Misunderstanding Evolution: From Chimpan-A to Chimpan-Z with Dr. Greg Bole

Nerdin' About Podcast Transcript, Season 2 Episode 7

Michael
Hey everyone, welcome to Nerdin' About, I'm Space Michael. With me as always is someone who I'm concerned about, because of what's happening out in the ocean, it's been pretty windy here these days, I saw some kite surfers the other day, and that is Dr. Kaylee Byers. How's it going, Kaylee?

Kaylee
Oh, hello, I'm fine. Thank you, you should be concerned for me, because I've actually learned that I lack something called common sense. So, it has been quite windy here lately. I think last week it was like 15 or 20 knots, and I did see that in the weather forecast, and I still decided to go swimming. I am now about 20% ocean water.

Michael
I saw these kite surfers, and they were getting some massive air. But my big question is: Where do these kite surfers come from? It's a massive thing. Do they just have it in their storage for one day out of the year, and then pull it out?

Kaylee
Oh, they descend from the sky. When the winds come, that's when you see them, and then they go back away. That's the origins of kite surfers.

Michael
Amazing.

Kaylee
Actually, you know what's funny is today we're going to be talking a little bit about origins and evolution. So today, we are delighted to introduce you to Dr. Greg Bole, Dr. Bole is an Associate Professor of Teaching in the departments of Zoology and Botany at the University of British Columbia. In addition to teaching, he has been very active in local science communication initiatives like Science Slam, and Nerd Nite, where he occasionally gives talks dressed up as Darwin. Hi, Greg, how are you?

Greg
Hi, it's great to be with both of you. I'm doing okay,

Kaylee
It's so lovely to see you. We've collaborated quite a bit through Nerd Nite in the past, and now we get to collaborate on this podcast, which is a really fun new medium for us.

Greg
Absolutely. I love everything you guys do.

Michael
Aww.

Kaylee
We love you too! So, to start out, we're going to be talking a little bit about evolutionary biology today, what it is, some misconceptions about it. But before we dive into all of that, can you tell us a little bit about how you became interested in evolutionary biology? Because I imagine you have to be pretty interested in it to do a few talks dressed up as Darwin.

Greg
Let alone a seven-year PhD. But yeah, it really has sort of two stages, I would say. What got me interested and continued my interest in biology, and then how did I focus specifically on evolutionary biology. So, my love of biology goes back to as far as I can remember, like, in first grade, the teacher said, "Okay, now everybody pose like the job you want to have in the future when you're an adult, and then I'll try and guess what they are. So okay, Billy wants to be a fireman, and Sally wants to be a police person, and I have no idea what Greg's trying to be." I was a pet store owner. I was like dipping fish out of an imaginary aquarium, and my teacher couldn't figure that out, I couldn't believe it. So, I have loved animals for as long as I can remember, that love was really fueled by lots of time outdoors, lots of time visiting nature centers, and places where they rescued animals, and so I was just animal crazy. That was even through grade school and getting into middle school, and by the time I got to high school my love of biology was completely solidified. I knew that's what I wanted to go on and do at university. So, I specifically looked for a good biology program in university. I grew up in the States, and I ended up at the College of William and Mary, in Virginia, which has a fantastic biology program. That's where I first started hearing a bit about evolutionary biology, and the coolest classes I took in biology and the coolest lectures, and professors that I had, according to me, were the ones talking about evolution. It blew my mind, it made everything else makes sense to me, and I just developed such passion for it that I knew that was going to be my future.

Kaylee
Very cool. So, to lay the basis for today. Can you tell us what evolution is exactly?

Greg
Sure, absolutely. We're going to be looking at some major misconceptions about evolution, some very common ones that a lot of people hold, maybe a lot of our listeners still hold them, even though they think they've got a good handle on evolution. But to get there, we first need to really talk about what it is, and then we're going to debunk each of these misconceptions. So, evolution really comes down to change, but it's a little more detailed than that in how we study it in evolutionary biology in the field of science. We are interested in the change of traits at the level of a population over multiple generations. So, you really need all of those components to say that a population, or a species, or group of animals, or plants, or any other living organism is evolving.

Kaylee
So, when I'm talking about a population, what might a population be?

Greg
Just a bunch of individuals of a given species that live in a certain place. So, if we have wolves on the west coast of Canada, and wolves on the east coast of Canada, they might be evolving, but they might be evolving in different ways if they're not in contact with each other.

Kaylee
And if we think about traits, I mean, traits can be anything? If I'm a wolf, fur colour? Snout length? Howl capacity? (laughs)

Greg
Howl capacity I didn't know that's one that you would have to worry about in such detail. But yes, howl capacity would definitely act as a trait. So, the kind of traits that are easiest to track, and easiest for us to think of, are the physical ones that we can see and measure, right? How long are the legs? How big is the body? But then there are other traits that are a little harder for us to see with our eyes, but we can see them other ways, looking at DNA, looking at microscopes. So, it might be the physiology of an organism, how it actually runs its internal processes that might evolve in different ways. What it can digest, for example, might evolve over time. So those are definitely traits that we can still study as evolving traits, but they're not ones that are quite so obvious.

Michael
So, Greg, if we kind of take a step back, and look at the big picture here, you know, evolution is sort of the study of everything, how everything got here, how we got here, how the plants got here. Of course, I was taught that it doesn't even exist, because I grew up Baptist Christian.

Kaylee
Oh no!

Greg
Poor Michael. (laughs)

Michael
So, this is the study of all of these things, and yet, there is a lot of misconceptions about what it is. So maybe you could walk us through some of the big misconceptions that you as an educator have come across in your time?

Greg
Yeah, absolutely. There are sometimes ones that can even create controversy, even whether they should or should not create controversy has nothing to do with the thought. It's just the people's misconception leads them into thinking it creates a controversy. So, I taught a number of different classes at UBC, but a lot of the first-year biology classes we would teach evolution, and genetics and ecology. So, I'd run into a lot of the misconceptions that students had coming right into university. So, a big one that is kind of foundational, because you hear people trying to argue against evolution, they want a quick little gotcha. They say like, "Oh, yeah, evolution is only a theory." I don't know if you've ever heard that one before? But we have to be careful here, because even though I want to teach you about evolution, I'm repeating the misconception. So, the danger is you remember the misconception, and not the explanation. So, let's set that one aside in bright blue highlight and say “evolution is just a theory” is a wrong way of thinking about it. This boils down to what is a theory in everyday language, versus what is a theory in the language of science. So, in everyday language, it is often just a guess, a speculation, just a feeling that you have. You know, that can play a role in science in other ways, when you're developing hypotheses or trying to understand observations, but it's not the foundations of science. The theory in science is our best understanding of what's going on given all of the evidence that we have. So, we can think about the theory of relativity, or theories or laws of gravity, or of motion, or all those kinds of things in physics, same idea,

that's our best explanation. Can it change? Sure, if you get different evidence, get new evidence that gives you a new perspective on it, those things can change. But it's not just a guess, its hard-won information.

Kaylee
Well, and for all those budding science communicators out there, this is a really great example of how words can mean multiple things across fields, in science versus outside of science, and why it's really important to think when you're communicating about the words that you use, and how you describe them to make sure that everybody's on the same page with your meaning of it.

Greg
We should also mention that we do this all the time, right? We should mention that the we do this as scientists, we'll slip up sometimes and go, "Oh, yeah, I've got a good theory about that one. Oops, wait, I meant hypothesis."

Michael
Okay, so we've established some of our vocabulary. So, what are some of the other misconceptions of evolution?

Greg
Well, I'm going to give you two that are closely tied together. I guarantee you; you've heard the second one. In fact, I guarantee everybody listening has heard the second one: humans evolved from monkeys. So, if you go to Google, and just look up the word evolution, all the images are this monkey-to-man progression, right? That's what everybody thinks of as the meaning of evolution. That's not an entirely incorrect, but it has some deep, deep flaws built into that idea of humans evolving from modern day monkeys. So that's the misconception, and it's kind of tied into a greater misconception, which is that evolution is not a march of progress, and that's what that monkey-to-caveman-to-human makes us think. Right? It makes us think that we're going from something simple to something smarter, something smaller, to something bigger, something dumb to something more creative. In some cases, that can be true in certain evolutionary lineages, but you can also have change happening in the other direction, things can get simpler, things can lose different parts they no longer need. So, it's not any kind of progress, because there's no end goal. So, let's set aside the idea of progress for a moment, and come back to this idea that humans evolved from monkeys. By the way, I asked my students at the end of the term, what is the thing about this entire class that you have found most interesting or most useful, and about 40% of them say "that humans did not evolve from monkeys" That's the thing that out of the entire class they felt really useful, because they can go to their friends and say "no, that's wrong, and here's why it's wrong, and here's what it actually means." So that's kind of cool. So that progression, that march of progress is true in that humans had ancestors that had things more in common with some modern-day species of monkeys and apes, than they do with other things alive today. But it doesn't mean we evolved from monkeys, because those things in the past were also ancestors to modern day monkeys. Right? So, they're not a monkey, they're an ancestor to both living species of monkeys, and to Homo sapiens our own species.

Michael
So where do you think that came from? Because you mentioned that diagram, is that the root of it? Where do we get this idea that we evolved from monkeys, and that is now a popular idea in culture?

Greg
Well, Darwin did not talk about human evolution very much. In his most famous book, The Origin of Species, he had a single line in the book saying "much light will be shed upon this topic", but he only tackled it later in his career in some of his later books, including the main one that introduced the idea of sexual selection, and he talked about human evolution a lot in there. Just the fact that Darwin was saying that all living things, as far as we know, have a common ancestor and related to each other, and that they change through this process of evolution, often driven by natural selection, but not always, which is another misconception we could get to. He was introducing this idea that we are connected to all life, and I think that's a beautiful idea, but guess what, a lot of the people at the time, a lot of the religious leaders of the time, did not think this was such a great concept or idea. He was largely mocked during his lifetime about "Oh, man and monkey", and "can't make a monkey out of me", and "you're a monkey's uncle", and all these other things that came up. I agree with you, I think that diagram really solidified things and that did come out during Darwin's lifetime, but it was not from any of his books. It was from a different book of somebody interpreting what Darwin was saying.

Kaylee
Is there another big misconception that you find that you encounter frequently in your classes?

Greg
Yeah, this next one is kind of tied to this idea of evolution being a march of progress, which we said is related to this idea of monkeys evolving into humans. Just to tie a bow around that one, it's that modern day species of monkeys, and apes, and humans, all had common ancestors, and those common ancestors had traits, and features that were very different from all the things that live today. So, we can't place a chimpanzee in our past, because they're alive today, they're not our ancestor. Okay, so our third misconception is that organisms will evolve adaptations that they need, or that will help them in the future. That's not how evolution works, we'd have to get into a little bit more detail about how evolution does work to really show why that's a misconception, but it's a really, really common one. So, for example, a student might say, there's a bunch of bacteria living in somebody's kitchen, and that person sprays anti-microbial spray in their kitchen. It kills off most of the bacteria, but some of those bacteria will evolve an immunity to that, because they were sprayed. That kind of sounds convincing, right? Like that's a lot of what the process of how evolution works, but the big problem is, they didn't evolve it because they needed it, or because the spring was there. It's just that a few lucky bacteria already had immunity to that, so they were the ones that survived. Those traits have to already preexist, and that's where some randomness can come into it, right? Random mutations, random combinations of chromosomes through parents and children, all those things give us genetic variation, and genetic variation is sort of the building blocks that evolution can work upon, that selection can work upon.

Kaylee
Well, you could probably even bring that back to the current covid-19 pandemic, and the bane of our current existence, this B117 variant, right, like that variant existed, but it didn't necessarily be like, "Oh, I'm going to be the one to be a super spreader."

Greg
It's sitting there planning, right? (laughs) No, that's a much better example. Let's say, the Brazil variant, which is better at spreading, and maybe in some cases better at killing, unfortunately, as well, it's not that that virus had any way of planning to do that, because it would be useful. It

just randomly happened to have the right parts that made the virus survive better, the host survive a little bit less, but it allowed it to spread really rapidly. That's evolution in that line of microbes.

Kaylee
Yeah, and there's any number of other mutations that we don't see, because those weren't great for spreading.

Greg
And they just get wiped out.

Kaylee
See you later… m225.

Greg
So, I've got a question for you guys. I have a question for both of you that I want to sort of test your acumen of evolution now that we've got some misconceptions going on. So, I'm going to make a statement, and you're going to tell me whether you think the statement is correct or not. Maybe we'll start with Michael, whether he thinks that statement is correct or not, and then we'll move on to Kaylee, the biologist, I might remind our listeners,

Kaylee
I think I'm a chemist or a physicist, this my nightmare. (laughs)

Greg
And you're going to tell us why or why not that statement is correct or incorrect. According to Michael's best estimate. Okay, so let's set up another of these scenarios. We use these case studies or scenarios a lot when we're teaching biology. In this case, though, we've got a species that probably most of us are familiar with here in Vancouver, the bald eagle, we can see bald eagles if you go out and wander around now by the seawall at the right time of year. Or you can go to the north shore and see literally dozens or hundreds of them at the right time of year when the salmon are running. So bald eagles have pretty good wings for flying quickly, and getting their prey, right? That's something we would all probably agree with. Here's my statement, and you can tell me whether you think this is true or not, or why. So bald eagles have evolved the best wings.

Michael
I'm going to say that is incorrect, because you said the words "evolved best", which with what you had just previously said was that in evolution, it doesn't necessarily mean that you were improving something, it just means that there is a certain strain of change that has happened…

Greg
Okay, I'm going to pause you, they're definitely in the right direction fantastic job. So, Kaylee, why does it not make them best? And maybe you can draw on some other species as examples as well?

Kaylee
Yeah, I would say it doesn't make them best. They might be well adapted for their habitat and behaviors, but that other birds will benefit from having different wings. So, thinking of hummingbirds probably wouldn't do well with super broad wings.

Greg
Let's throw some eagle wings on a hummingbird and see how well it gets nectar. (laughs)

Kaylee
Exactly, or even swifts, right? Swifts have quite long, narrow wings for their flight, they need to maneuver in tight spaces quite a bit of the time, I think. So having eagle wings wouldn't really benefit them either. So best for whom?

Greg
Best for that species, given its past history, given its current environment, given the random mutations that it had available, all those things are things we need to take into account. So really, there is no best we can't use that word best. That's this same idea as this march of progress. We're trying to get to an end result. That's what that monkey-to-man is kind of suggesting that we are the best, right? We're the best species out there! Well, I have news for you. We're trashing our environment at a rate that maybe would not make us the best species on the planet.

Kaylee
Yeah, we're kind of garbage.

Greg
What about the wings of a penguin, or an ostrich? Are they the best? Well, they might be the best for them, penguins might have the best wings for swimming underwater and getting fish. So, we can't really use that word "best". Evolution is not better or worse. It's just whether it's successful and passed on or not.

Michael
Let's steer this eagle home here, Greg, and give us your next misconception of evolution.

Greg
Let's go with our last one. Evolution is entirely random. That's one of these arguments that anti-evolution people like to use. They like to say, "Oh yeah, so you're expecting me to believe that all of these complex parts of the hand or the eye were just a bunch of random mistakes that happened to come together in the right form to be able to function properly. The eye is actually a really great example of this, because it was argued for a long time that the eye is too complex to have come about through evolution or through sheer randomness. We have studied in great detail all of the different stages of eyes evolving from a simple cell on the outside of the skin of an animal or organism that detects light a little bit better, all the way up to a fully functional camera eye like we have. So, the idea there is that randomness plays a role. We talked about mutations, and we talked about how mutations can be random mistakes in copying DNA. Or if we didn't talk about it, I just said it right there. That's the random part, but the selection, the natural selection is the non-random part. It's not random which things survive, it's the eagle with the better wing for catching its fish in it's a current environment that has a better chance of surviving. So that's not random. There's only a random element to the generation of this variation.

Kaylee
What's the example that's commonly taught in high school with the moths and the industrial revolution?

Greg
Yeah, *Biston betularia*. The white and black moths.

Kaylee
I was going to say I bet you know the Latin. (laughs)

Greg
Well, my professor in university, one of the ones who I told you first inspired me, worked on that species. He didn't do the original work. That was a scientist named Kettlewell. But he did work on that species on trying to continue to figure out what's going on. Yeah, so using that as an example, moths can come in lots of different colours, from light to dark, just by its random shuffling of genes that happens through mutation that happens through the formation of chromosomes, and the combination of chromosomes, and eggs and sperm. So, you get this variation in the next generation, and if you stick all of these variants, from very dark moths to very light moths, up against a light background, like white colored tree trunk, like a birch or something, then the predators are going to be able to see the dark ones and eat them quite easily. That gene did not survive as well, and they're going to not be able to see the light coloured ones as easily, and so more of those will survive. So, you get evolution, but then the Industrial Revolution came along, soot was everywhere, it blackened these tree trunks. So now the environment has suddenly changed, tipped itself backwards, and so now it's the dark ones, they're doing a better job of surviving, and the white ones are not surviving as well, because they contrast against their background.

Michael
Should we let our nerd herd get in here and ask Dr. Greg some questions?

Kaylee
Oh, let's see what misconceptions they have.

Michael
If you want to get in on the nerd herd questions, we post them on our socials @NerdNightYVR on Instagram, Twitter and Facebook. Our first one comes in from Pramodh, "how is speciation defined in modern biology?"

Greg
Oh, cool, great question. Speciation is something that we didn't really have a whole lot of time to get into, but it's a really important and really exciting part of evolutionary biology, and it's actually one of the things that I was studying when I did my PhD research, and that is the formation of or evolution of new species that previously did not exist. So that could be one species splitting into two, it could be one species changing over time that it's so different, we give it a different name. The real critical element that I think modern evolutionary biologists have come to some agreement on, and you know they'll never agree on everything, you get 12 scientists in a room, and they'll never agree on everything, but the key to this idea of speciation, or new species forming, is the fact that these groups are taking different evolutionary trajectories. So that kind of begs the question, "Well, what do you mean by these different evolutionary trajectories?" And there's a number of different ways to measure that. You can measure it by how much physically

they change, or whether they look like each other. You can measure it with their DNA molecularly how similar are they? How similar are their DNA sequences, you can measure it with their behavior? If they're a sexually reproducing species, how often or frequently are they capable of reproducing a successful offspring together? And so, any one of those could be used as an indication of speciation, but I think you have to use as much evidence as you have available to you to really come to the best understanding of how a new species has come about.

Kaylee
We have another question here from Armin, "How did people perceive of Darwin when he was alive?"

Greg
Well, it depends on which people you're talking about. (laughs) His wife liked him very much. That's actually not just a throwaway statement, it's actually an interesting statement, because his wife was a very religious person. Emma Darwin was no shrinking violet, she came from a very well-off family, and she knew what she was doing. She did cool things like she was taught piano by Franz Liszt, which is pretty awesome. I guess, when you have the big bucks, you can do things like that. She had a strong conviction in her own religious beliefs, and some of those came into conflict with what her husband was proposing in his books. The way that she settled this was that the parts where she thinks there's enough evidence or enough convincing, then she's convinced. So, you know, she agreed with him a lot, she could follow and understand this just as easily as anybody else at the time. But she didn't think that they could be 100% be on the same page, because she had some different beliefs than he did. What was really beautiful about the relationship is they were both okay with that. They were like, I'm not going to try and change your mind, and I'm not going to bother you every day about this. I'm not going to divorce you or anything. It's okay that we can disagree on beliefs, especially if they don't require evidence. So, there were plenty of people that were close to Darwin, that were big supporters, a lot of botanists and geologists and biologists. But there were everyday people that were also fascinated by Darwin, whether they thought of him as a hero, or a genius, or a crackpot, it's tough to say, but his book was a best seller, the first printing sold out before it was even done printing. So, it was very popular at the time.

Kaylee
In pre-orders!

Greg
Maybe you can even download on your Kindle, and you get it faster that way. I don't know why they didn't think of that. (laughs) The story that I always liked is that they dropped the quality, and the price of the Origin of Species at one point, because they wanted everybody to be able to afford it, and to read it. For example, like four or five miners would get together and pool their money and buy a copy of this book, just because everybody was talking about it. It wasn't the highest quality book, but the ideas were there, and if they were open minded thinking people that could look at the evidence and try to figure out what's going on, then they would be supporters. So, I think the vast majority of people did support Darwin, and did support the book, simply based upon that he was arguing from first principles, he was writing a book that everyday people could understand. You couldn't say the same thing about Newton, and the Principa Mathematica. That's not something that everybody could understand, right? So that's the beautiful thing is he was writing in a language and you can go out, and you can get a copy of the Origin of Species, and you can follow along, sounds a bit stiff in places because it's written

in 19th century jargon. He's talking about pigeons, and dogs, and eagles, stuff that you can imagine him thinking of and seeing around in the real world. You can go "yeah, that kind of makes sense."

Greg
Our final question, Greg comes from Lisa, who asks, "When are we getting rid of this useless pinky toe?"

Kaylee
Everybody wants to know.

Greg
Well, Lisa, I do have a set of very sharp pruning shears. So, if you wanted to drop by, we could, you know, have that toe off in no time at all. I don't think that's what she meant. I think what she's referring to is this idea of vestigial traits, traits that maybe served a purpose in the past, but no longer serve any or at least the same service to the organism in their current environment and how they live. So, our ape like ancestors had not only opposable thumbs, like we do, but they had opposable big toes. So, what we would call a foot is like another hand, it could do everything that their hands could do, could grip, it could peel, so that was really useful for them and their lifestyle, less so for us. This brings up another one of these misconceptions, does something disappear simply because it's not being used? Sometimes the answer is: yes, if it's a costly thing to make, if it costs a lot for the organism to put resources or put time into growing or maintaining this thing. You're already making toes, so a little extra toe, not really much of a thing. So, unless there's some reason that it's decreasing the ability to reproduce, or their fitness, then there wouldn't be a strong reason why pinky toes would start to disappear.

Kaylee
So, you lose your toes by pruning shares. The idea that you then pass that on is very Lamarckian, the idea that you would remove them and then your children will not have them is not a thing, and still have the genetics to make those toes.

Greg
It's wrong. Yeah, you go. That's a great misconception you just debunked. Lamarck is coming back a little bit, more in fashion these days, as we learn more about molecular stuff, where there are certain genes that if they're used more often can be can be passed on more frequently, and things like that. It's kind of cool. Not everything that he said was great, but he actually believed in evolution at a time when other people didn't. So, Lamarck is okay in my book.

Michael
Well, since we brought up Lamarck, should we nerd out some more?

Kaylee
Oh my gosh, yes. Lamarck is always an excuse to nerd out some more, bring it on.

Michael
If you want to get in on the nerd outs, you can send them to us on our socials @NerdNiteYVR or you can email us vancouver@nerdnite.com. Our first one came in from Catherine, who's nerding out about the classic sci-fi show Babylon 5. Have you ever seen Babylon 5, Greg?

Greg
I've seen it in bits and pieces, not as much as I've seen Star Trek: The Next Generation.

Michael
What's your go to show been during this past pandemic?

Greg
One that's maybe a little nerdy, but a little cool at the same time. I've been really getting hooked on a show called Ink Masters. It's kind of a reality show like Survivor or something, but it's all about people judging tattoo work.

Kaylee
Yeah, I've seen them all.

Greg
So being a person that has a number of biologically themed tattoos, I really like to see what they come up with for their tattoos.

Kaylee
Yeah, some of those tattoos are fantastic. Sometimes people get done dirty.

Michael
Greg, what have you been nerding out about recently?

Greg
Okay, so I'm going to take a kind of hard left here. If you guys don't mind. We've been talking about, you know, frivolous and simple things like evolution. But I want to get serious for a bit, because there is one main thing that has been dominating my life recently, and it's the fact that I've been diagnosed with cancer, for the third time. So, this is my third kind of cancer, the first two we were able to deal with. So how we were able to deal with the first two kinds of cancer? Science, right? I think it's so cool that biology plus medicine plus chemistry means that people can live today that couldn't live five years ago, or 10, or 15 years ago. So, I was lucky enough that my first kind of lymphoma was one of the first types of cancer that had ever been treatable by a drug, so that was pretty well established, and its well under control. But three strikes and you're out, the most recent kind is probably not something that I'm going to be able to get past. So, it's similar to a pancreatic cancer, or a bile duct cancer, and it has spread, that means its stage four, not good news. So that means that I'm kind of figuring out what I'm going to do with the rest of my life, when it doesn't look like it's going to be all that long, and talking to you guys is a great way to spend it, talking about nerdy things and talking about science, and that's what I love to do. So, I'll be doing lots more of that. I want to tell you in specific about three drugs that are being used to treat my cancer and this is not a cure for the cancer, this is just to try and slow it down to try and get me as many months as I can. So, one of them is called irinotecan, and it is a plant derived compound. Already pretty cool, right? They found this compound in plants and now use it as a chemo drug. It basically operates to inhibit DNA replication, and DNA transcription. So, if you're ever curious why people have their hair fall out, sometimes when they get chemo, it's because it's basically carpet bombing every cell in your body that's dividing. So, the hair is dividing very quickly, and the cancer cells are dividing very quickly, so, it's wiping those out. Here's another one, oxaliplatin, it makes crosslinks in DNA, both between the same strands and between different strands. So, it's basically messing up

DNA replication, it's going in and effing things up. So, it's just messing with the ability for the cells to replicate, and that will slow them down. Here's my question for you. When do you think this chemotherapy drug was approved?

Kaylee
I'm going to guess 30 years ago; I don't know why. That's my guess.

Michael
I'm going to say sooner. I'll say 15.

Greg
Very, very close, Michael. It was in 2015. So, it's been less than 15 years, and in our recent past, like you go back to 2013, when I had my first cancer diagnosis, and if I had this cancer back then that would not be a tool, we'd have in our arsenal, it did not exist as a treatment for chemotherapy. So, it shows you how quickly it's moving, and how fast science is working to wipe out cancer. So yeah, a little bit of a downer, but think of all the positive, and the people that are saved by this. So, I think it's pretty cool, pretty nerdy.

Michael
Well, you know, we're going to try to get to the end of this podcast here Greg. I don't just want to move on from this monumental information that you just shared with us, of course this isn't brand new news for us. We have talked before Greg and this is really devastating for us, but we're really excited to have this time with you, and that you are on the podcast. We went for an amazing walk the other day and hopefully we can do it again, and you gave me a book. Thank you so much, Greg for giving me and forcing me to read a nonfiction book that's not solely about space. I've never read a book about evolution. So, my brain was just pulsing as I was reading this. So, when it comes to popular science books, which this one sells itself as, for me Cosmos was that book. That book was important, because as I mentioned before, it started to nudge me out of the world that I grew up in, which was religion, which everything in this book about evolution would be fiction. So here I am looking at the title of this book, which is "Life Ascending: The 10 Great Inventions of Evolution" by Nick Lane. As a kid, I would have looked at this and I would have been first off curious about it, but I would have been like, "what the hell? What's going on here?" So, I thought I'd do a little technique. As I was younger, and making this transition from being a sheltered kid to now a science communicator, I worked at Chapters, and one of my techniques that I did to devour everything, of course I couldn't read every book, but I would read the table of contents. Which I think is really good in this book, because it's the 10 great inventions, which are: 1. The Origin of Life, 2. DNA, 3. Photosynthesis, 4. The Complex Cell, 5. Sex, 6. Movement, 7. Sight, 8. Hot Blood, 9. Consciousness, 10. Death. Then I would also read the beginning of the book, and then also the end. What I thought I'd do is mirror this with the book that also told me about the beginnings of the universe, and its end, which is the Bible. Okay. So, here's how the beginning of the Bible starts. Genesis 1:1. "In the beginning, God created the heavens and the earth." That first paragraph goes on about creating humans, and then the last line is "God said, "Be fruitful", Be fruitful and multiply, fill the earth and subdue it, have dominion over the fish in the sea, the birds in the air, and every other living thing that moves on this earth."

Greg
Heavy stuff.

Michael
Okay, so here's how Life Ascending starts in the chapter, Origin of Life, which I don't know if he did this on purpose, because it seems like he's saying I'm going to tell my own version of the beginnings. Here we go, first line. "Night followed day in swift succession." That's all he says, and then skipping to the end of the paragraph, he says, "Humans could not survive here. Our eyes would not bulge and burst as they would on Mars, but our lungs could find no breath of oxygen. We'd fight for a desperate minute, and asphyxiate." Hell, yes. If I was a kid, and read this, I'd be like, "Oh, yeah, what an amazing story." Like, that's way better.

Greg
Yeah, and how did life overcome that right?

Michael
Exactly. And, it goes in depth into so many different parts of the chapters, and I won't go on because I don't want to take up time. But thank you so much, Greg, for this book. I really enjoyed it. I will definitely be reading more books about evolution.

Greg
Oh, you're very welcome. This is a book that Kaylee and myself and you have all read now. Life Ascending is a pretty cool book, and Nick Lane is really neat writer. He focuses a little more in the biochemistry side of things, but that's really important, especially to the origins of life.

Michael
Kaylee, what have you been nerding out about?

Kaylee
Well, I think I'm going to continue this thread a little bit. I've been really nerding out about science communication, but more like the science communication community lately. So, if you listen to this podcast, you know, we're really into science and science communication, but building community is also really important. I've been reflecting on how lucky we are to have such a very supportive community of people here in Vancouver, but also in Canada doing really interesting science communication work. So, Greg, you're here on the podcast today, I met Greg through Nerd Nite. We both met Greg there when Greg came to talk at Nerd Nite.

Greg
Wait, you invited me to Nerd Nite so you must have met me before then, if you invited me.

Kaylee
I knew who you were.

Greg
Okay. You had heard rumblings, heard rumors. (laughs)

Kaylee
I heard some rumblings through the grapevine about you. I mean, we probably had met, but I didn't know you very well. You gave a talk at Nerd Nite. I remember being like, this guy's really cool, I want him to be my teaching mentor. So, I went and learned how to be a better instructor from you. You're also involved in not only Nerd Nite, but in Science Slam, which is also a really incredible science communication event that we have here and in other cities throughout

Canada. You've been really involved with lots of different groups around science. Just thinking about what a really cool dynamic group of people, is so passionate about science that we want to hang out together, and talk about it, and explore it together. That to me is so incredible, and so special. And through the podcast we've been able to chat with even more people and build that community outside of Canada and to learn from folks and to celebrate them. So as a bit of a community update, previous guest Elizabeth Carlen defended her PhD today and is now officially Dr. Elizabeth Carlen. So a huge shout out to Dr. Carlen. The reason I've been thinking about this is because Science Odyssey is coming up. So, Science Odyssey is a festival for science, it's happening from May 1st to 16th. There's actually going to be over 1000 different events, as you can imagine many of them virtual this year. Science Slam is running one, we're in the process of organizing one, by the time this comes out, you should be able to check for it. I guess this is my promo to say science communication in Canada is real wicked, and if you want to see some very cool events, go check out Science Odyssey, come to our event, and engage with your local science communicators.

Kaylee
That's what I've been nerding out about.

Greg
Super cool.

Michael
Well, Greg, thank you so much for joining us on the podcast. This is you know such a treat every time we get to talk to you. I can imagine there might be some people that are hearing this news about your health for the first time, they might want to message you, where should we direct people if they want to do that.

Greg
So, the main charity or donation or support that I've been pointing people towards is just BC Cancer, and you can specify what kind of cancer you're interested in supporting, but there's also just general BC Cancer support stuff as well. If you want to support cancer in your own local neighborhood or your own country or state if other people are listening, that's totally cool as well. But people here in Vancouver, if you just type in BC Cancer, it's pretty easy to find.

Kaylee
Thank you so much for being here today with us. It was such a delight to chat with you all about evolution, which is one of my favorite things to talk about, and misconceptions about it which would be one of my second favorite things to talk about. Thank you everybody so much for listening. If you want to hear more from us, you can find us on our socials @NerdNiteYVR on Twitter, Instagram and Facebook. We'll be back in a couple of weeks, but until we meet again, remember, there is no best, you just do the best for you.

Transcribed in part by Otter.ai