

Evolutionary Biology with John McCormack

Ologies Podcast

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Hiiii, it's your eccentric-but-quiet neighbor, Alie Ward.

Hey, how did you get here? Why don't we have flippers? Is a fly my cousin? What is life?! Welcome to evolutionary biology.

Now, this is a special episode because, frankly, I thought it was lost to extinction. I thought it was plum *dead*. I recorded it with an evolutionary biologist who works at the same lab at Occidental College as our ornithologist from episode seven. So, late last year - before I had better microphones or necessarily a good interview rhythm down - I visited with this evolutionary biologist, and before the tape rolled we talked about birds, and our upcoming holiday plans, then we sat down to chat about natural selection. Then I lost the file for, like, a lot of months. I found it on a drive and it was oh! So exciting! It was like encountering a dodo bird in a PF Chang's parking lot. I was ecstatic.

Another thing that's exciting? Your support. Thank you to everyone funding the production of this podcast on [Patreon.com/ologies](https://patreon.com/ologies). It's run completely independently and your pledges - for as little as 25 cents an episode - totally keep it going. I'm able to pay an amazing editor (What's up Steven!) to cut it all up and put it back together. You can also support by getting some sweet, sweet Ologies merch. Get a shirt \$20 bucks on [OlogiesMerch.com](https://ologiesmerch.com) in whatever color you want.

Or you can support for free, no money, just by telling a friend, or you can tweet about it, or subscribe on iTunes. Are you subscribed? Go check. Sometimes Apple just unsubscribes me from things. And it also helps so much to rate or leaving a review. This week, Ologies was #20 in Science Podcast on iTunes. Sure, we had some ghost podcast to beat, but #20 is thrilling as hell for an indie podcast.

I creep all your reviews. I read them all, every single one of them. This one was very kind; BigZoZoo [phonetic] says:

You are the podcast you want to buy a drink for in a classy bar. The music is low, the mood is right, I buy you the top-shelf beverage of your choice, and then you delight me with the most interesting facts my brain could possibly absorb with gin. Thanks for rocking my pod-socks on the rocks!

Well you're welcome BigZoZoo! I'm trying to think what drink I would order top shelf at a classy bar and I'm like, "Do they have wine spritzers?" I dunno.

Okay, evolutionary biology. In this episode you'll pick up some sweet ass definitions like taxonomy - what is it? - epigenetics, genetic drift, phylogeny. What is all this mouth salad?! You'll learn about some crowdsourced cancer fixers, super erotic whales, finch gossip, relationship goals and about how Charles Darwin had a wonderful, but super shitty, but also wonderful, life that involved probably a lot of bad toilet experiences and a lust for a family member! Who was it?!

Please enjoy this chat that essentially boils down to: our mutations are our strengths and adaptability is a virtue. Meet evolutionary biologist, John McCormack.

[Intro Music]

John McCormack: I think I'm going to change chairs because this one is a little squeaky...

Alie Ward: That works! So are you, by trade, an evolutionary biologist?

John: Yes. That's kind of... I wear a couple different hats, I'd say. Evolutionary biologist is probably the broadest one. Sometimes I consider myself an ornithologist as well. I should hope so, as the curator of a bird collection.

Alie: So, would you say that you have genus and species on the brain a lot?

John: Oh yeah. Yeah, all the time because that's a lot of what we do here, with a specimen collection or just, you know, naming the basic units of biodiversity.

Alie: Do you remember, as a kid in class, learning the... what was it, King Philip... What is it again?

John: Yeah... Well, I can't remember it. *[laughs]*

Aside: Let's talk taxonomy, which is how science organizes things. So, you may have learned that plants, fungi, and animals are classified into domain, kingdom, class, order, family, genus and species. And now you're like, "Wow Alie! That's amazing! How did you memorize that? You are a genius." I know that's what you are thinking. Now, the mnemonic device is clutch here. I never remembered the mnemonic device for this. I remember we learned one; I think it was like, "Dear King Phillip Came Over From Germany, So." Which is weird. What's the So about? What's the rest of the story? Anyway, I never remembered it. "Dear King Phillip Came Over For Grape Soda" is another way to remember Kingdom, Class, Order, Family, Genus, Species.

Another alternative you could use is "Dickish Ken Poured Coffee on Fran's Good Shirt." Fuck off, Ken! Or, "Dang, Kinky People Come Over For Group Sex, which is apparently what some biology teachers use. They know marketing. They know how to get your attention.

"Don't Kick People Coming From Goldman Sachs" is another alternative, depending on your thoughts about it.

Calling an organism or a specimen by its genus and species is kind of like saying your last name first. It's what we call Linnean taxonomy, even though Swedish ecologist Carl Linnaeus didn't really invent it. Someone else did, it was kinda already established.

So, John wasn't busy learning Carl Linnaeus mnemonic memory devices in high school. But he was down with a different Carl. Carl Sagan, who, despite being an astronomer and cosmologist, wrote about evolution.

[clip of Carl Sagan saying, "We sometimes represent evolution as the ever-branching ramifications of some original trunk, each branch pruned and clipped by natural selection."]

Sagan has an 8-minute animated video that essentially details the journey from a single-celled animal, to a polyp on the sea floor, to human's jawless, fishy ancestors, to an amphibian, to a shrew, to primates, to apes branching off into bipedal creatures with big brains that poke stuff, and will eventually invent things like game shows and salad spinners, human beings. I added that last part because I'm writing this in bed. Honestly, evolution and humanity are freaking me out. It's like, nothing matters, but everything matters, everything changes, we're all mutable. How did I get here? Think of all the people that had to mate in order for me to be alive right now. What have I even done with my day?

Anyway!

Alie: What is it about the Linnaean system of taxonomy that you dig?

John: Well, I've always been an organizer, and a list maker, so it always appealed to me. You know, so when I found out a lot of taxonomy is lists and organization, I liked that.

Alie: In your regular life, your day-to-day life, are you as organized as you are as a scientist? Or is your house just like a disaster, and you're not sure... Like, Christmas list isn't ready?

John: Well, unfortunately, that's kinda the plight of the academic, to be extremely busy and wearing a lot of hats. I'm certainly not as organized as I would like to be.

Alie: Is that a difficult admission for you?

John: *[laughs]* A little bit, yeah. You know, I guess I'm still, I'd say, fairly organized about my things. But yeah, in terms of just general life, and scheduling, and things like that, it's a bit of the disaster you might expect from an academic.

Alie: And so tell me a little bit about when you first kind of grasped the concept of evolution. When did you start to realize, 'okay, mutations are responsible for a lot of these different appearances, and behavior, and capabilities of animals'? Like, when did you start to get excited about evolution?

John: I think it was when I was doing some of those early readings in high school. I know there are other people that have spoken at more length about evolution than Carl Sagan, who was principally an astronomer, a cosmologist, but it was some of his books that delve more into evolutionary ideas that got me into it.

Aside: From there, John studied at University of Arizona and took an evolution class by Dr. Nancy Moran, who is a badass and a MacArthur fellow. She researches the gut biome of aphids.

John: And it was really there for the first time that I learned just, kind of, the basic framework of evolution and its processes; mutation, natural selection, and then some things I'd never heard of, like genetic drift, which is the, sort of, random way that evolution can take gene frequencies and populations, and that there are whole aspects of it I hadn't heard of. That was pretty exciting too.

Alie: What's an example of genetic drift? How do you describe that at a cocktail party and to somebody who's half a glass of Chardonnay in?

John: Well, I guess I'd point to the M&M bowl.

Aside: So, see that M&M bowl? Genetic drift is when you take...

John: A small handful of M&M's and you end up with three green ones instead of the full rainbow of colors. That's genetic drift. And that's what can happen. And in populations sometimes, generation to generation you don't always get a random draw of the genes that are out there. Sometimes you get a very non-representative draw and that can have a big influence on evolution. And I kinda liked the idea that there's that sort of chance element in there too, as well as the more, what we call, deterministic or, kind of, the more predictable outcomes of natural selection.

Alie: Are there any movies or TV shows about evolution that you either really like or that really annoy you? Where you're like, "That's. Not. Evolution."

John: That's a great question. You know, *Gattaca* comes to mind as one that's a fairly interesting and informed movie with evolutionary ideas. It's been long enough since I've seen it that I can't really tell you that much, but the ideas of what can happen with genetic engineering and our more consumer-based eugenics that we have now, or enhancing our genes because we want to, and some of the outcomes are pretty interesting.

Alie: I did talk about *Gattaca* on the paleontology episode, about how I always really respected that they only used an ATGC to make the name, that's pretty dope. How do you feel about CRISPR and gene editing?

John: On the one hand, it's incredibly exciting, and I think people tend to focus in on the aspects of it that involve genetic engineering and humans, and that is one avenue that obviously a lot of caution needs to be taken. But there's so many other applications of CRISPR technology, just to the study of evolution, that it's quite exciting. I mean the possibilities for experimental evolution are vast and that's great.

Aside: So, what is it about birds that make them prime for studying evolutionary biology? Well, people freakin' love birds! There have been a lot of them observed, described and collected, so there's a good base of knowledge there, as opposed to like, slime molds, which nobody goes to hunt down and marvel at. Probably a few people do, and I hope they're friends with each other. Anyway, Birds.

John: The starting place for a lot of that is, "What is called the evolutionary tree of relationships?" Just knowing who's related to whom is an important starting point, and if you don't have that, then that's kind of your first step. And so with birds, they've been worked out well enough that that first step is already completed, and you can, sort of, jump to answering some of the broader questions.

Alie: Because you know the characters in the story.

John: Exactly, right.

Aside: Let's take a quick Darwin detour. Who was he and why should you care? I'm gonna run this down as quick as I can for you. So, Charles Robert Darwin was born in England in the early 1800's. His father was a super rich doctor, and Darwin tried to go to medical school but he haaaated it! He was also the grandson of prominent abolitionists, which is cool, and he loved nature, geology, and collecting beetles. LOVED it. His dad was like, "Kiddo, you're a loser." Darwin was like, "Dad, can I just go on this boat, the HMS Beagle and travel the world and I'll write about it? Will you please finance it, rich Dad?" His dad reluctantly agreed, but at one point said to him, [*old-timey grouchy man voice*] "You care for nothing but shooting, dogs, and rat-catching, and you will be a disgrace to yourself and all your family." But, haha, joke's on you pop! He wasn't a disgrace to his whole family, because Charles married his cousin. [*deep male voice, sensually, "Ooooh yeah"*]

Apparently when he was considering taking on a cousin-bride, he was so accustomed to filling notebooks with thoughts on various specimens and animal breeding that he scrawled out a page with one column headed "Marry" and another "Not Marry." Advantages included "constant companion and a friend in old age ... better than a dog anyhow." Well... I don't know if I agree with that.

Cons were “less money for books” and “terrible loss of time.” So, constant companion, friend in old age, or less month for books and a terrible loss of time. He decided to make this family affair, into a *family affair*, and had several babies with his cousin. [DJ airhorn]

Back to the Beagle. Charles Darwin did a bunch of writing, kind of like travel blogging but with more dysentery and smeared ink. His diaries were made into a popular book, *The Voyage of the Beagle*. It was on these travels that he started to come up with a theory of evolution, but it took him yeeeeeears of tinkering, and re-writing, and illness (which may or may not have been Chagas disease from a parasite of something called an assassin bug). He was also a little thwarted by, I think, procrastination. But finally he published his *On the Origin of Species* book in 1859. It was a huge deal. He also, kind of, published it alongside a contemporary of his, Alfred Wallace.

Now, Alfred Wallace – never heard of him before I started researching this episode – he was working on a very similar theory but had a harder and more impoverished life than Darwin. Like, Wallace’s ship full of work sank to the ocean floor, he was adrift at sea on a lifeboat. Alfred Wallace, who no one really ended up caring about.

But back to Darwin on that Beagle trip. Darwin stopped for supplies in the Galapagos Islands off the coast of South America and noticed that different animals on different islands had slightly different features. For example, all those finches, why do they have different beak shapes? They’ve got crushing bills, they’ve got probing bills, they’ve got grasping bills! Why all these bills?! Ahhh, they must all be adapted for different food sources on each little tiny island climate, so he theorized.

Alie: Were you really inspired by Darwin's finches? Was that a big deal for you at some point where the evolution, natural selection, and birds, and specialization of beaks, and colors... Did that inspire you a lot?

John: Absolutely, because it's such a great story because it's, kind of, the complete package in terms of evolution happening on such a short timescale that humans can observe. It's happening in, sort of, a contained environment that you can wrap your mind around, right? This island where Peter and Rosemary Grant studied the finches, you could walk around it in an hour

Aside: I did not know who Peter or Rosemary Grant were. Oh man! Oh god! Oh man! If you've been in mourning since Brangelina split, have I got a couple for you, boy howdy! What sexy motherfuckers. Born in 1936, this British evolutionary biologist couple went to Daphne Major, a Galapagos island, and they've been studying the finches there since 1973. They live together on a remote island half the year and are Princeton professors the other half. Who are these sensual lovers? They met when Rosemary was lecturing in embryology and genetics, and Peter was still a Zoology grad student - and her teaching assistant. They've been married, like, 56 years and they've been capturing, tagging, and tracking these finches in the Galapagos, and they've been able to show that natural selection can be observed within even a couple of years. Darwin thought this took eons before you could see natural selection. They're like, “Nope. Check this out. We figured it out. It can happen super quick.”

And yes, the Grants produced offspring: Two daughters, one of whom I just found and followed on Instagram. I think she studies psychology and is into making cakes. Have I mentioned I'm creepy? I JUST WANT TO BE FRIENDS. Okay, back to the finches.

John: And there were maybe, you know, a thousand, or a couple thousand finches on the island. They could catch them all and have them color banded. And so, it's kind of one of those...

you know, it's almost evolution in a test tube, but the test tube is nature. And then the other aspect about it is just, kind of, the romance of field work in a faraway island. There's a great book called *The Beak of the Finch* that, sort of, follows the Grants and their graduate students on this decade-long chase for uncovering evolution. And that was really inspiring for me because it, kind of, dispelled some of the myths of field work like, 'it's all fun and hanging out on the beach.' [laughs] It's a lot of hard work.

Alie: I imagine less margaritas, more bugs in your clothes.

John: That's right. And scorching hot sun. But that story, I just think it's so inspirational and it's so easy to grasp. And so that's why I make it a point... Just last week, I have an entire class, two classes in fact, where I walked through the Darwin's finch example with my students in my evolution class and, kind of, give them the whole story.

Alie: How do you feel about people going to the Galapagos as tourists? Does it piss you off?

John: [laughs] No, it doesn't. I've been there myself as a tourist. Any situation where people are out there enjoying nature, and to see people making such a long trip at such expense to see nature firsthand, and to see the work of evolution, that makes me happy. Sure, once you get there, there's always cases that you can look at that make you grumpy. You know, the person with the camera right in the face of the seal. But I try to take a broader picture and think of how great it is that people can get so excited about biodiversity.

Alie: I once went to an island in Thailand and I saw a tourist tipping back a Pepsi into the mouth of a monkey. And I had a hard time with that, just feeling like, "We should all go home. This shouldn't be happening."

John: There's plenty of ways that you can observe humans interacting stupidly with nature, and now with social media, you know, we could just do nothing but watch humans interacting stupidly with nature. And so it's a concern, right? It's a problem and people need to be educated. But again, I think taking a slightly more optimistic, sort of broad viewpoint, I'm glad that people are jazzed up about nature.

Alie: Right. Do you ever look at yourself, or people in your life and say, 'Way to go J-Man. I am the result of a bunch of evolution'?

John: It is a pretty marvelous thing when you think about it. I tend to not focus so much on humans as the pinnacle of evolution.

Aside: Ouch. Yes, okay, reminder: Humans are not the pinnacle of evolution. You have a point

John: I like to look at other situations and marvel over the millions of years of evolution that produce some remarkable radiation of birds, for example. But when you stop to think about it, everything that's alive today is the survivor of, essentially, 3.7 billion years of evolution.

All those species, millions and millions of species that are crawling around on this very thin crust of the earth, are the products of that 3.7 billion years of evolution. And it's a remarkable thing, you know? And each one, even from a bacteria to a human, has evolved just as much through just as much time. I think it's easy to think about certain species alive today as being more evolved than others because maybe they have a few more adaptations, or they look more complex. But at the end of the day, that bacterium, that human, we're all the products of 3.7 billion years of evolution.

Alie: Even if you do nothing but play *World of Warcraft* and eat from a barrel of cheese puffs, you're still a winner, right?

John: You are the product of winners. You got here because your ancestors won the evolutionary game. Now, what you choose to do with all that winning is another question.

Alie: [laughs] It's a very diplomatic way of saying, "don't just play *World of Warcraft* and eat cheese puffs." Very diplomatic.

John: [laughs] I'm not into telling people what to do with their lives. But at the end of the day, evolution is about fitness, and it's about offspring, and so eating Cheetos in your basement is maybe not going to get you to the finish line there.

Alie: You never know.

John: You never know, though.

Aside: Disclaimer: I know nothing about *World of Warcraft* or how good of a life you can have playing video games in a basement, but this did cause me to stumble upon a Cracked article about "farming gold," which seems like some sort of earned token you can sell to other players. One guy does these 72 hours a week and makes about \$25k a year. And he lives off pizza and Monster energy drinks. So, it's possible... It is possible you can make a living playing *World of Warcraft*. And then you can put 'Gold Farmer' on your business card!

What's on John's business card? Is it ornithologist or evolutionary biologist?

John: I tend to describe myself as an evolutionary biologist who studies birds. But you know, I'm an ornithologist as well.

Alie: Own it!

John: Maybe I should own it.

Alie: And besides, you can be both. I'm sitting next to your business card and it doesn't even say an ologist of any kind. It just says, Director and Curator of the Moore Lab of Zoology. You gotta throw some titles on these!

John: Well Alie, I've got to bring you in for PR, I guess. [laughs]

Alie: Let me be your life coach. Zoologist – Ornithologist - Evolutionary Biologist. Come on!

Let's debunk some flim flam. What is a myth about evolution that you feel like people hang onto, other than just creationism?

John: One of the great myths is embodied in that classic symbol of evolution where you see, sort of, the chimpanzee evolving through something that looks like a Neanderthal into modern humans.

Aside: This linear illustration of primates up to modern human species is called *The Road to Homo Sapiens* or *The March of Progress*. It was published in in 1965 in a *Time Life Science* volume. You've totally seen it. It has silhouettes of gibbons, and then chimps, and apes all marching in a line up to tanned, muscular Neanderthals. It's such a good psychological test in trying to figure out how far back in species it becomes inappropriate to want to smash. Like, some of them look like shaggy-haired rock climber boys with good butts who just need a shower and you're like, 'Shoot, these are cave people. Check yourself, girl.'

There are so many parodies of this illustration. I'm sure if you see it that you almost expect the devolving into Homer Simpson, or a Martian, or something. Rather than this linear evolution, evolution looks more like a tree, as they call it a Tree of Life, where one thicker branch represents a common ancestor and new species branch outward outward. That's called phylogeny, and Darwin sketched it in one of his Beagle-era notebooks with the words [quizzically] "I think" scrawled above it, which I think is super adorable and very humble.

I have a friend who has this tattoo of this Darwinian Tree of Life sketch, and I hope Darwin's stodgy father would be proud. Okay, back to that *Road to Homo Sapiens* linear evolution illustration, and how that's not really how things happen.

John: Although it's even used by people who are pro-evolution, I think it, kind of, leaves people with a misimpression of how evolution actually operates, because you know, chimpanzees and humans are each other's closest relatives, and humans didn't evolve from chimpanzees. We evolved from some common ancestor that we shared with chimpanzees. And so, that depiction of evolution is, kind of, following a linear pattern. It belies the true branching history of evolution that's underneath. One of the most common questions you get, and you know... Just recently on Twitter, Tim Allen, of all people, was going to weigh in on evolution, and ask the question you get a lot, which is if humans evolved from apes, why are there still apes? And again, it's embodied in that symbol that's not true. We didn't evolve from apes. Gorillas, and chimpanzees, and us all evolved from a common ancestor that was neither an ape, nor a chimpanzee, nor a human, but something else.

Alie: Maybe that was just a personal branding question for him because he did make his mark on the world by grunting, right? He grunted a lot. He's like, "Shoot, maybe I ought to rethink this."

John: See, he's got good PR people, maybe.

Alie: He does. I saw that and I was like, 'Tim Allen, sit down. Just go away.' I do have some questions from listeners, and I don't know if they're going to be easy questions. You can say pass on any of these.

Dr. Teagan Wall wants to know: What are the best ways are to differentiate bad post hoc Evo Bio claims from actual science? For example, bananas evolved to be eaten by humans because we have hands, things like that.

John: A lot of the examples of evolution you see written about in the popular press, kind of, fall into this trap of portraying evolution as though it responds to needs. And sometimes this is just loose shorthand.

Alie: I have heard that people get... Like, I had a science teacher tell me she hates when she hears like, 'oh, this species evolved because it wanted this,' You know what I mean? Like, evolved out of need instead of out of chance.

John: Exactly. Yeah, right. The recent example was birds that have evolved to feed off of bird feeders in Great Britain. So, 'birds have evolved longer bills to feed off of bird feeders' was kind of the headline that you saw, and it gives this impression of evolution that it responds to needs, like the bird, sort of, thought to themselves, 'Look, I really need a longer bill here, let's go for that. Let's try to reach that pinnacle of evolution.' Again, underlying that is the true evolutionary mechanism, which is differential survival and reproduction.

Aside: Differential survival and reproduction being fancy talk for, 'little variances in genes means good mutations, which help a plant, or a bird, or a snail thrive and mate in its particular environment.' Boom. Natural selection.

John: You know, the way I would say it would be much longer. It would be something along the lines of, "Birds with longer bills were able to feed more effectively from bird feeders and thereby produce more offspring, which led the population as a whole to have longer bills." Now, you can understand why a headline writer isn't going to go there, and why I don't have a job as a headline writer. *[laughs]*

Aside: *[old timey newsreel music and film projector in the background, Alie using a comical old-timey urgent news voice]* Breaking News! Birds with longer bills were able to feed more effectively from bird feeders and thereby produce more offspring, which led the population as a whole having longer bills.

[back to normal] It's very wordy.

John: But I think there are ways to depict the evolutionary process in headlines in a more effective way.

Alie: Right? Right. A little bit less sensationalist. How do you feel about Lamarckian theory of acquired genetics, that people maybe still kinda believe in it?

Aside: French biologist Jean-Baptiste Lamarck, by the way, had a theory of acquired genetics, such that offspring would take on the characteristics their parents adopted in their life: like if a giraffe slowly stretched its neck ever further to try to get leaves, then its babies would have a liiiiittle bit longer necks, depending on the giraffe's effort. Or, if your mom was a competitive body builder, you were destined to be ripped. Turns out not so much. Lamarckian genetics predated Darwin's theory of evolution, and once Darwin came on the scene people would like, 'Uuuuh yeah, bye Lamarck, au revoir. Na... no.' So how does John feel about Lamarck?

Alie: And also, did Lamarck get the shaft? Or do you think he should've never been, kind of, known?

John: I'm a big believer that Lamarck, you know, has been overly vilified. I mean, the fact was, Lamarck's theory was the first, kind of, full and coherent theory of evolution that involved a mechanism for how it occurred. No one had really done that before. So even if he was wrong, he got people talking, and he got people thinking, and he got people like Darwin thinking about why he was wrong, and that move things forward. So yeah, I'm a big fan of Lamarck. He did a lot of things right. And he just happened to be wrong about how traits changed and how they were passed down through the generations.

Alie: What about epigenetics? How do you feel about it?

John: Right. So, this is so funny, my students will laugh when they hear that question because just yesterday I went on a long, unannounced rant about epigenetics. You know, the term is misapplied these days quite a lot, especially in media accounts. I understand it's a buzz word.

Aside: Super quick primer: epigenetics is kind of a buzzword these days. Essentially it refers to when your gene expressions change, not the DNA or genetic code itself but just the expression of it changes. John says it really applies to specific cases where DNA can be

silenced by the addition of molecules to something called the histones. Histones are proteins that make up the structure that DNA gets wound around.

John: So, those molecules can attach and effectively silence certain parts of the genome. And in some cases, it seems that those silencers can be passed down from parents to offspring, and in some cases that silencing can happen during the lifetime of an organism in response to its environment. So, it's at least theoretically possible and I think it's been shown in maybe just a few cases where this sort of silencing occurs in the lifetime of an organism and then gets passed down to its offspring.

So, it is possible that it's a contributor to evolution, and in a sense it's Lamarckian, right? Lamarck's theory of acquired characteristics was the idea that traits picked up during your lifetime, you can pass down. And so, epigenetics in the narrow sense, sort of, adheres to that idea. How often has that actually contributed to evolution, and is this not something that, at the end of the day, is found in the genetic code? The silencing and turning off and on of these genes at the histone level might itself be encoded in the genes.

Aside: So, your genes might already be saying, "Hey! Turn these things on, turn those guys off!" They might already be on top of it. It might be part of the code.

John: But then there's all sorts of ways that people use epigenetics that was already folded into what we know about Darwinian evolution.

Alie: So, Darwin was already hip to it.

John: I don't know if Darwin was hip to it, but certainly those people in the modern synthesis. Darwin didn't know the genetic mechanism of how heredity happened, but after... Mendel showed us the genetic component, and then that was, sort of, incorporated with Darwin's views and natural selection.

Alie: More listener questions. You Ready?

John: Yeah.

Alie: Okay. I hope these aren't too insane. Chasing Katie [ph.] wants to know... I don't even understand this question. I'm just gonna read it: If he works in sequence alignment, I want to know what is the most significant discovery arisen from resolving anomalies in human DNA?

Aside: I just re-read this question again, like, 17 times and still don't understand it. I looked it up and it seems to involve finding matching sequences within DNA to point to one common ancestor. Does that make sense?

John: I think the question is about how we take multiple sequences from multiple individuals and know that we're looking at the same piece of DNA across individuals. Sequence alignment is a very important part of building a tree of evolutionary relationships from DNA data. A lot of times you get pieces of DNA from very different species, and evolution has taken them in such different directions that you almost don't recognize that those pieces of DNA are related to one another.

It becomes quite challenging to align it all together and know you're looking at, sort of, the same base, or the same chunk of DNA, or the same gene across different species. We have had new computational tools come online that have vastly improved our ability to do that

by eye. It used to be you got these chunks of DNA and then you would just look at them on a computer and, sort of, move them around by eye.

Alie: That sounds terrible.

John: It sounds terrible, but actually it's a pretty darn good way of doing it, as it turns out. We've had new computational tools come online that have allowed us to, sort of, align DNA across whole genomes in a way that it would take years to do by eye. You can get most of it close to correct. But then it turns out those really, really tough spots to align are actually almost best done by eye. A computer really hasn't figured out how to effectively do that.

And in some cases, people have used crowdsourcing to do it. So, they've put these really complicated chunks of DNA online and then people can go on like a little game and, sort of, move the bases around and, kind of, come up with the best explanation for how they should be aligned to each other.

Alie: Like citizen science projects.

John: Yeah, exactly.

Aside: So, I looked into this, and there's a game called Phylo. It's put out by McGill Centre for Bioinformatics. It kind of resembles a linear, brightly colored TETRIS, with blocks that you try to slide around until they match each other. Each block represents 'nucleotide sequences of different phylogenetic taxa'. I sucked at it at first, but I didn't care because it features jazzy piano background music, which is hella sweet, and also you can select which disease you'd like to help cure by matching nucleotide sequences of different phylogenetic taxa! You can click on the menu, like, infectious diseases, blood diseases, heart and muscle disease. It's quite an impressive menu. I chose brain and nervous system disease, which had kind of a powerful effect because as you're playing it'll hit you that maybe you're helping researchers find out more about, say, my mom's disease, multiple sclerosis. Maybe by playing this video game I'm helping out.

I looked at a video, and an earlier version of Phylo used a graphic in the lower corner to represent your score, and it was silhouettes from *The Road to Homo Sapiens* aka *The March of Progress* illustration. It looks like they've since changed that, which is good because having these Cro-Magnon hotties, super distracting. JK.

So, if you need a break from gold farming on *World of Warcraft*, you might want to hop over to Phylo and just play a couple rounds. Full disclosure, I did eat Cheetos, like, yesterday, so no judgement on that life. Moving on.

Alie: Dustin Groek [ph.] wants to know: What are your favorite evolutionary anachronisms?

John: He might be talking about, like, structures like evolutionary holdovers that don't have a use any more. I mean, the tiny hipbones of modern whales are a great evolutionary anachronism because they really speak to the fact that special creation... If you believe that each species is created perfect for its particular niche on earth, why would modern whales have tiny hipbones unless there's something in their evolutionary path that points to the fact that they were once land animals?

Alie: I've never known that. That makes me want to go look at whale skeletons. Like, oh, Whales, you don't need that.

John: Yeah, why are you carrying that around? [laughs]

Alie: It's overpacking.

Aside: So, whales. We all know, whales, they live in the sea. Whales started in the sea, then they lived on land as freakish, hairy, walking whales, and then they slipped back into the sea, like your drunk friend on spring break who disappears from playing Cards Against Humanity to go sit in the hot tub and nurse a Corona alone. So, whales, you're in the sea, why do you have hip bones? You don't need 'em. I looked it up, and whale hips may not be a hiccup some ancestral relic.

The explanation may in fact be much more, as one National Geographic articles puts it, *erotic*. That's right: whales be thrustin'. They need those hip bones for boners, and because lady whales like sweet moves (maybe). And there's a lot of competition out there. So, sexual selection. Whale grinding. Like two tractor-trailer Mack trucks made of wet blue leather just slowbonin' it out. [*whale call*]

Gotta love love.

Alie: Celestia [ph.] wants to know: Are there any species that we can see currently evolving in order to adapt to our modern world?

John: Viruses. Viruses are constantly evolving to humans, and the flu virus that's hitting us in one flu season is going to be yesterday's news next year there's going to be a flu virus 2.0. That's evolution that you can see over the course of generations, just a couple of years even.

Another great example is antibiotic resistance. That's another scary one. And sometimes people don't necessarily file that under evolution, but they should because it's a direct result of natural selection pressures that we are placing on bacteria through our overuse of antibiotics. The reason we're getting these superbugs is because of evolution.

Alie: Do you ever worry about human interference with evolution, particularly since you study birds? Do you ever worry like, "ooh, we're cutting down so many trees! What are we doing to the birds?" Or do you feel like, "Well, evolution is evolution and that's another thing to adapt to"?

John: I guess I like to see evolution kind of proceeding through its natural course, unfettered, to the extent possible, by humans. But that's not to say... You know, we live here in Los Angeles and you can't turn a blind eye to the fact that we've got a big city here and it's not going anywhere. And so, if you're going to be studying urban wildlife, you're going to be studying evolution altered by humans. I'm not against that either. I think that there's a lot of interesting things that we can study about evolution in human-altered landscapes.

Alie: It's a good attitude to have, that you're not... Part of me, if I were an evolutionary biologist, would spend some time under the couch crying about how we've messed up everything. Right? You've got a better attitude than I do.

John: Well, it's probably because I've gone through all the stages, right? I mean, I've been there, where I've learned about all the amazing biodiversity on the Hawaiian Islands that we've lost by introducing mosquitoes and all kinds of other things. So, I've gone through the despair.

Alie: The stages of grief?

John: Yeah [*laughs*].

Alie: You listened to the Thanatology episode and you got through it. [*laughs*]

John: That's right. At some point, you've just... especially if you're teaching the next generation, you just... you've got to be a little optimistic.

Alie: That's good. That's responsible of you.

PilotStig [ph.] wants to know: What do you say when some assface rants, "evolution is just a theory"?

John: Well, yeah, evolution is just a theory. You'd like to think that you approach that person by telling them, and sort of informing them, what a theory is in science. It's an idea that's backed up by a lot of facts.

Alie: Burn. Sick burn.

Aside: Just a reminder that the scientific method does not place 'theory' in the bumbling beginnings of an experiment; rather, theory is the product of a tested hypothesis. So, it goes roughly: you get a question; you come up with a hypothesis; experiment; analysis; finally you come to the theory or a conclusion.

You can think of it like, Queen Hildegard Eats Apple Turnovers. Questions Hypothesis Experiment, Analysis, Theory. Or use something filthier, if you want. I'M JUST TRYING TO HELP. But yes, the theory of evolution isn't just a hairbrained theory.

John: Honestly, I've never encountered that, like, face to face, someone telling me evolution is just a theory. I've encountered other misconceptions of evolution like the, 'if we evolved from apes, why are there still apes,' or 'if we evolved from monkeys why are there still monkeys.' Actually, in that case, I've found... That kind of a question, I think, speaks more to people's just... you know, they haven't been exposed to ideas. I've gotten that question earnestly from people.

And I found that if you just sit down, you know, with a cocktail napkin, and you sketch it out for them, and you say, "Look, evolution is not linear. It proceeds through branching and we're related through ancestors." I've found that that has changed some minds and some of my students have actually come back to tell me that they found that that changed minds. Someone who's coming at you with 'evolution is just a theory,' I found that those people are usually just, kind of, more entrenched in ideologies and unlikely to change their minds.

Alie: So, they're trolls, kind of, I imagine. I think it's a little trolley.

John: Don't feed the trolls.

Alie: [laughs] This is my own theory, tell me what you think about this: When I think about cars, I always get, kind of, caught up on the taxonomy of them, because I do feel like make and model is very genus and species, and then over the years the same species can maybe evolve, and maybe they all have certain common ancestors. Maybe there's like an evolution, like divergent evolution. Do you think that we created our automotive system, with headlights in the front, engine in the front, exhaust in the back, four wheels, quadruped, to model animals at all? Or does it just sound like I smoked too much weed (which I don't)?

John: [laughs] I think what it sounds like, and what I think you've clued into there, is the fact that in a lot of human-created structures we can see, sort of, a history of how they've been designed. And so, evolution is not something that's just confined to the biological world. People use evolutionary theories to study language because there's all sorts of quirky ways that languages evolve through some of the same processes of selection and random ways

like drift. And we can reconstruct histories of how the things we see now are related to one another.

You can do the same thing with shoes, with cars, with candy bars. What it's saying is not so much about whether there's a designer behind it as there is with a car, or the lack of a designer in the case of the biological world. What it's saying is, things usually evolve through a history and through having ancestors, and any time something goes through time like that, it leaves a record of evidence of who shares a more recent common ancestor. You can see that in cars, you can see that in shoes, it's just in that case humans are the designer.

Alie: But need is ultimately the designer, right? I mean, it's based on how well it adapts to the environment. Like, I feel like Hummers kind of went extinct because the environment no longer had cheap gas, or that kind of ostentatious displays of wealth. Do you think about that ever? About how things, kind of, work themselves out based on what resources are available?

John: Yeah. And you know, this kind of gets into theories that, sort of, compare the marketplace to evolutionary ideas. I think there's something to be said for that, and you know, sometimes that's called Evonomics. There's branches of economics that, sort of, focus on evolutionary ideas. I'm not an expert on those, but I think there is some credence to the idea that, you know, products are selected for or against, and sometimes the ones that don't get selected die out. Now, sometimes the ones that are terrible products continued to be perpetuated on us, right?

Alie: That's a very good point.

Aside: I tried to look into this further, and found a website called Evonomics, touting itself as "the next evolution of economics." And I can't quite vouch for it because I clicked around and I found an article titled *Is There Anything That Working Less Doesn't Solve?*, but I only read the first few paragraphs because I had to get back to work. Because whale sex facts don't research themselves! Speaking of work...

Alie: Now, what is your least favorite thing about your job, or a time in the field that was awful, or something that you just...is like, maybe not the highlight? And then I'll ask you your favorite. We'll end on a good note.

John: Even the worst field experience is always better than answering emails. *[laughs]* I'm sorry for those people, you know, I will get to your email sometime soon. I promise.

The fact is, and this goes for a lot of jobs but I think it's especially true of field biologist, we got into this job because we love to study animals and nature. And I still get a lot of wonderful opportunities to do that, don't get me wrong. But they never tell you that you end up spending a good 30% of your time sitting at your desk answering emails or filling out forms. So yeah, those are the worst aspects of my job. Not that I don't enjoy communicating with people but, boy, I'd rather be talking over a beer than answering an email.

Alie: Or having a stomach parasite in a jungle: Preferable to email.

John: Yes, absolutely. Absolutely. *[laughs]*

Alie: Now, what has been your favorite moment, say, out in the field on an expedition? Like, have you ever had a moment where it's just like, "aaahhh"? *[heavenly angels singing]*

John: The moments when you can take people out to an incredible field site, people who are either just getting excited about science and biology or birds, and you can take them to a place that you've been to that's just way out there and is just incredible, those are the moments I live for.

We got a chance to do that recently when we went up into the mountains of Northern Baja. There's a mountain range called the Sierra de San Pedro Mártir, and it has basically been untouched, by human habitation anyways, in modern times. There's still cattle that they run up there, but nobody really lives up there, and you almost don't see any place like that in the United States. So, this is a place... People don't really realize this, but there's a huge number of California condors up there. We had the opportunity to go up there, and just taking some of the expedition members and student from Occidental College, and giving them the opportunity to see this place and see these contours up close. I mean, it's spectacular.

Aside: Oh, super quick: a condor is a type of vulture, and it's inky black, and huge, and it was on the brink of death, but is being bred in captivity and released, and it eats dead things, and doesn't have a song, it just grunts sometimes.

And since I was in an ornithology lab, I had one more very important scientific question from someone who's having a birthday this week:

Alie: My friend Daylin Rodriguez [ph.] has a question about condors. She wants to know: Are they the most goth of all the birds?

John: Um... I don't know. I think... I mean, they're pretty goth with the shaved head, and especially a lot of vultures kind of have the grays and the black hues to their feathers. But I mean, does it get more goth than a vampire finch?

Alie: I suppose not!

John: That's one of Darwin's finches. Their main food source is, they fly and they peck the backs of these poor boobies (the birds called boobies) until they draw blood, and then they eat the blood. So, I don't know... Yeah, condors are goth, but it's hard to compete with the vampire finch.

Alie: The only way to do it is having a dance off. Someone's gotta play Bauhaus. They've got to have a dance off. You have a new goal in terms of evolutionary biology.

Thank you for entertaining these questions.

John: [laughs] Absolutely.

To learn more about John McCormack's work, you can follow on Instagram [@MLZBirds](#), which is the account for [the Moore Lab of Zoology at Occidental College](#).

Follow me @alieward on [Instagram](#) or [Twitter](#), and @ologies on [Instagram](#) and [Twitter](#). And to rock a *sweet* Ologies shirt, or pin, or canvas tote, you can head to [OlogiesMerch.com](#). Thank you Boni Dutch and Shannon Feltus for all of your help with that.

Thanks as always to Steven Ray Morris for piecing this together from an insanely highlighted transcript. Thank you Erin Talbert and Hannah Lipow for admining the [Ologies Podcast Facebook group](#), which is full of a bunch of really high quality, awesome people.

Special thanks this week to Ologite Alex Anderson and any listeners who weighed in on gender and identity matters following last week's gynecology episode. I learned so much, and I loved hearing what you all had to say, and what your experiences were. Alex was super cool, and we jumped on the phone and chatted about it for a while. And I included a new intro at the very tippy top of that episode in case you want to go back and listen. You might learn some more stuff.

And thanks especially to all Patrons who fund the podcast so I can pay Steven, and buy equipment, and pay for hosting, and buy memory cards, and batteries, and stupid stuff that's also fun. You can join the Patreon party at Patreon.com/ologies, and that also lets you know what episodes are coming up so you can submit questions to the ologists. I try to ask them all. I sometimes don't get through all of them, but just keep asking.

The theme music was written and performed by Nick Thorburn of the band Islands. And there are more links about the episode at alieward.com/ologies. So if you want more research, just head there.

As always, I tell a secret at the end of the episode as a thanks for sticking through the credits. And today's secret... It's another snack secret. I was going through my laundry, and at the bottom of my laundry I found a purse I haven't used in a while, and I looked in it. There was one piece of, like, a chocolate coin, like Hanukkah gelt. And I was like, "Ah, sweet!" And there was some lint on some of it, but I peeled that off, and I ate it. I ate it! So what? It was in there. People have eaten a lot worse things.

And I thought, "It's April now, that had to be from Hanukkah, that must've been in December." Then I was like, "oh well." Then I realized, y'all it was just from February when I went to Portland. I just remembered that I got a chocolate covered coin up there from the dinner with Cole Imperi, Shannon Feltus, and Boni Dutch! It was still in my purse, and I was really proud of myself that the chocolate I ate was only a month and a half old, instead of being three or four months old. But sometimes you find chocolate in your apartment! You've got to eat it! So what. I'm still alive guys! Still alive. Not going anywhere quite yet. Anyway... Berbye!

[*Outro Music*]

Transcribed by Sam Gottfredsen

Berbye from your weird Uncle Sam (No, not that one!)

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[Carl Sagan, explaining evolution](#)

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[Parodies of the ape mural](#)

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[Newreel music](#) that is fun to put in your podcast as long as you credit it

[Ah man, poor Larmarck](#)

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