: Volcanoes and boiling mud, the genesis of life in some cases. Well, in these kinds of scenarios, there are a couple of things that will happen. Number one, you can purge your system, you can kill everything that's there, and there are organisms that will survive that. And the way I look at it, wherever there is an organism, there is likely a virus that infects it and uses it as a host. For example, if you go to Yellowstone national park, there is hot springs, some of the springs are sitting at 80 degrees centigrade and there are bacteria in there called *Sulfolobus* bacteria that grow in that environment. But those bacteria are amazing because they are also growing in a very acidic environment. It's like a Ph of around 3 and there are viruses that infect that bacteria. And so that to me is fascinating because it starts telling us that life does exist in extreme conditions and there are always viruses that will infect those extreme microorganisms.

Dr. Biology: Ah, got it and they actually have names form them called extremophiles.

Arvind: Exactly.

Dr. Biology: Tell me, I've had, oh, at least three or four people on the show that spend their time around viruses and we've had this question come in for more than 20 years to Ask A Biologist. Are viruses alive?

Arvind: This is where I smile and look up in the air and go, how should I answer this question? And in a way I would like to give them the title yesterday are alive primarily because they're able to manipulate systems, right? Look at the rabies virus that actually many plates, the brain of the animal it infects. It changes the behavior of the dog. It makes it salivate, and through the saliva and the biting aggressive nature of the dog, the virus moves to a new host. So in a way it's got character and it's got a character that manipulates another animal. So are they alive? I think that would be a philosophical question and some people would say, yes, they are alive.

Arvind: Others would say, no, they're not alive because they need a host to replicated. I think I am one of those individuals who sits on the fence and admires both parts of the debate.

Dr. Biology: So you're kind of playing it safe on that one. One of the things that - on this show is that I never let a scientist get out of here here without asking three questions. So are you ready?

Arvind: Yes, I am.

Dr. Biology: All right. When did you first know you wanted to be a scientist?

Arvind: I think I'd got to realize that I wanted to be a scientists probably in high school and it was a biology textbook that I was completely engrossed in. And that was the heart that I was looking at. And there was something about the heart that just, I don't know, I just loved looking at that image of the heart and going, wow, this is all the chambers and this is what it does. Isn't it fascinating.

Dr. Biology: So you went from that and now you're all the way into viruses?

Arvind: I guess. So you know, life is a weird journey and the journey is never straight forward. And the life we live, we've got peer pressure, family pressure, a variety of different things. And our families, at times, they've already decided a career path for us. But then there are renegade individuals like myself who think I don't think I want to do that. And you end up doing something totally different and you realize that you're doing something totally different because you love it and it's not for the money. So you're turning your hobby into a job. And if you can do that, I think you fulfilled living because you're happy everyday you're doing what you really want to do.

Dr. Biology: Now that you're happy. I'm sorry to say I'm going to take it all away. I'm going to take away all the researching you're doing. I know that you are at a university and almost all of us love to teach, so I'm going take away teaching. And since I know you're a world traveler, I'm going to take away the fact that you can't be a

professional traveler. I'm not gonna let you do that. If I take all those things away from you, what would you be or what would you do?

Arvind: If you took all of that away from me. I would probably be content living in the mountains, climbing, hiking, and just subsist. I guess I could easily be a farmer. There's part of me that thinks that could be a small subsistence farmer, living out in the hills, have a small paddock where I can tend to a few sheep and actually live an active life. I think that is something that's important for me.

Dr. Biology: You can have a daily life of observing as well, just what the scientists does.

Arvind: Exactly.

Dr. Biology: Okay. We've taken it all away from you. You're off and, uh, we're letting you on your, your little patch of land. But let's get back to the idea of being a scientist. What advice would you have for a young scientist or perhaps someone who's thinking about a career change into the sciences?

Arvind: For anyone who's thinking about a career change into science or even thinking about whether to go into sciences and not, if you're curious, do it.

Dr. Biology: If you're curious, do it. It kind of gets us back to when we started about the idea of adventure and exploring, you know, if you really love doing that, just do it right.

Arvind: I would like to add that one thing is important about science and that is it actually teaches you how to think critically. And if you can think critically, I think you can undertake any task in life. And also move between one job and another, or even move from one career to another.

Dr. Biology: Um, I do have a followup question and because I know that, uh, you do a lot of traveling in your current career, but I believe you've had some really crazy travels as a kid.

Arvind: Yeah. I guess I did, I was fortunate that I lived in Kenya. I grew up in Kenya and my backyard, well not literally where I stayed, but um, the backyard in general was full of animals, wild animals. And so on weekends I used to get away into the bush. All I had was a map and a compass and my rucksack sleeping bag and outdoors. And I'd plot a route. I'd go from one hill or a peak to another and then in between find schools, local schools and go speak to the headmaster and try sleep in on the floor of the schools. And so that was my adventure when I started off young. And that's when I realized that I liked the outdoors. And perhaps that's what instilled this whole concept of field work and how I tried to blend in my interest in science with my hobby, which was being outdoors and observing things in nature and bringing those boards together to build a career out of it.

Dr. Biology: Ah, the ability to retool and educate yourself as you go along your - basically your life's journey.

Arvind: Yeah, and I look at our undergraduate systems as undergraduate teaches you how

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to think and once you can think, you can actually re-skill yourself in different areas if you want.

Dr. Biology: I couldn't agree more. Excellent. Well Arvind, I want to thank you for joining me on ask about just thank you very much for having me on.

Dr. Biology: You've been listening to Ask A Biologist and my guest has been Arvind Varsani a professor in the School of Life Sciences and a researcher and the Biodesign Center for Fundamental and Applied Microbiomics as well as the Center for Mechanisms of Evolution. If you want to, you can read more about him in our story Hunting for Hidden Viruses on the Ask A Biologist website. Just search for "biologist hunting for hidden viruses" and you'll get the link to the story. The Ask A Biologist podcast is produced on the campus of Arizona State University and is recorded in the Grassroots Studio, housed in the School of Life Sciences, which is an academic unit of The College of Liberal Arts and Sciences. And remember, even though our program is not broadcast live, you can still send us your questions about biology using our companion website, the address is askabiologist.asu.edu, or you can just Google the words, Ask A Biologist. I'm Dr. Biology.