00:00:00	Music	Transition	"*Oh No, Ross and Carrie!* Theme Song" by Brian Keith Dalton. A jaunty, upbeat instrumental.
00:00:09	Carrie Poppy	Host	Hello, welcome to *Oh No, Ross and Carrie!*, the show where we don't just report on fringe science, spirituality, and claims of the paranormal, *[incoherent sputtering]* what? No! We take part ourselves.
00:00:18	Ross Blocher	Host	That's right, when they make the claims, we show up so you don't have to. I'm Ross Blocher.
00:00:22	Carrie	Host	And I'm Carrie Poppy.
00:00:23	Ross	Host	And uh, we're here today with an interview.
00:00:25	Carrie	Host	Yeah.
00:00:26	Ross	Host	Another interview from CSICon. C-S-I-Con in Las Vegas 2019.
00:00:31	Carrie	Host	Yeah, so this was you and him, you and he, the interviewee.
00:00:36	Ross	Host	Yes, Nathan H. Lents. He's a biologist and he wrote a book called *Human Errors: A Panorama of Our Glitches, from Pointless Bones to Broken Genes.*
00:00:45	Carrie	Host	Sounds cool.
00:00:46	Ross	Host	Yeah, I'd mentioned this on a previous episode, 'cause I was so jazzed after reading it, and it was a pretty fun story. I kind of talk about it when I interview him, but I saw a guy who had the book on his lap and I said, "Oh, that's a really good book." Like, I thought I was doing him a favor, oh, you're gonna enjoy that. And he said, "Oh. Thanks. I wrote it." *[Carrie laughs loudly.]* "Oh!" And uh, a beautiful friendship was begun.
00:01:08	Carrie	Host	Was this at CSICon?
00:01:09	Ross	Host	Yeah.
00:01:10	Carrie	Host	Oh, wow.
00:01:11	Ross	Host	Yeah, I was just, you know, on my way to my seat.
00:01:12	Carrie	Host	Oh my gosh, that's so funny.
00:01:14	Ross	Host	Yeah, so those are kind of fun happenstances. Also got to see former guest of the show, Britt Hermes.
00:01:20	Carrie	Host	Nice.
00:01:21	Ross	Host	The naturopath. Also saw Susan Gerbic.
00:01:23	Carrie	Host	Former naturopath.
00:01:24	Ross	Host	Yes, good clarification there. Also Susan Gerbic and Mark Edward, our buddies, and a lot of people there. It was a great convention.

00:01:32	Carrie	Host	Nice. You know, speaking of pointing at something and saying, “I like that X” and it turns out they make that X, when I was in Atlanta recently, I walked into this like art fair, and I was wearing an ORRAC shirt, *Oh No, Ross and Carrie!*, and this girl said, uh, “Oh my gosh, I love that show! No one else ever knows about it except for me! I’m so—” *[Ross and Carrie start laughing.]* “I’m so excited to meet someone else who likes it!” and I just let her do it for a good minute, and then I was like, “Okay, I host that.” And she’s like, “Oh my god! Oh, I’m sorry, oh my god!”
00:02:06	Ross	Host	That’s so fun.
00:02:07	Carrie	Host	It was great. It was a delight.
00:02:08	Ross	Host	Anyway, so here’s my interview with Nathan H. Lents.
00:02:10	Carrie	Host	Can’t wait.
00:02:11	Ross	Host	Alright, so today we’re really excited to have a guest on the show, and I had a very funny way of meeting you, which is I saw at SCICon 2019, the conference, I saw a gentleman with a book that I’ve mentioned on the podcast before sitting on his lap. It’s called *Human Errors: A Panorama of Our Glitches, from Pointless Bones to Broken Genes*. Excellent book, and we’re gonna talk a bit more about it, but I pointed at it and said, “Oh, that’s a great book,” thinking I was helping somebody out. “Oh, you’re really gonna enjoy that book.” He said, “Well thanks. I wrote it.” So everybody, here we have Nathan H. Lents. Welcome.
00:02:47	Nathan H. Lents	Guest	Thank you very much, and just to clarify, I don’t go around with copies of my own book. *[Both laugh.]* I had brought a copy for—
00:02:54	Ross	Host	You were giving this.
00:02:55	Nathan	Guest	—someone—I brought a copy for Richard Dawkins. I wanted him to get a copy from me personally, because we had tried to track him down to get an endorsement for the book, when it was gonna come out in the U.K., but he was in Antarctica at the time, so he was—he had an away message on his email and we couldn’t reach him.
00:03:09	Ross	Host	That’s the best excuse I’ve ever heard.
00:03:10	Nathan	Guest	I know, I was like, “That’s a good one, I’ll need to remember that.” But, uh, so I knew he had heard about the book, and we have a common friend who had talked about it, so I said, “I’ll just bring him a paperback and sign it and give it to him then.” So that’s why I had a copy, I don’t go around with a copy of my own book.

00:03:24	Ross	Host	Okay, good. Well, I'm glad we could clarify that. This isn't some weird ego thing. Well, of course the great Richard Dawkins. I, myself, was raised a Creationist, and went to a high school where I had one of those Bob Jones university text books, I still have it, and I had learned ways to argue against evolution, and I went to a series of lectures and I saw Richard Dawkins. I read first *The Selfish Gene* and then *The Ancestor's Tale*.
00:03:47	Nathan	Guest	Excellent book, yeah.
00:03:48	Ross	Host	That's what really clenched it for me, where I finally went, "Oh, I get it. This explains everything, and either I've been lied to or some well-meaning, poorly informed people have led me astray." But that was a super helpful book. So was Neil Shubin's *Your Inner Fish*. And I felt like over the years I've read a lot of really great books about human errors, and kind of the things that are the not so intelligent pieces of design, but reading your book taught me a whole lot more, and so that's why I've been eagerly telling everybody about it. So, super fun to meet you. Can you tell us a bit about yourself? Where do you work, what do you do?
00:04:24	Nathan	Guest	So I work at John Jay College which is one of the colleges of the City University of New York, and I'm in the forensic science department actually, so about half of my research life is in the world of forensics.
00:04:35	Ross	Host	Oh wow.
00:04:36	Nathan	Guest	And then the other half of it is genetics, molecular biology, and right now I'm studying genome evolution. So I'm a scientist part of the day, and I teach classes part of the day, and then with whatever time I have left, I've started writing books and articles of popular science. Because I really enjoy, as a teacher, you know, partly, I really enjoy talking about science and teaching people about science, and I think that biology and specifically evolution, it's not esoteric. It really effects your daily life. You are the product of billions of years of evolution, and in fact, I would emphasize the last ten million years of our evolution really can be seen in our daily lives. Things you do every day, the way we use our bodies, the way we think, and I think it leads to a richer life. You live in better harmony with your own body when you understand how it came to be. And it's led me into, sort of inadvertently at first, into becoming a defender of evolutionary science in the public sphere. And that was a fight that was picked with me, I didn't go out looking for that fight. I spend most of my time with scientists and I live on the coasts and I grew up Catholic and it was foreign to me that people would have all this resistance to evolution and see it as such a big threat, and so when people started picking on me for talking about evolution, I just considered it ridiculous that you wouldn't already believe and understand this stuff. But I've since sort of tried to understand more about what people's

			problem is, why it makes people uncomfortable, this idea about evolution, and I think that I've learned a lot about empathy in the process, and I think that that's something that we sometimes—the humanity of all this gets lost when we argue. And we're never at our best online, right, social media, and that's where the fights often start today.
00:06:12	Ross	Host	Yeah, and we didn't evolve with online forums.
00:06:14	Nathan	Guest	We definitely didn't. We evolved to look people in the eye. Yeah, and when you sit down with a Creationist and talk with them, you'll have a very different kind of conversation than when you're fighting with them online.
00:06:25	Ross	Host	Absolutely.
00:06:26	Nathan	Guest	And a better conversation, when you're talking with them in real life. And you'll meet them where they are and you'll have this personal connection, and you'll understand a little bit more about why they think the way they do, and why they're resistant. And that, for me, is the first step towards undoing whatever it is that makes them so resistant.
00:06:44	Ross	Host	So, the takeaway from this podcast then, first step, go hug a Creationist.
00:06:48	Nathan	Guest	Hug a Creationist.
00:06:49	Ross	Host	Look him eye to eye and have a conversation.
00:06:51	Nathan	Guest	Yeah, that's it, and I do work with Evangelicals right now. I'm involved in a process of—it's science first, so I'm not about trying to bend science so that it can work with religion, that's not what I do. I see a lot of people bending religion to fit science better, and that's fine with me, because science is the winner in that. So, when the two collide—
00:07:09	Ross	Host	Whatever you need to do to make it compatible.
00:07:11	Nathan	Guest	Yeah, exactly. That's how I feel about it. And when the two collide, science doesn't bend, and even if we wanted to try to bend it, it is what it is, right? These things that we're discovering, they don't care that they're being discovered, right? Evolution happened whether we believe it or not, whether we discovered it or not, and so we were the product of four billion years of evolution before we realized we were the product of four billion years of evolution. And so, I'm not worried about science being twisted to fit other narratives. I'm just not worried about it. The truth wins.
00:07:37	Ross	Host	One thing I love from Pope John Paul II is he had an encyclical called *Truth Cannot Contradict Truth*, and I think that's such a powerful statement. So you just always go with the truth, and you'll either have better, newer information, or you'll realize that, you know, you were wrong, but now you can embrace more truth.
00:07:52	Nathan	Guest	Yeah, and the Dalai Lama actually said it I think even better, is he said, "Well, if science discovers something that proves Buddhism

			wrong, Buddhism has to change." And I love that, 'cause here's the leader of a faith tradition admitting that science is going to eventually reveal the truth and we'll have to respond to that. And the thing is they all have done that anyway, right? Because if you look at the Christian tradition and how much it's had to bend and yield and it's been embarrassed by its resistance to science in the past and they've learned that lesson, and I think the Catholic church painfully learned the lesson, but by the time the Big Bang was first really proposed, you know, someone told the Pope, "Don't look stupid again. Don't oppose this. Find God in it, if you will, but don't oppose it." And so I think—
00:08:38	Ross	Host	"By the way, it's 1992, time to apologize to Galileo."
00:08:41	Nathan	Guest	Yeah. Well, but did you see the apology? It was like— *[Ross laughs.]* —there was blame on both sides. Oh gee, that's really not an apology.
00:08:48	Ross	Host	Non-apology.
00:08:49	Nathan	Guest	Yeah, non-apology.
00:08:50	Ross	Host	In another 400-500 years.
00:08:51	Nathan	Guest	"But Galileo was arrogant." Well, it's, you know, arrogant's one way to look at it, correct is the other way. I do think, though, that we are on the precipice of a breakthrough, at least when it comes to evolution. I think that a lot of Christians in this country are embarrassed to be so resistant to science, and they know it doesn't make them look smart, it doesn't make them look good, and especially among the young generation of Christian Evangelicals, I think they are looking for a way out of this fight. So I'm part of that, and I know I'm going out on a limb here and there—
00:09:15	Ross	Host	That's great, but you want to give them an olive branch, an easy path to get there without having to be shamefaced or apologetic or anything like that.
00:09:23	Nathan	Guest	Exactly that, exactly that. In fact, um, can we swear on this podcast?
00:09:26	Ross	Host	Yes. Please do.
00:09:27	Nathan	Guest	Okay, so in the talk earlier today, he echoed a talk nine years ago where the message is, "Don't be a dick." You know, you can defend sound evolutionary science without calling people stupid for not understanding it. And also, before you call anyone stupid for not understanding it, have you explained it to them?
00:09:42	Ross	Host	Right.

00:09:43	Nathan	Guest	Have you really? Because there's so many misconceptions out there. And I'll admit, I had misconceptions about Intelligent Design. Big misconceptions actually about what it is and what it says.
00:09:52	Ross	Host	Because you said that you wrote *Human Errors* aware that there are Creationists out there who maybe need to understand more about our human body plan and how that comes from our evolutionary antecedents, but that you weren't too aware of this Intelligent Design movement, and writing this book sort of brought them down upon you.
00:10:10	Nathan	Guest	Yeah, exactly that. I didn't think I was picking a fight with them, and in fact I was annoyed at first because they said, "Well, you entered this by talking about design." I was like, "I didn't know you owned that topic. I didn't know I had to clear my book by you, and whether I satisfied all your critiques. I just wrote a book for bio—" I assumed the people who would read my book had already bought into evolution and they wanted to be delighted and entertained about the evolution of the human body, that's what it was. But they accused me of sort of entering the design debate, and then writing a book that was a poor refutation of Intelligent Design. First of all, they didn't read the book, it's very clear. But I didn't write it as a refutation of Intelligent Design. I didn't have Intelligent Design in mind at all. I would have written it very differently if I wanted to go out there and argue. However, the content of the book does challenge Intelligent Design, so I'm not, in hindsight I'm not surprised that they were offended.
00:10:58	Ross	Host	You're talking about some of their favorite discussion pieces, like junk DNA and evolutionary pathways.
00:11:03	Nathan	Guest	Exactly, and they—but the problem is they're very, I know this is not the right word to use, but they're very schizophrenic in how they approach this. And this confused me too, because half of their criticisms of my book were, "Well, we didn't say perfect design. So, you're arguing against a position we don't hold. You're arguing against the straw man of perfect design. We're not saying anything about perfection." Okay. And then the other half of their criticisms were about the individual flaws that I discussed, and how they're not really flaws at all, and it's actually good design. Well, which is it? Are you saying that we do have these flaws and that's fine, or we don't? So, you know, it took me months, I'll admit it took me longer than it should have to realize what Intelligent Design is, is that it is a very loose confederation of very different views. So there's people in the Intelligent Design community that are Young Earth Creationists. There are those that believe in common descent and real age of the Earth, and everything in between, and they don't have any coherent theory that brings their ideas into focus, like we have with evolutionary theory, which explains evidence, makes predictions, can be tested. They don't have anything close to a unifying theory. So that's why it's so schizophrenic, that's why it's so all over the

			place and doesn't make sense.
00:12:12	Ross	Host	Yeah. What we experienced at, looking at an extreme example, the Flat Earth movement, rather than having a cohesive map or model of how all this works, all they have are a collection of arguments against the other position, and it doesn't matter if they're mutually exclusive or incompatible.
00:12:28	Nathan	Guest	That's exactly right for Intelligent Design as well. It's a collection of criticisms, many of which have been answered, by the way. But it's a collection of criticisms loosely affiliated under this. And occasionally they'll even admit it. One member of the community named Paul Nelson, who is a very nice man, smart man, nice man, I've interacted with him always positively, thoughtful person, and he got caught sort of admitting publicly that movement still is yearning for a cohesive theory to be articulated. This was 15-20 years ago. Still waiting on that theory. And I know he takes a lot of heat from his community for occasionally telling the truth.
00:13:03	Ross	Host	Pointing that out.
00:13:05	Nathan	Guest	But they don't have a coherent theory. And we didn't either as the scientific community until 1859, right? So, you know, it's fine. They're floundering because—the way we were.
00:13:14	Ross	Host	It's funny, that is a refrain of the Flat Earth movement as well, like, "Well, you've had 500 years to get your story straight."
00:13:20	Nathan	Guest	Yeah. Right. Okay. Well, until then. But if you've read books about the history of scientific ideas, this gets into philosophy a little bit, but the importance of a unifying theory that gathers the evidence is really crucial to good science.
00:13:34	Ross	Host	Because then you can start making predictions.
00:13:36	Nathan	Guest	It's the predictive elements of it, yeah. And so when you don't have that, it's totally unfocused.
00:13:41	Ross	Host	Maybe we should take just a step back to define Intelligent Design, if someone's not familiar with that movement. It kind of came out of Creationism, but Young Earth Creationism, the idea that the Earth was started in 4004 B.C. or literally six day creation, that has very clearly, and court battle's been shown to be religiously motivated and not science, not apropo, for the science class. And so kind of the newer movement within the Christian community has been to say, "Okay, well let's be far less direct about it and say, well at least we see signs of a design or someone who created all of this biological complexity that we see." And they have the Discovery Institute in Washington, I think that's—
00:14:19	Nathan	Guest	In Seattle, that's right.
00:14:20	Ross	Host	—their main think tank. So you're talking about a lot of those people that you've interacted with.
00:14:25	Nathan	Guest	Yes, for the most part. Most people I've interacted with have been either affiliated with or working at the Discovery Institute. They call

			themselves the intellectual home of Intelligent Design movement, and it is a collection of criticisms mostly, for the most part, and it comes down to they don't think it's plausible that all the complexity we see in life could come about by random molecular events. And so, it is more narrow than most people think, even than I thought before. It is quite narrow. And they would even admit to micro-evolution, for example, and natural selection. They have no trouble with natural selection on shorter time scales, but they don't think it gets you to very unlikely things, and that's when there has to be some sort of intervention, some sort of design. So they sometimes say that evolution of species and maybe even genera, possibly families of organisms can happen by just random changes, but big, innovative things can't happen by that random process, and of course, why do they—they've moved that goalpost several times. Even Michael Behe himself has moved that goalpost recently. But the point is that, of course they don't argue with some of those level of changes because we've already seen them in the lab. But we don't have a time machine where it's necessary to see millions of years of change.
00:15:36	Ross	Host	But we've made a step in the right direction, because at least they're accepting a lot of the accepted science, but then you have a God who sat over a world of bacteria for, you know, three billion years before more complex life came about. You know, that's a separate theological issue, but it seems like they really fixate on particular things like, hemoglobin, how did you get to that molecule, or—
00:15:59	Nathan	Guest	Blood clotting, cascade, things like this.
00:16:00	Ross	Host	The flagella of the bacteria.
00:16:02	Nathan	Guest	Right, well, I love the flagella as an example, first of all because it used to be the eye that they loved. The eye has all these parts, there's no way that it can function—
00:16:10	Ross	Host	Darwin himself admitted that, you know, it was difficult to explain.
00:16:12	Nathan	Guest	—how could it function until all the parts are in place? Because you don't have any advantage until they're all there, so there's no way you could have evolved it. First of all, the eye doesn't—evolution doesn't form fully formed parts and add them to it. The whole thing evolves as a unit.
00:16:25	Ross	Host	It co-opts whatever is there.
00:16:27	Nathan	Guest	Exactly. And then—but we've now, of course, basically figured out, because of their criticisms party at least, we have really good examples of the evolution of the eye, among extant organisms and from fossils. We actually don't have any in real—
00:16:39	Ross	Host	There's something like forty convergent, like separate evolutions of the eye.
00:16:43	Nathan	Guest	Oh, yeah. The eye itself has been invented many, many times, but

			even if you just consider the vertebrate eye, we have so many intermediate examples from living organisms, from fossils, there's not any big black box on eye evolution, so they've retreated to this example of bacterial flagellum. And—because that doesn't fossilize, so of course it's going to be very hard for us to—but we have good, really good theories on that.
00:17:04	Ross	Host	Right, I love as soon as the Intelligent Design proponents will suggest one of these things where we don't have a clear pathway, then that kind of invites a bunch of scientists to look very closely and do a lot of good research and models and then point, "Oh, this is exactly how it could have happened."
00:17:20	Nathan	Guest	That's right, and so criticism is good for science. Criticism is how we do our best work. So, I don't want anyone to come away with this thinking that we resent the criticism. In some cases, it does, like you mention, focus us. Other times, though, we have to spend a lot of our time and energy batting away silly criticisms, which does take away from honorifics.
00:17:37	Ross	Host	Right, and they don't always quickly change their arguments based on those responses.
00:17:41	Nathan	Guest	To my knowledge, they've never admitted any mistake. There's—so, there's two commandments in the Discovery Institute. One is never cede a point. Never, ever admit any point. Move on if you must, but never admit a point. And number two, never criticize your fellow Intelligent Designer. And this is how Young Earth Creationists and someone like Michael Behe, who does accept the true age of the Earth, and common descent of all things, they can get along under this camp, because they have this commandment keeping them in line, even though—
00:18:10	Ross	Host	The enemy of my enemy is my friend.
00:18:12	Nathan	Guest	Exactly, and I have more in common scientifically with Michael Behe than any of these Young Earth Creationists do, but he's still in camp with them. But the thing about the Discovery Institute that can't be missed here is that it is first and foremost a political activist organization. That's how it was formed, if you look at its foundation documents, articles incorporation, they have an advocacy role. They're not a science group. And that makes a big difference, because it organizes their motives, it organizes their thoughts, and if you've read anything about what Noam Chomsky has written about organizations and people versus individuals, you know, they can totally warp your thinking, warp your motives, and you have this sort of group think and it closes you off. That's their organizing principle. They're not open to other interpretations because that's why they're there, that's why they exist. So to even contemplate a natural view of evolution is an existential threat, so they're not gonna do it.
00:19:03	Ross	Host	Right, so you're already constrained within that answer that you've arrived at, now we have to work backwards to get the reasons to hold that—

00:19:10	Nathan	Guest	Yup, it was born of conservative politics. Socially conservative politics.
00:19:13	Ross	Host	Right, and we have examples like that book *Of Pandas and People*. You know, it was written as a Creationist textbook, and then they realized, oh shoot we can't do that, and so they did a search, a word replacement—
00:19:22	Nathan	Guest	Yeah, Microsoft Word, yeah.
00:19:23	Ross	Host	—to replace God with Designer, essentially.
00:19:26	Nathan	Guest	And that—I mean, they got caught red handed with that. They got caught red handed with lots of stuff, they never admit it. I mean, you must have heard of the Wedge Document that they have, it sort of organized them.
00:19:35	Ross	Host	They showed that political strategy.
00:19:36	Nathan	Guest	Yeah, and they'll never admit that. And if you follow Evolution News and Views, which is their website—I don't follow it, but they've written about me so many times that I have been on the website to read their articles. Some articles are about science, other ones are about euthanasia, abortion, gay marriage, or the family in marriage. I mean, is this an evolution science website or is this, you know, it's clearly about politics.
00:19:57	Ross	Host	Wow. I was not aware of that, wow.
00:19:59	Nathan	Guest	Oh yeah. He writes—they go off on these assisted suicide things, legalization of drugs, they can't help but sort of show their political affiliations.
00:20:09	Ross	Host	And yet they won't ever say—they won't ever tie the Intelligent Designer to God explicitly because they want to have that sort of plausible deniability.
00:20:16	Nathan	Guest	And that's what, at that point it does irritate me, because it's dishonest. Right? Like, I'll tell you my politics, I'll tell you my motives. It's all out there in the open. I don't try to do this, but I'm really trying to do that. They're just not honest.
00:20:30	Ross	Host	Yeah. That's a problem. Well, you said something fantastic today about how even those of us who kind of understand the evolutionary worldview and how we got to be where we are still have kind of these lingering illusions about our bodies. Can you talk a bit to that?
00:20:44	Nathan	Guest	Sure. So, the first thing that my book pushes back against is this idea that evolution produces perfection, or that organisms are perfectly adapted for their environment. A lot of people think this way, even scientists think this way. It's sort of embedded in our view that the wonders of nature, and look how everything is perfectly suited for its environment.
00:21:03	Ross	Host	Somehow we are the peak of—
00:21:06	Nathan	Guest	Yeah, the corollary to that is that humans are the ultimate expression of biological perfection. Everything else is a lower form,

			it was a march of progress toward the human form. Neither of those things are true.
00:21:18	Ross	Host	It has this kind of built in teleology to it. There was an intent that eventually we'll get to humans.
00:21:24	Nathan	Guest	That's right. And it was goal oriented in that. And so I pushed back against both of those ideas separately. Nature does not produce perfection, and in fact there's no such thing as perfection in nature. I mean, you can't even theoretically think of what that would be, so do this little thought experiment: What is a perfect organism? So, it beats all of its infectious diseases, it has no parasites, it out-competes its competitors, escapes its predators, it eats all of its food. How long could it stay that way, right, before it's eaten all the food, and it's taken over, and—
00:21:54	Ross	Host	It's expanded, used all the resources, and there's nothing left for it. Now it's a failure all of the sudden.
00:21:59	Nathan	Guest	Exactly. So you can't even theoretically think of what a perfect organism would be. Everything is a struggle, the Red Queen hypothesis has taught us that, that you have to struggle to stay alive even without major adaptation going on, just to stay a member of our planet.
00:22:12	Ross	Host	And even success is tied to the environment that you live in, and the environment changes.
00:22:16	Nathan	Guest	It changes constantly, at the micro level especially but even at the macro level. So if we look at the organisms that have persisted the longest—horseshoe crabs, great white sharks, things like this—they still are evolving on the molecular scale just to out-compete infectious diseases, if nothing else. But there's more than that.
00:22:31	Ross	Host	That's always an interesting thought, that even something that has held a pretty consistent form over millions of years has changed quite a bit in terms of genetics. *[Ross replies affirmatively several times as Nathan speaks.]*
00:22:38	Nathan	Guest	Yeah. Underneath, their anatomy hasn't changed much because they're living in basically the same way, because their environment hasn't undergone—and if you think of great white sharks, they are apex predators, so what they eat doesn't matter, right, they'll eat different things and so they really don't have to undergo any major anatomical changes, but they are certainly evolving on the molecular scale at least, because of infectious diseases and changes in ocean temperature. I mean, all of these things will have an effect. So I push back against those two things. Humans are not the pinnacle of evolution, we have our own problems, and in fact—I didn't get a chance to say this much at the presentation today, but I strongly believe that humans are more flawed than most, possibly the most flawed of all vertebrate animals, actually, because something radical has happened in us. It took time, and this is happening over a lot of time, but we have made cultural evolution

			the engine of our evolution rather than genetic and biological. So what that means is, when we encounter a change in the environment or we move to a new environment, we don't wait around for mutations to solve the problems.
00:23:39	Ross	Host	Right, we sell parkas, or we build heaters and air conditioners.
00:23:43	Nathan	Guest	Exactly, and even before that, like even in the simplest sense, we have division of labor, and we're the ultimate generalists. I mean, think of it this way. So there's an animal that's stronger than us, there's an animal that can climb better than we can, run faster. There's not a—
00:23:56	Ross	Host	Any feature you can name.
00:23:57	Nathan	Guest	There's an animal that does it better, but we can do it all. Find another creature that can climb, and run, and swim, and do all of the things that we can do. So we became ultimate generalists first of all, so we can survive all these different ways, we can eat all kinds of different foods, so that's great, but then we also started solving our problems with our intricate social structure, division of labor, reliance on each other, and of course, just our big brains. So we're solving the problems with our brains instead of our bodies, and that took natural selection's watchful eye off of our bodies. So, when you can be really weak but still survive because you contribute to the group, weakness isn't weeded out. If your poor vision means you just do a different job, then poor vision doesn't get—imagine a hawk with poor eyesight.
00:24:41	Ross	Host	That doesn't get to eat.
00:24:42	Nathan	Guest	There's exactly zero hawks that have poor eyesight.
00:24:44	Ross	Host	It will notice an immediate effect on its ability.
00:24:45	Nathan	Guest	Immediate. But you, if you have poor eyesight, you just do a different job.
00:24:49	Ross	Host	Yeah. Or get surgery or glasses.
00:24:50	Nathan	Guest	Well, yeah, but even before that.
00:24:52	Ross	Host	Yeah.
00:24:53	Nathan	Guest	So the point is, we've been—we haven't been living and dying on the strength of our bodies for a very long time, and so that's why our bodies are so flexible.
00:25:00	Ross	Host	It always comes back to selection, and yeah, we've kind of removed the natural selection.
00:25:05	Nathan	Guest	Yeah, so it's a good—I think my book is an uplifting story. Aren't you glad that your body doesn't have to be perfect for you to contribute? So it is a triumph in a sense, that we're allowed to be such crappy a species in most ways but yet still survive. Another way I put it is, there's no mammal that can live in coldest tundra, the driest desert, the wettest rainforest, temperate, every single climate on this planet, we're the only mammal on this planet that can do it, because we

			invented clothes and shelter and homes. So, it's not our bodies that are capable of that, it's our brains that figured out how to do that. When you do that, when you stop following the regular rules of natural selection, and you put cultural evolution in the driver's seat instead of genetic evolution, then it does end up with these consequences. So our bodies, we need vitamin C in our diet, for example, and other weird things, and so that's—I think it's a good thing overall, though. I'm certainly glad to be living this way instead of the alternative.
00:26:02	Ross	Host	Oh, by all means, I think if I had to choose where to be born, I would choose now rather than any other time in our evolutionary history. So, let's get into some of these things. One I had mentioned on the podcast before is what you had said about vitamins. Now, you have kind of—you have three broad fields, or different types of these errors, and one was like, mismatching.
00:26:22	Nathan	Guest	Mismatch, yeah. So this is just the idea that we're now living in a very different world in very different ways than our bodies were evolved to live in. We're very—we have great bodies for the African savannah in the Pleistocene, but we now work in offices and sit in chairs, so that's a good category of flaws in the sense that you can do something about that, you know, you can get a stand up desk and you can make sure you get up and walk around a lot and you can look at your diet and say, "How much does it match the diet of the ancestors and what can I do to make it better?" There's lots of things you can do. I like those categories very much because we can still take charge, and I've learned a lot over the last five years, and I'm living in a more evolutionarily correct way, I would say. I've learned from Dan Lieberman and others.
00:27:04	Ross	Host	Yeah, how do you sit when you're working at your desk when you're writing?
00:27:07	Nathan	Guest	I stand. As much as I can, I stand.
00:27:09	Ross	Host	Okay, you've got a standing desk.
00:27:10	Nathan	Guest	Yeah, and then I don't stand as much at work because I get ridiculed, so I had a stand up desk for a while and so I—social pressure, and uh, *[Laughs.]*
00:27:17	Ross	Host	Oh, interesting. We have, at least at my work, we have desks that you can adjust and you can—
00:27:22	Nathan	Guest	Well, you're in California, it's more accepting. In New York they just uh—
00:27:26	Ross	Host	We're all hippies.
00:27:27	Nathan	Guest	In New York they just make fun of you. But no, no, I try to—
00:27:29	Ross	Host	You were saying this to the audience and I was sitting in the chair, and I'm comfortable, because I'd been there for hours.

00:27:35	Nathan	Guest	Yeah, chairs are just not good for us in any way. Get out of that chair as much as you can. So those are mismatch flaws. I like those, but there's other kinds of flaws that there's no fix for most of these things. So some of them, I call them trade-offs—well, I don't call them trade-offs, they are trade-offs. They're evolutionary compromises. So you gain one function, you lose another, but then some of our quirks are just bad luck that wasn't corrected, and so our diet's a good example of that. When we started eating in this very generalist way as we moved away from, you know, being vegetarians to being more omnivorous, we had all these different rich sorts of foods, and what that was was nature was providing us on a silver platter all these rich, nutritious foods, and then our ability to make those things ourselves, and even extract them in some cases, just got diminished over time. Because even though Lamarck missed the mark in some ways, he actually wasn't wrong about this idea of use and disuse. So if you don't use something over evolutionary time—
00:28:32	Ross	Host	You lose it.
00:28:33	Nathan	Guest	—it does go away, yeah, because of the randomness and mutations, it'll eventually strike something, if there's no consequences you could lose it.
00:28:38	Ross	Host	So the story of vitamin C was such a good example of that, and for me that was fascinating reading your book, because I had always wondered that, like why can I give my cat this same daily basic diet and that's enough for her, and yet I need to eat all these different things, and I'm tired if I have to eat Italian twice in the same day, you know.
00:28:57	Nathan	Guest	That's right, and we are built to seek out that diversity of food, I believe. That's part of our natural appetite. And citrus fruit is a good source of vitamin C, but most animals have no need for that in their diet, and in fact it's not healthy for them, but humans, and actually all primates, need vitamin C because we lost the ability to make it ourselves. A key gene was mutated.
00:29:17	Ross	Host	What did you say, the GULO gene?
00:29:18	Nathan	Guest	The GULO gene, G-U-L-O. It stands for L-gulonolactone oxidase. The thing is it's a key step in vitamin C synthesis, and without vitamin C you can't make collagen, and collagen is important for all the tissues of our bodies, structural integrity of those tissues, and so if you don't get vitamin C, your tissues fall apart and we call that scurvy. But how did this happen in the first place? How did the first primate, the ancestor of all primates, when she got this mutation, why didn't she just die of scurvy and that was the end of it? She took those mutations with her. Well, she had vitamin C in her diet already.
00:29:49	Ross	Host	She was surrounded by some sort of citrus probably.

00:29:51	Nathan	Guest	Yeah, or other sources, and where do primates live? In the Rainforest, where there's plenty of vitamin C around. So it makes sense, and then of course through bad luck it got fixed in the population, and this happened to be a population that would become the ancestor of this great clade of organisms and it was primates. And—but, primates have always been restricted to environments that have vitamin C in them, mostly tropical and Rainforest, and so every time primates tried to go into other areas I'm sure they died of scurvy. The continent of Europe was primate-free for all of its history until Neanderthals, and then later modern humans. We're the only primates that successfully colonized it, and probably got a lot of scurvy as they did so. There's actually an exception to that now. I love this story. So there's a species called Barbary macaques, and as the name suggests—
00:30:37	Ross	Host	Barbary coast.
00:30:38	Nathan	Guest	—they live in Northern Africa, and they have started migrating, and they're threatened, severely threatened in Morocco, but they've started migrating through the Strait of Gibraltar on boats to Southern Spain, where they're now thriving.
00:30:50	Ross	Host	On boats.
00:30:51	Nathan	Guest	Yeah, so they—
00:30:52	Ross	Host	Hitchhiking?
00:30:53	Nathan	Guest	They hitchhike. They stow away on these boats and they end up—there's wild populations now of Barbary macaques in Southern Spain, but there's dates and other things that they can eat for vitamin C. So that's why they live there and they're thriving there, and I love this so much because that's Barbary macaques on the cover of my first book. A family of Barbary macaques, two parents and a baby, and by the way, those are both females.
00:31:13	Ross	Host	Oh, really!
00:31:14	Nathan	Guest	It's a matriarchal species, and—
00:31:16	Ross	Host	Not just the Bonobos.
00:31:17	Nathan	Guest	Nope, there's lots of matriarchal species out there, and the great thing about Barbary macaques is they're also engaged in alloparenting, meaning—
00:31:25	Ross	Host	It's a fungible asset, like anyone can—
00:31:26	Nathan	Guest	Yeah, that's right. They all contribute to parenting, and there's not that much preference to parent only your own kin, so they're another species that teaches us that nature is not just red and tooth and claw, but actually cooperation and social support is something that humans did not invent, but we did capitalize on and take to its extreme.
00:31:47	Ross	Host	So we should mention that book, *Not So Different*. That was your

			first book.
00:31:50	Nathan	Guest	That's right, and it's—
00:31:51	Ross	Host	I look forward to reading this.
00:31:52	Nathan	Guest	Yeah, it's kind of an evolutionary psychology book. I don't take it that way. What I do is just look at behavioral similarities between humans and other animals, so let's dissect human behavior by looking at animal behavior. "Why do animals do these things and have these emotions, what do these emotions drive them to do?" as a way to sort of understanding our own emotions and what it drives us to do.
00:32:11	Ross	Host	This weighs very heavily on discussions of human morality, because we'll often say, well, where do you get your morals? Well, look at the animals, where do they get theirs? Because they practice many of these same things.
00:32:21	Nathan	Guest	Exactly, humans did not invent morality. We invented ways to talk about morality, and ascribe the source of morality to something other than nature, but—
00:32:30	Ross	Host	But morality is all about existing within a group, you know, it's all about your relationship with others, and that had to be hammered out to some extent before we could talk about it.
00:32:28	Nathan	Guest	Yeah, that's right. We have moral instincts, and some of them come from, as you said, group living and how you can get on, but also some other things, like shame and gossip and reputation—
00:32:50	Ross	Host	Shunning.
00:32:51	Nathan	Guest	Yeah, we didn't invent any of that, actually. Other species do it. We do it, we're very sensitive to gossip and shame and reputation, and so we act in moral ways because we want people to think we act in moral ways. *[Both laugh.]* But again, people think like, "Ah, doesn't that just make it a cold view of life?" I don't get that at all. I don't understand that criticism of an atheistic world view one bit, because to me, to know that our system of morality, of treating other people with dignity and care, the fact that it has millions of years of history enriches it. That doesn't cheapen it, and it shows that it's in us. It doesn't have to come from somewhere else, it doesn't have to be handed to us. It's part of us, it's baked into our DNA to care about other people.
00:33:32	Ross	Host	And we care about stories, and that makes us part of a very long and very cool story.
00:33:36	Nathan	Guest	Very long, very cool story, and we are storytellers, right? And so it's not surprising that we would try to come up with origin stories for example, and stories about morality and all, that's not surprising. What's surprising is how persistent those stories have been in our psyche when we now have such great evidence for where this all actually came from. That's the stubborn part, and I talk about that a

			little bit in *Human Errors*, how when you form an opinion, you are really wedded to that opinion. We all do it, it's one of our many cognitive biases, that we are very refractory to alternative evidence to what we actually really want to believe. So that's what I do. That's why I do what I do.
00:34:15	Ross	Host	That's fascinating, and we can kind of point to evolutionary reasons why we have some of those predispositions.
00:34:20	Nathan	Guest	I think it's served us well in the past.
00:34:21	Carrie	Promo	Uh, Ross.
00:34:22	Ross	Promo	Um, hi, Carrie.
00:34:24	Carrie	Promo	Sorry to interrupt your convention.
00:34:25	Ross	Promo	That's weird, you're not here.
00:34:26	Carrie	Promo	I'm speaking to you through telepathy.
00:34:27	Ross	Promo	Oh, very cool. Well, welcome to my head.
00:34:30	Carrie	Promo	Yeah, no problem. It's good to be here. Boy, there is a lot of shit in here. There's so many number—what are all these numbers? What is—is this the periodic table?
00:34:39	Ross	Promo	Just leave everything where you found it.
00:34:41	Carrie	Promo	*[Laughs.]* Okay, fair enough. Well, you know, Ross.
00:34:46	Ross	Promo	Yes, Carrie, voice in my head.
00:34:47	Carrie	Promo	I came here to talk to you about bras.
00:34:50	Ross	Promo	Oh, okay. I am talking to Nathan Lents right now, but, by all—hold on, Nathan. Carrie's gonna tell me about bras.
00:34:56	Carrie	Promo	Did he tell you anything about boobs?
00:34:58	Ross	Promo	Uh, no.
00:34:59	Carrie	Promo	The evolution of boobs?
00:35:00	Ross	Promo	He did not.
00:35:01	Carrie	Promo	Okay.
00:35:02	Ross	Promo	Yea or nay. Not that I recall, you know, I think boobs escaped the category of human errors.
00:35:07	Carrie	Promo	I guess boobs are one of those things that we don't need a lot more explaining for. It's pretty obvious how those came to be.
00:35:14	Ross	Promo	Okay. Yes.
00:35:15	Carrie	Promo	I mean, if you—yeah. If you believe in evolution.
00:35:16	Ross	Promo	They work relatively well.
00:35:18	Carrie	Promo	Yeah, you make milk, if you want to. Anyway, the point is, Ross, if

			you have boobs and you want to put them in something, you want something comfortable!
00:35:26	Ross	Promo	Yeah, evolution didn't give you that.
00:35:28	Carrie	Promo	Exactly.
00:35:29	Ross	Promo	And yet, we know a company that did, which is ThirdLove.
00:35:32	Carrie	Promo	Precisely. ThirdLove. It's a great brassiere company. One of my favorite bras is from ThirdLove, it's super light but it still does its job. Often you have to trade between those two things, you know?
00:35:44	Ross	Promo	Oh, right.
00:35:45	Carrie	Promo	You get a real sturdy bra but it's also weighing you down. This does both jobs, and—
00:35:50	Ross	Promo	That's impressive.
00:35:51	Carrie	Promo	Yeah. If you have sloping shoulders like I do, it doesn't slip off your gosh dang shoulders like everybody else's bra.
00:35:57	Ross	Promo	Boy, that's an advantage. So, whatever breasts the good evolution gave you, you can try the fit finder quiz at ThirdLove, and it'll tell you which size you should be wearing. You might find out something you didn't know.
00:36:10	Carrie	Promo	Exactly, and it's nice to be able to order these things from the comfort of your own home, and ThirdLove bras are designed to be super comfortable, they're lightweight, they have memory cups, and they have tagless labels, which is nice. No itchy tags.
00:36:23	Ross	Promo	Yeah, and you have 60 days to wear it, wash it, put it to the test, and if you don't love it, return it. ThirdLove will wash it and donate it to a woman in need.
00:36:31	Carrie	Promo	ThirdLove knows that there's a perfect bra for everyone, so right now they're offering our listeners 15% off your first order.
00:36:28	Ross	Promo	Just go to ThirdLove.com/ohno right now to find your perfect fitting bra and get 15% off your first purchase.
00:36:45	Carrie	Promo	That's ThirdLove.com/ohno for 15% off today.
00:36:48	Ross	Promo	Hey Carrie, before you uh, leave my head.
00:36:51	Carrie	Promo	Yeah, what's up?
00:36:52	Ross	Promo	And next time, I dunno, maybe ask or some—I dunno, text me—
00:36:54	Carrie	Promo	Hmm. Mm-mm, mm-mm.
00:36:55	Ross	Promo	—in advance, I dunno.
00:36:56	Carrie	Promo	That's not how telepathy works.
00:36:58	Ross	Promo	Okay.
00:36:59	Carrie	Promo	I am here all the time now!

00:37:01	Ross	Promo	Mm. Alright, but you do tell me when you're here, right? *[Carrie aughs in a quiet, sinister way.]* Oh, jeez. Okay. Well.
00:37:07	Carrie	Promo	Okay well, before I go then, *[mocking tone]* because I don't want to interrupt you again and freak you out.
00:37:12	Ross	Promo	Yeah, yeah. Wait a sec, I bet you know what I was gonna mention next.
00:37:15	Carrie	Promo	I—okay. You're thinking of a bird.
00:37:17	Ross	Promo	Yes. Yeah.
00:37:19	Carrie	Promo	Okay, you're thinking of a bird that's got great balance.
00:37:24	Ross	Promo	Yes.
00:37:25	Carrie	Promo	You're thinking of a bird that's got great balance and eats fish.
00:37:29	Ross	Promo	Mm-hm.
00:37:30	Carrie	Promo	You're thinking of a bird, great balance, eats fish, often seen at the zoo.
00:37:34	Ross	Promo	Okay, yes.
00:37:35	Carrie	Promo	You're thinking of a bird, great balance, fish, zoo, associated with Florida.
00:37:39	Ross	Promo	Correct. Amazing.
00:37:41	Carrie	Promo	Okay. Okay. Are you thinking of the bald eagle?
00:37:44	Ross	Promo	No. That's entirely wrong.
00:37:45	Carrie	Promo	Oh, fuck. Okay, I can't read minds.
00:37:48	Ross	Promo	Well, I was very impressed there for a moment. I was thinking of flamingo.
00:37:51	Carrie	Promo	Oh, flamingo.
00:37:53	Ross	Promo	It might have thrown you off, I mean I was thinking of the bird but I was also thinking of the hotel where this conference is being held, and also an amazing company that produces ladies' shaving razors.
00:38:03	Carrie	Promo	It's funny you mention that, because I have a Flamingo razor. I love it. They—don't tell anyone, Ross—but they sent me one for free to try it out. I liked it so much, I went and used my own money dollars to buy more.
00:38:16	Ross	Promo	Fantastic.
00:38:17	Carrie	Promo	Yeah, they're really good.
00:38:18	Ross	Promo	Okay, well I won't tell anybody. Yours and my secret.

00:38:21	Carrie	Promo	‘Cause, you know, I like to keep a shaved leg, but also some of these razors, they’re not so good. Ah, you’ve probably had this experience on your own face. Some razors, like, you shave and it’s like, I really don’t have to do this for another few days. Then some razors you use them and it’s like, I’m prickly tomorrow.
00:38:37	Ross	Promo	Correct.
00:38:38	Carrie	Promo	Flamingo does the job.
00:38:39	Ross	Promo	Oh, that’s awesome.
00:38:40	Carrie	Promo	Keeps the hair at bay.
00:38:41	Ross	Promo	That’s always an amazing thing, when it somehow, I don’t know, pulls the hair and cuts it, so it kind of snaps back into your skin, it seems. Like it’s hidden again. Extra close shave. So, it does one of that.
00:38:52	Carrie	Promo	Is that what it does?
00:38:53	Ross	Promo	I think that’s the idea is that it kind of pulls the hair, cuts it, and then it—
00:38:56	Carrie	Promo	Oh, woah.
00:38:57	Ross	Promo	—sort of snaps back in.
00:38:59	Carrie	Promo	Woah.
00:39:00	Ross	Promo	That’s my mental picture anyhow. How often do you shave?
00:39:03	Carrie	Promo	Well, now probably, mmm, with my Flamingo I would say only like twice a week.
00:39:08	Ross	Promo	Wow, okay. So that’s an improvement. Excellent.
00:39:10	Carrie	Promo	Yeah, it’s doing great. And what a coincidence we’d be talking about it, because this episode is sponsored in part by Flamingo.
00:39:16	Ross	Promo	Well, uh, hey, evolution gave you hair on your legs and if you don’t want it there, this is just the right product for you, and this solution comes from the folks behind the razor brand Harry’s. Flamingo makes body care for women with hair. They’ve got razors, shave gel, body lotion, the works.
00:39:30	Carrie	Promo	So listen guys, think about it. You probably spend more than sixteen bucks on razors and blades already. With a Flamingo shave set, you can upgrade for the same amount or even less than you’re paying now, including the parts you skimp on like shave gel and exfoliating lotion, and they even send you a shower holder.
00:39:46	Ross	Promo	Flamingo shave set features their award winning product for just $16, and it ships free directly to your door.
00:39:52	Carrie	Promo	It’s a $22 value for just sixteen buckarinos with free shipping today when you visit ShopFlamingo.com/ohno.
00:40:01	Ross	Promo	That’s right, visit ShopFlamingo.com/ohno.

00:40:05	Carrie	Promo	Did you hear that, Nathan Lents?
00:40:07	Ross	Promo	Yeah, he says he did.
00:40:08	Carrie	Promo	Oh, good. Well, I'll be back later, bye!
00:40:10	Ross	Host	Now, if I can ask you a quick follow up question about the vitamin C thing. What do you think would happen if we did take a healthy working copy of a GULO gene and CRISPR it into somebody's genome?
00:40:20	Nathan	Guest	So, it wouldn't be as simple, unfortunately, as fixing the one gene, because other steps of the pathway have since decayed.
00:40:27	Ross	Host	It's very interconnected.
00:40:29	Nathan	Guest	But let me take the question at face value and say, if we could fix this with CRISPR, absolutely that would be great, except I don't think we need more reasons to not eat well. *[Both laugh.]* Right, so I would just assume we actually have the fix for this gene, and that is eat your vegetables and fruits. So you just do that, you're better off for a number of reasons. I would like to deploy CRISPR for a lot of things, but not really for vitamin C.
00:40:52	Ross	Host	Okay. I mean, you've got to tell the story about vitamin B-12, that's another fascinating one. I went vegetarian three years ago, but I get enough animal products still that I'm not worried about being deficient, but I have a lot of vegan friends, and that's really the one thing, 'cause people will say, oh well look at our teeth, look at our guts, we were built to absorb meat and eat meat. For the most part, no, but B-12 is a legitimate thing that vegans have to supplement.
00:41:15	Nathan	Guest	That's right. B-12, there's almost no plant sources of B-12. Cobalamin is the name of the—actually, cobalamin does exist, but we can't extract it from plant sources.
00:41:24	Ross	Host	Oh, interesting. Cyanobacteria I think can grow it?
00:41:27	Nathan	Guest	Yeah, so you can get it from seaweed.
00:41:28	Ross	Host	Okay.
00:41:29	Nathan	Guest	Right, so you can get it from seaweed. Cyanobacteria, I don't know how to make that in a dietary form for humans, but for kelp, for seaweed, if you—and they have seaweed chips. I don't like the seaweed chips myself, but my kids love them. I'm like, "It's so fishy and salty", but they love it. So if you get that, then you actually don't really have a problem. But B-12 is the one thing that vegans have to worry about, but the crazy thing with B-12 is, you might be wondering, well all the animals that we eat that provide us with B-12—
00:41:55	Ross	Host	Where do they get it?
00:41:56	Nathan	Guest	How do they get it? Yeah, they're all vegetarians.

00:41:57	Ross	Host	Cow's not eating other cows when we're not looking.
00:41:59	Nathan	Guest	Yeah, so where do they get B-12? Well, the answer is that they have bacteria in their guts that make vitamin B-12 for them as a byproduct, you know, secrete it, and then they absorb it right there in their intestines, right at the place of synthesis, it's very convenient. We have a vitamin that we do the same thing with, vitamin K, which is involved in blood clotting. You may not have even heard of vitamin K, because nobody's heard of it, because you don't need it in your diet, because you make in your intestines. You don't, but your bacteria do. And so the question is, why don't we just get those bacteria? Well, we already have those bacteria. They live in our intestines. Well, jeez, what's the problem? Are they not making B-12? No, they're making B-12, and they're in our large intestines, but we can only absorb vitamin B-12 in our small intestines.
00:42:38	Ross	Host	Womp-womp.
00:42:39	Nathan	Guest	Which comes first in the row of traffic, so it's too late when the B-12 appears, and we send it to the toilet, instead of absorbing it. So you can be vitamin B-12 deficient but still have it in your gut and send it to the toilet rather than absorbing it.
00:42:52	Ross	Host	And this was the horrifying fact, you said that if you did eat human fecal matter, yes there would be a sufficient amount of B-12 in there. But don't that.
00:42:59	Nathan	Guest	That's right. Don't do it.
00:43:00	Ross	Host	There's better ways.
00:43:01	Nathan	Guest	There is a study though, there was a paper where they measured vitamin B-12 in human feces and they found it was a dietarily sufficient source.
00:43:07	Ross	Host	This is why I love science. *[Both laugh.]* You get a paper like that.
00:43:11	Nathan	Guest	Yup. Yeah, but it just goes to show that the body is not necessarily intelligently designed, and it doesn't think ahead very far. So what happened clearly at some point, as we made the transition from vegetarianism to omnivory, our bodies just got lazy. Here's all this vitamin B-12 that's just being served up to us, so our small intestine absorbed it instead of the large intestine, because it was there, and we lost the ability, and so now it's a problem.
00:43:35	Ross	Host	And you think, "Oh, if I had the ability of a super CRISPR, dare I say an intelligent designer, I could go in and I could make little tweaks and adjustments."
00:43:45	Nathan	Guest	Yeah, and in fact I would say, we don't know the mutations that caused that loss. In fact knowing just this whole story is fairly recent science, but what's cool about that is to fix it I assume would be

			very easy, if we were gonna do that, just because we don't need any new genes or anything, it's just the genes not being expressed in the right place. So that's just a promoter issue in genetics, so it would be relatively easy to fix. If we could find it, it would be relatively easy to fix.
00:44:09	Ross	Host	Yeah, and of course that involves the interaction with bacteria, other organisms, so that's another thing you're spoke about is just sort of the makeup of how much of our genetic makeup is actually human versus little copied pieces, ancestral viral DNA, and then of course our bodies themselves are filled with other organisms.
00:44:30	Nathan	Guest	Yeah, well, definitely bacterial cells outnumber human cells in the human body. We don't know exactly the numbers, at least two to one.
00:44:37	Ross	Host	Yeah, I should probably clarify because I think I may have even repeated the wrong statistic before. Because I had heard many times that there's something like a ten-to-one relationship.
00:44:47	Nathan	Guest	Yeah, that was the number that was thrown about years ago. We know that's too much, but between one-to-one and two-to-one seems to be the number most microbiologists would say. But definitely there's more bacterial cells than human cells in the human body, and we rely on them very, very dearly for lots of things. If you kill the bacteria that live in, on, and around you, you'll be in trouble really fast.
00:45:07	Ross	Host	And that's the problem, if we could do the Jurassic Park thing and bring back dinosaur DNA, well, we wouldn't have the bacteria that they were collaborative with.
00:45:14	Nathan	Guest	Well, that's one of many problems, yeah.
00:45:15	Ross	Host	One of many.
00:45:16	Nathan	Guest	But yeah, that's true, I never thought about that. We wouldn't know—we wouldn't be able to inoculate them with the right microbiome. I never even thought about that, but that's absolutely true. And you get your microbiome from your mother, first of all, first and foremost, but then you're interacting with the environment your whole life and so you are not you, you are the collection of a lot of different things, and in your DNA—so there are certain viruses that are just very nefarious in the sense that they take their genetic material and put it in ours, inside our chromosomes, it actually inserts there, and then sometimes we defeat that infection but the carcass of that virus is left, it's still there in the chromosomes.
00:45:49	Ross	Host	And our immune system can use that to help identify things.
00:45:53	Nathan	Guest	Potentially, but a lot of times it just sits there, forever. And of course we only pass it on to our descendants if it's in our gonads, you know, if it's in the sperm and egg. Your DNA and all your other cells dies with you.
00:46:05	Ross	Host	Right, 'cause of Lamarck being wrong and all that.
00:46:07	Nathan	Guest	Yeah, exactly. But the DNA of sperm and eggs get passed on, and

			so when one of those progenitor cells defeated a virus infection and the genome is still there, and in fact 9% of human DNA is actually viral DNA, it's a virus.
00:46:21	Ross	Host	9%. And what did you say is the actual, like, human encoding DNA?
00:46:27	Nathan	Guest	For protein encoding genes, it's 3%. So you have three times more viral DNA than protein encoding human DNA.
00:46:34	Ross	Host	So that brings us roughly to 12%, what's the rest of the makeup?
00:46:38	Nathan	Guest	Well, so another 20-25% is what we call regulatory DNA. So this is DNA that helps us use our genes effectively. When they're expressed, where they're expressed, how much they're expressed, the interactions among genes. So that takes a lot more DNA than the actual gene itself. The actual gene is the smallest, easiest thing to do. Using it properly, that's how we get all our complexity. That's the part of the DNA that we don't really share with bacteria, because bacteria is very simple. They're very successful but they're fairly simple, whereas we have all this complexity, so we need that regulatory DNA. So that still only gets you, you know, 25-30% of our genome really does anything helpful. The rest of it is pure junk. Repetitive sequences.
00:47:18	Ross	Host	It's kind of like the equivalent of Jack Nicholson typing out, you know, "all work and no play makes Jack a dull boy". Like, you know—
00:47:24	Nathan	Guest	We know how that story ended.
00:47:25	Ross	Host	Yeah, you pick up the human genome and you find the pages and you're horrified, like, what was it, Shelley Duvall?
00:47:30	Nathan	Guest	Yeah.
00:47:31	Ross	Host	Shelley Duvall, you're going through the pages, "Oh no, what is this? Ahh, it's all repeated!"
00:47:35	Nathan	Guest	You—oh my gosh, so I do this for a living, I look through the genome. I feel like Shelley Duvall all the time. *[Ross laughs.]* All the time, because—like for example, we don't even always know how many copies of certain genes we have, and in fact I just—we're—I'm working on a gene right now, the evolutionary origin of a very interesting microRNA gene, and god damn it, I have the human genome at my disposal, I can't tell how many copies we have of it. Because if you look back at previous drafts of the human genome project, it comes up different numbers of times. You're like, wait a minute, whatever the number is, you should be able to tell what it is. You know why we can't? Some of these things are so highly copied that when we're sequencing DNA, piecing together chromosomes, we can't even tell when it stops.
00:48:16	Ross	Host	'Cause the sequencing process involves chunking, right?

00:48:18	Nathan	Guest	Chunking, exactly and so you do the overlap, but imagine it's all repetition, so how many overlaps do you have?
00:48:25	Ross	Host	Where do you break it off? Oh, I lost count. Shoot, where do I pick up again?
00:48:28	Nathan	Guest	Exactly that, and so right now we just finally had a breakthrough I think, where the previous draft of the human genome has it correct. We have two copies of this gene, but we were working on the assumption that we had four. And so we've been chasing our tails for about eight weeks on this project, Shelley Duvall style, and uh, I think we've got it figured out that the previous draft of the human genome, hg19—we're on hg38 now, don't worry about why the numbers are crazy like that—and yeah, I think we got that sorted out. So this is a new gene that we're looking at. So I study how genes are born in the human genome, which is, I'm an obstetrician so to speak, and it's funny because I started a new collaboration on this project with a computer scientist, because I'm drowning in data, you really need somebody who's a professional data scientist to do this work. He doesn't know that much about genetics, he's fairly naive to all this, and he just goes, "You know, the human genome is kind of a disaster." He's like, "This is a mess. How did we get anything out of this?" I was like, "I don't know."
00:49:20	Ross	Host	And this is someone who kind of works with information theory.
00:49:23	Nathan	Guest	Oh yeah, so the information theorists just think it's chaos, and I said, "That's exactly right." Because evolution is not about efficiency or being neat and tidy, it's just a hodge-podge, and our genome really is the hodgiest-podgiest of all. But yet it all comes together somehow, and that's the magic of it, and that's what—that's why I don't find this to be a cold and dehumanizing way of looking at life. It's so much more interesting that we can make sense out of this nonsense. Gibberish becomes genes.
00:49:50	Ross	Host	Right, and if it were somehow sad and cold and depressing, it would still be the truth.
00:49:54	Nathan	Guest	That's right.
00:49:55	Ross	Host	But how lucky are we that it actually is kind of inspiring and cool?
00:49:57	Nathan	Guest	It is, yeah.
00:49:58	Ross	Host	And it gives us action items. It gives us things that we can do about it.
00:50:01	Nathan	Guest	That's right. And when you're doing this kind of work, you also sometimes have to step back and realize now incredible it is, because this planet's been around for 4.6 billion years, and only now are we at the point where we can even ask these questions, that we knew these things were happening. The other day I was just scanning through genome sequences from a fifty thousand year old Neanderthal. Well, her remains are fifty thousand years old. She was a woman, a real woman, and we have her almost complete genome sequence. And I'm scanning through

			it, and this is available online. If you have a computer you can go and look at genome sequences from a woman, a real woman, who was alive fifty thousand years ago, who had hopes and dreams and she might have had kids, she certainly had parents and friends. She was a real person who was wandering the Altai Mountains and died in a cave and we were lucky enough to find her, and I'm looking through her genes like I'm checking out a book at the library.
00:50:50	Ross	Host	That's amazing.
00:50:51	Nathan	Guest	It is fascinating, and every once in a while you have to catch it, you stop and be like, you know, this wasn't even theoretically possible ten years ago, and now my undergraduates are doing it.
00:51:00	Ross	Host	Okay, this is a question I always have. Do you ever kind of look at previous discoveries and feel frustrated that, "Oh shoot, we would have excavated that in such a different way. I wish I could go back and kind of re-acquire that sample."
00:51:13	Nathan	Guest	Yes. I think that happens a lot in any field where you look back in the past and you look at the way the science was done, you're like, "Gosh, we were so naive."
00:51:22	Ross	Host	"They brushed away all of these scale imprints" or something like that.
00:51:25	Nathan	Guest	Yeah, we were so naive. And now, we've learned that lesson where, to request a fossil, for example, for DNA analysis is very hard, because it consumes the sample, so you have to be very careful. But what cool things that we're learning from it. It's a pleasure, it's an honor. It really does feel like a privilege to be doing that work, because, you know, I get to go to work every day and do this, and people pay me to do it. I don't produce anything for them except hopefully knowledge every now and then, and I don't know what you do with information about Neanderthals in terms of real world applications—
00:51:54	Ross	Host	That's such an important point too, because there's no immediate commercial application, and so that can't always be the impetus for science. Sometimes you just need to ask the questions, do the hard work figuring them out, and then yup, maybe they'll pay off, and when they do they pay off big.
00:52:08	Nathan	Guest	They do, and you can't predict when it will and when it won't, and that's such a terrible way to decide how to do science, because sometimes when you're studying, for example, the bacterial immune system, you discover something like CRISPR. So no one could have predicted, you know, that that would have worked out that way, so that's why it's important to fund science without any eye of commercial products, but just for what's interesting, what's neat, and what also might reveal something profound. And when you put any kind of blinders on science, it's not good science. Right now we're in sort of a precarious time, because science funding is down, it's low, and it's also tied to this—they want you to do industry relationships and how does this market, how does this benefit the country?

00:52:47	Ross	Host	What's the ROI, return on investment, for this?
00:52:50	Nathan	Guest	Yeah, and it's just like, come on, we can't be motivated by that, and also isn't it self-explanatory why science benefits society? I mean, I shouldn't really have to explain that.
00:52:57	Ross	Host	Yeah, do we have to keep making that point?
00:52:59	Nathan	Guest	Yeah, I mean, and things that did inspire us—in the U.S., anyway—to become world leaders of science, the Cold War was a big one, and look at everything that came from it. Without necessarily thoughts of, okay, going to the moon, does that make us any richer or—no, it's going to cost an enormous amount of money, but look how it motivated all this other technology that came from it. And so when we invest in science, you always get ten dollars for every one you spend, you just can't predict it ahead of time, and it's bad science if you even try. So I think that we're in a poor period for that, because our psychology about science is so utilitarian, but I think we're close to breaking through that. I hope we're close to breaking through that.
00:53:39	Ross	Host	Excellent.
00:53:40	Ross	Promo	Wait, wait, hold on again, Nathan. I'm—ugh.
00:53:42	Carrie	Promo	Hello!
00:53:45	Ross	Promo	I can detect you.
00:53:46	Carrie	Promo	Hello! Anybody there?
00:53:47	Ross	Promo	In my head.
00:53:49	Carrie	Promo	Ross?
00:53:50	Ross	Promo	Yes, hello.
00:53:51	Carrie	Promo	Oh, made contact again! This is what I've been doing while you're gone, I've been working on my telepathy.
00:53:55	Ross	Promo	Well, I gotta say, this is impressive.
00:53:56	Carrie	Promo	Thank you.
00:53:57	Ross	Promo	And uh, I think we should be able to sign you up for the CFIIG's challenge. You know, $250,000.
00:54:04	Carrie	Promo	Why?
00:54:05	Ross	Promo	Because you're a telepath now, and that's worth a lot of money.
00:54:09	Carrie	Promo	Huh. I didn't really think of it as like a paranormal ability, I just figured I just evolved to do this.
00:54:14	Ross	Promo	Unless you're using a sufficiently advanced technology that is—
00:54:17	Carrie	Promo	My brain.
00:54:18	Ross	Promo	—indistinguishable from magic.

00:54:20	Carrie	Promo	Yes.
00:54:21	Ross	Promo	I think that qualifies.
00:54:22	Carrie	Promo	My own brain.
00:54:23	Ross	Promo	Okay well, now that you're here again, what do you want?
00:54:24	Carrie	Promo	I forget. Oh! I was here because I wanted to wish you a happy birthday.
00:54:30	Ross	Promo	Why, thank you, except it's not my birthday.
00:54:32	Carrie	Promo	Oh, wait, it's Shark's birthday!
00:54:34	Ross	Promo	Oh my goodness. Happy birthday, Shark, and uh, you know what, it's from Shark's younger sibling, who says, "Thank you for introducing me to ONRAC. Here's to many more investigations."
00:54:45	Carrie	Promo	That's awesome. So apparently, Shark's birthday was actually on November 9th.
00:54:49	Ross	Promo	Happy belated birthday.
00:54:51	Carrie	Promo	A belated birthday to you, and an early happy birthday for 2020. Oh, November 9th, 2020. Fingers crossed, Shark. Fingers crossed.
00:55:01	Ross	Promo	Oh, boy.
00:55:02	Carrie	Promo	Oh you don't have fingers, you're a shark. I'm sorry, that was—really, I should have thought about that, it was inconsiderate of me.
00:55:08	Ross	Promo	Yeah, boy. The world will—
			[Carrie groans in distress.]
			—have its fate decided again. We're nervous.
00:55:17	Carrie	Promo	Anyway, happy birthday!
00:55:18	Ross	Promo	Happy birthday!
00:55:19	Carrie	Promo	But also, Ross, sorry, I know you have to get back. But while you've been gone, I've been just like sort of catching up on my podcasts, and I'm all out. I wondered if you had any recommendations for some good listening.
00:55:31	Ross	Promo	Oh yeah, you know what, I'm gonna twist my ear here and it should play an excellent show from Maximum Fun.
00:55:36	Carrie	Promo	Oh shit.
00:55:37	Promo	Promo	**Music:** Gentle, upbeat piano music.
			J. Keith van Straaten: Hey everybody, this is J. Keith van Straaten, host of *Go Fact Yourself*, a live game show here on the Maximum Fun network. On *Go Fact Yourself*, we take the smartest people we know, and make them look dumb.
			J. Keith: Paul, by the way, how much do you know about chicken

husbandry?

Paul F. Tompkins: You gotta give ‘em that grain.

J. Keith: Alright!

[Audience laughs.]

Paul: You gotta give ‘em that grain!

J. Keith: And then smart again.

J. Keith: What future hall of fame pitcher for the Cleveland Indians became the first active player to enlist—

Speaker 1: Rob Fuller.

J. Keith: —wh—oh. Okay!

[Audience laughs again.]

J. Keith: We’ve got me, co-host Helen Hong, plus celebrity guests and actual surprise experts.

J. Keith: Alright, we have an expert on hand for sure.

Speaker 2: Is it Allan Havey?

J. Keith: Helen, who do we have tonight?

Helen Hong: Allan Havey!

J. Keith: Allan Havey!

[Crowd cheers.]

J. Keith: In the coming weeks, you can hear guests like Maria Bamford, Tom Bergeron, Paul F. Tompkins, Janet Varney, and Grant Imahara. Check us out on the first and third Friday of every month, here on the Maximum Fun network.

[Music continues for a moment, then ends.]

00:56:29	Ross	Host	As I was reading *Human Errors*—and I really enjoyed reading it—
00:56:32	Nathan	Guest	Thank you so much. It’s such a great thing to hear.
00:56:34	Ross	Host	—it’s—well, it’s well written, but also there’s so many interesting tidbits, and I found the thing that I would do most often as I was reading it would be to stop people and be like, “Oh, hey, did you know that—look at this.” But beforehand, I felt like I knew a lot of great examples, like the octopus has the retinal nerves at the back of the eye instead of puncturing through it, or laryngeal nerve, and look at what it does in the giraffe, but you provided so many other great examples. Can you tell the story of the sinuses?

00:56:59	Nathan	Guest	The sinuses. Well, so this is one of my favorite stories, because a lot of the examples in the book have been written about before, so I collected things from various sources, but some of the—I do tread new ground in a couple places. I wanted to be even more bold with this section on the sinuses, but I waited for the book, because I'm now writing an article with some surgeons on it. The bottom line here is that, first of all, the sinuses have served no function really in the human body. We don't need our nasal sinuses, and if you want to prove this to yourself, try breathing through your mouth. It works. It actually works fine. See? Did you—was that okay?
00:57:30	Ross	Host	Yeah, I'm doing okay.
00:57:31	Nathan	Guest	Yeah. So you don't need to breathe through your nose at all. You can breathe through your mouth, and that air is just fine, your lungs do just fine. So you don't need your nasal passages, your nose, your nasal passages at all.
00:57:43	Ross	Host	Yeah, what do people usually say, like it heats up air?
00:57:45	Nathan	Guest	Yeah, if you read medical textbooks they say, oh the sinus cavities warm and humidity and purify the air. Right, so if you breathe through your mouth, then it's dry and unpure and cold? I don't know. I have no trouble breathing out of my mouth. I do it all the time. So, anyway, so my issue with the nasal cavity though is that they don't drain very well, particularly the largest nasal cavities—I'm pointing to my face, I know this is a podcast, but—the largest nasal cavities are in your cheek bones, they're called maxillary sinuses. They're just behind your cheek bones, above your jaw.
00:58:16	Ross	Host	Nathan was pointing to just that big area under the eyes, the north half of the cheeks.
00:58:20	Nathan	Guest	Yeah, that's right. Maxillary sinuses, and they're the largest cavities, and they do create mucus and that mucus flows and it flows through the system, collects in your nasophar—you're always producing mucus. People don't always realize this. You know how you have to clear your throat every now and then? The reason why is mucus collects in your nasopharynx, which is basically the part of your throat just above your mouth, and then drips down your throat, and either you swallow it into your stomach or it can neutralize whatever's in it.
00:58:46	Ross	Host	Completing the great circle of life.
00:58:47	Nathan	Guest	That's right. So it's a steady flow of mucus. Well, here's the problem. The drain pipe for these big nasal passages is at the top of the chamber, not the bottom of the chamber, the top of the chamber.
00:58:59	Ross	Host	Wait a second, I'm a designer, I know about gravity, I'm gonna put the drainage at the bottom.
00:59:03	Nathan	Guest	So imagine if you had a shower, I'm looking at a shower right now,

			or a tub, and you put the drain halfway up the wall instead of at the bottom, so it has to fill up before it would drain. That's kind of the design we're talking about. Now, of course, we have cilium—which are these microscopic little hairs that push the mucus upwards—but you do have to work against gravity. They have to push this thin, watery mucus up to the top of the chamber so that it can drain through the ostium into the nasopharynx. Well, if it gets thick, if it gets full of dust or particles or bacteria, the drainage slows and eventually stops, and you get mucus pooling in the bottom of this chamber, just sort of filling up with mucus, festering bacterial infections, viral infections in that space, and that's the common cold, or a sinus infection.
00:59:45	Ross	Host	And you said this was all, again, evolution doing its tinkering as it receded our snouts into our faces.
00:59:51	Nathan	Guest	That's right, so the nasal sinuses were so important in most mammals because most mammals use their sense of smell, and so what the snout was really for, what the passages, nasal passages, are really for is for concentrating all of these olfactory receptors, odor receptors, in the long snout of mammals so that they can navigate the world smelling. And dogs have such an intense sense of smell—I mean, it's millions of times more sensitive than what we have, both in what it can discriminate and just how sensitive it is. We don't navigate the world with our noses very much.
01:00:21	Ross	Host	Yeah, and you're saying for a dog really, that's the primary sense, so if your identical twin walks in, they'll know it's not you because—
01:00:27	Nathan	Guest	They will not be fooled at all. That's right. They use visual cues, but nowhere near the way that they use their sense of smell, and in fact a lot of veterinarians tell stories of someone bringing their dog in and they say, "I think my dog doesn't see very well," and they tell some story where it didn't see the ball or whatever, and the veterinarian takes a look and says, "Your dog has been blind for years."
01:00:45	Ross	Host	Wow.
01:00:46	Nathan	Guest	And they had no idea until they rearranged the furniture or something like that, because they know their way around the house by smell, and they can navigate their world by smell.
01:00:53	Ross	Host	I just realized you can solve one of our previous investigatory topics. Do humans have any pheromone sense?
01:01:00	Nathan	Guest	Yes, we do have pheromone sense. It's fairly unconscious, we can't always—here's the thing, our sense of smell is our most ancient sense, right, it's a chemoreceptor sense, I mean, from fish, even before fish, the ability to detect molecules this way—
01:01:16	Ross	Host	It's the one that can't be created synthetically as easily, like, you know, we create television, since it's easy to vibrate molecules and create sound, it's easy to jostle light and create images, but smellovision hasn't happened yet.
01:01:26	Nathan	Guest	That's right. It's chemo detection. We're detecting molecules basically, but the reason I said it's so ancient is that it's also

			connected with the most ancient areas of our brain, the hind-brain, the mid-brain. So our sense of smell, it's why it brings on vivid memories, it's not as connected to our conscious perception—
01:01:44	Ross	Host	But down to that bottom half of the brain.
01:01:46	Nathan	Guest	That's right, so the more ancient brain, sometimes called the reptile brain. I don't really like that word for it, but our deeper brain. And so pheromones and other odors can sort of make you feel and act in certain ways that you're not even conscious of, so it's kind of a little scary in that sense, but anyway. Primates, what made us different as mammals going back a hundred million years, the origin of the primates, is we started to use our sense of vision, our sense of sight, much more than our sense of smell, and to do that we brought our eyes forward. So most mammals have their eyes more on the side of their head, with the big snout in the middle, and they have a great field of vision but they have very poor depth perception, because you need two eyes looking at the same field of vision to get that stereoscopic, three dimensional—
01:02:26	Ross	Host	Which is usually described as something predators really need, is that intense ability to scrutinize distance.
01:02:33	Nathan	Guest	So mammals, switched to sight, brought their eyes forward. Problem is, if you have this big snout right in the middle when you brought your eyes forward, it's right in your way. It's right in the middle of your—
01:02:41	Ross	Host	Filling up a bunch of your visual field.
01:02:43	Nathan	Guest	Right, so we shrunk the snout at the same time. So the snout shrinks, retracts, and we get this flattening of the face that primates have. Monkeys, but then apes even more so, and humans most of all. We have the flattest face of all primates. So, we shoved those nasal passages just up in our head, instead of out in the snout, and when we did that some poor crazy design was the result. But the reason we did that is we didn't really need our sense of smell that much. We use it, but we don't use it that much. It's not near as sensitive, we don't have near as many olfactory receptors, and what we have are this crazy redundant set, but it's all just sort of shoved up in our head in weird design. But here's the lesson of the book. The question people have is, "Well, if these nasal passages are so poorly designed and we get sick from them all the time, why hasn't evolution fixed that?"
01:03:25	Ross	Host	Ah.
01:03:27	Nathan	Guest	"Why didn't natural selection fix this problem for us?" The answer is that the common cold doesn't kill you.
01:03:33	Ross	Host	It doesn't stop you from reproducing.
01:03:34	Nathan	Guest	Yeah, it doesn't kill you, so it's in natural selection's blind spot, and the lesson here is that evol—we are not evolved to be healthy or

			happy or comfortable.
01:03:44	Ross	Host	Evolution doesn't care about that.
01:03:45	Nathan	Guest	Doesn't care about our comfort. All it is is we're good enough to survive to reproductive age, and other than that it can't do—
01:03:51	Ross	Host	As Dawkins would say, it's indifferent. It's not against us, it's not for us, it's just, you know.
01:03:57	Nathan	Guest	It's indifferent. So we have these poor sinus cavities as a result of that, and we get these infections. Now, probably also wasn't as bad in the past as well, because if you get a cold, then you're immune to that particular virus, if you ever see it again, and when we lived in groups of 100-200 people, a cold could make its way through and then that was it. Now we live on top of each other in huge population density, so these viruses can circle through the population, by the time it comes back to you, it's mutated. Because, rhinoviruses in particular—which cause the common cold—are made of RNA genomes, so they mutate much faster. So there's a bazillion strains out there, and you can get three or four colds a year. That's the average, unless you have children, then it's three or four hundred colds a year, is what it feels like. So—but they're all slightly different versions, we can't really become perfectly immune to these colds anymore, because it's a different version of the cold. So we never probably had as many colds as we have now because of population density, but if you notice our livestock, they live on top of each other too and they don't have this problem, because they have properly draining sinuses. They have other problems, but this particular problem really is poor design of the sinuses.
01:05:00	Ross	Host	Amazing. Okay, I'm so tempted to ask about so many other things. I'm gonna try to focus on extracting one more human error from you. Childbirth. That's another great story, and many of us know about this in broad strokes, that—
01:05:13	Nathan	Guest	Well, it's a great story as long as you don't have to go through it.
01:05:15	Ross	Host	Yeah, right. Yes. Here we are, two men, talking about childbirth. But, you know, we all know that humans started to develop these big brains, and then that made the passage getting out into the real world very difficult, but you had some really cool details on top of that.
01:05:30	Nathan	Guest	Right, so we have these big brains, big cranium that gives childbirth a very difficult squeeze. However, the problem starts way before that, way before our brains exploded in size, what happened was the birth canal got a lot skinnier. The reason why is we brought our legs more forward and in a straight down position from our hips, which narrowed the birth canal. It narrowed the pelvis, the center part of the pelvis, quite a bit. And the reason why is we have this upright walking, we have this upright striding gait, as it's called. Our center of gravity doesn't bounce around very much, it's right over

			the top, and our legs move forward and backward, not flayed out to the side. So to really walk well upright, you gotta have nice, narrow hips, narrow pelvis. That happened first. So we walked upright, and we still had tiny little ape brains, and we did that for a couple million years before the real action began, but it's too late at that point. So the brain started growing bigger and cranial capacity got bigger and bigger and bigger with this narrow little pelvis, and that's a perfect example of evolution pulling on both ends of the rope. Because it's great to have a narrow pelvis for walking, but it's great to have a big brain for everything else, and women in childbirth essentially got stuck in the middle.
01:06:35	Ross	Host	These are those trade-offs that you were talking about.
01:06:36	Nathan	Guest	Exactly, it's a trade-off. It's a compromise. And the compromise was pretty bloody in a sense of a—probably infant-slash-maternal mortality was probably about ten percent for a lot of our history. It's hard to put numbers on this, but if you look at populations that have no access to medical care, that's about what it is. About ten percent of births, you lose one party or both.
01:06:54	Ross	Host	We've ironed out a lot of the kinks, but childbirth is still very difficult. Conceiving is difficult, that's another story you tell in the book.
01:07:00	Nathan	Guest	That's another one. We'll talk about that some other time. But yeah, but the childbirth itself is very dramatic and traumatic for humans, and it's just not that way in other species. Other apes have no trouble, very little trouble with childbirth, and it's really a uniquely human problem, and it leads to other problems too, because to prevent the problem from being any worse we're actually born very early. Humans are born, I would say, two months before they're really ready, and the brain continues to grow after birth, but—
01:0727	Ross	Host	But it's kind of the last—this is your last stop, either get out or you're stuck.
01:07:31	Nathan	Guest	Or both parties will die, yeah. So we are born as late as we can be, but probably about two months undercooked.
01:07:37	Ross	Host	You see all these other animals that drop out of the womb and they start walking around.
01:07:41	Nathan	Guest	Yeah, they shake themselves off and they're off and running the first day. Humans are incredibly incapable for years on end, requiring an enormous amount of parental care and investment. And to be honest, that's another part of the happy story, because this—along with concealed ovulation, menopause, a few other things—I think is involved in the evolution of the human family. Because when parental care is so important that men have to stick around, first of all, but you also have other family members helping, really, we really became groups and families around how incapable the infants are.
01:08:12	Ross	Host	We joined—it takes a village.
01:08:14	Nathan	Guest	It takes a village.

01:08:15	Ross	Host	We gotta join together and make sure—
01:08:16	Nathan	Guest	Because someone's gotta watch the kid, and you can't be, you can't take kid anywhere where the crying would subject you to risk, right. So.
01:08:22	Ross	Host	When you're a turtle you can lay 200 eggs and—
01:08:24	Nathan	Guest	Walk away.
01:08:25	Ross	Host	—hope most of them get to the beach. Some won't. But yeah, with the humans we're betting on fewer organisms than—
01:08:32	Nathan	Guest	Fewer and investing in them at great cost, and protecting them, and protecting yourself, and hopefully the baby doesn't cry too loud so the lions know where we are and eat us. And what a trade-off, just to get this big brain, but yet this big brain allowed us to invent podcasting and everything else.
01:08:48	Ross	Host	Yeah, pretty cool things, including excellent books like *Human Errors*.
01:08:51	Nathan	Guest	Well, thanks.
01:08:52	Ross	Host	Well, thank you Nathan. I could—I would love to pick your brain all day.
01:08:55	Nathan	Guest	Let's do a part two.
01:08:56	Ross	Host	Oh, gladly. Anytime. I wanna ask you about like tetrachromats and stuff.
01:09:00	Nathan	Guest	Yeah. That comes up in the book actually.
01:09:03	Ross	Host	Oh yeah. Ah, that's right. So uh, anyways, I can't highly recommend *Human Errors* enough for everybody, and I'm looking forward to *Not So Different*, but you have a podcast of your own.
01:09:12	Nathan	Guest	I do, yes. It's called *This World of Humans*. We don't have that many episodes yet. I'm still looking for long term funding. But we're talking about new research in biology and social science.
01:09:19	Ross	Host	Okay, well, we're all gonna listen to those and then eagerly tap our feet waiting for you to produce more.
01:09:24	Nathan	Guest	If anybody wants to fund the podcast, it's very cheap, I just need some money.
01:09:28	Ross	Host	Excellent. Any other way that people can follow you online, and your work?
01:09:32	Nathan	Guest	Yeah, I'm on Twitter. I was on Tumblr, but Tumblr's not much of a thing anymore. I'm on Facebook and Twitter, both Nathan Lents, you can find me there. And I have a Human Evolution blog. I only do maybe an article a month, but I write about things I'm thinking about and things I'm working on. I'm working on a book right now on human sexuality. We're really excited about that project. Basically, the evolution of human sexuality, and human sexual

			relationships, because, you know what's inspired me to write this book is the no labels movement. So, young people now are just sort of throwing off all the shackles of social constructions around their sexual relationships, so they're, "I'm not straight, I'm not bi, I'm demisexual" or whatever. There are all these interesting new terms and labels and then just no labels altogether, and then also their relationships, you know, like they're poly and they're open relationships, and what I found interesting about it is what they're really doing is returning to a more natural relationship with sex, in the sense that it didn't have all these crazy boundaries and labels in our past.
01:10:27	Ross	Host	Right, and now we have this control over it with contraception and—
01:10:30	Nathan	Guest	That's right, that's right.
01:10:31	Ross	Host	—prophylactics.
01:10:32	Nathan	Guest	I find it empowering and inspiring, so I'm writing a book about the evolution of human sexuality and how we're sort of reclaiming a more glorious past. So that's my next book.
01:10:40	Ross	Host	Oh, can't wait.
01:10:41	Nathan	Guest	Yeah, me too. It's slow going though. I do have a day job.
01:10:44	Ross	Host	Okay. Yeah. All the more impressive. Thank you so much, Nathan.
01:10:48	Nathan	Guest	I appreciate it. This has been a lot of fun.
01:10:49	Carrie	Host	*[Spooky ghost voice]* Ross.
01:10:51	Ross	Host	Oh, hi Carrie.
01:10:52	Carrie	Host	Hey. I've returned. Boy, you could sound happier about it.
01:10:56	Ross	Host	You know what, actually, I'm very happy to have you here. In fact, I just finished the interview with Nathan Lents.
01:11:00	Carrie	Host	Oh, how did it go?
01:11:02	Ross	Host	Very well. You know, if you'd stuck around you could have heard it, but.
01:11:05	Carrie	Host	Yeah, I've been working on this whole telepathy thing. It takes a lot of energy to get here to Las Vegas.
01:11:10	Ross	Host	Oh, I bet. Yeah. Well, well done. Anyways, yeah, I'll play it for you later. So, uh, any final words before we leave?
01:11:17	Carrie	Host	Well, I just wanted to remind you, Ross, that our administrative manager is Ian Kramer.
01:11:21	Ross	Host	Oh. Well, I would add to that that our theme music is by Brian Keith Dalton.
01:11:25	Carrie	Host	Oh, interesting. Well, did you know that we have social media accounts? You can find us on Facebook.com/onrac or Twitter @OhNoPodcast.

01:11:34	Ross	Host	If you haven't rage quit either of those, you can find us there. *[Carrie laughs.]* Also, you can support us by going to MaximumFun.org/donate. That is the best place to help contribute to what we do, to sending planes into the air with banners.
01:11:50	Carrie	Host	That's just one example, randomly chosen.
01:11:53	Ross	Host	Or for us to join conferences. All these other fun things we do, products that we buy, services that we sign up for. It's all made possible because of you, and our sponsors, but mostly you.
01:12:04	Carrie	Host	That's right. Another great way you can support us is to support our advertisers, use our promo codes, or write a review.
01:12:11	Ross	Host	Yeah. And uh, you know, hug somebody in your life. Consensually, though, make sure they want a hug first.
01:12:16	Carrie	Host	Check in, see that they want a hug, then hug them, then say, "Thank you for the hug."
01:12:21	Ross	Host	And then say, "Ross and Carrie say hi." See how this all tied in? I'm sure that won't be creepy. *[Carrie laughs.]*
01:12:28	Crosstalk	Crosstalk	**Ross & Carrie:** And remember!
01:12:29	Nathan	Guest	You are the product of four billion years of evolutionary success. Act like it.
01:12:34	Music	Transition	"*Oh No, Ross and Carrie!* Theme Song" plays, then fades out.
01:12:48	Promo	Promo	**Music:** Gentle, rhythmic music underscores the dialogue. **Janet Varney:** We are so thrilled at your interest in attending Hieronymous Wiggenstaff's School for Heroism and Villainy! Wiggenstaff's beautiful campus boasts state-of-the-art facilities and instructors with real-world experience! We are also proud to say that our alumni have gone on to be professional heroes and villains in the most renowned kingdoms in the world! But of course, you are not applying to the main school, are you? You're applying for our sidekick and henchperson annex! You will still benefit from the school's amazing campus, and! You'll have a lifetime of steady employment. Of course… there's no guarantee how long that lifetime will be. **Travis McElroy:** Join the McElroys as they return to Dungeons and Dragons with *The Adventure Zone: Graduation*. Every other Thursday on Maximum Fun, or wherever podcasts are found. *[Music ends.]*
01:13:41	Speaker 1	Promo	MaximumFun.org.
01:13:42	Speaker 2	Promo	Comedy and culture.

01:13:44	Speaker 3	Promo	Artist owned—
01:13:45	Speaker 4	Promo	—Audience supported.