Synthetic Biology to Become a Major Economic Driver, Part 2 – Amy Webb – #914

Dave Asprey:

You're listening to The Human Upgrade with Dave Asprey. This is part two of an episode on synthetic biology. In the first half of this, we heard from Andrew, who is one of the two authors of The Genesis Machine. This is a book about what is synthetic biology and what does the future of synthetic biology look like.

So the first half was let's learn. This now is about let's look at the future. One of the two authors is Amy Webb. Amy, welcome to the show.

Amy Webb:

Thank you so much for having me.

Dave:

You call yourself a quantitative futurist. Isn't that the opposite of a futurist?

Amy:

So first of all, there's different types of futurists. I'm the type that works with data. I do a lot of modeling. It's still very creative, but the type of work that I tend to do is trying to model out what plausible futures could look like. So we do more work in business and government, but I get to work with a lot of directors and producers. We've worked on shows and commercials and movies and things like that.

My background academically is game theory and economics. So I've always been interested in figuring out if A then B, and then what happens. And so, there's different ways to do this. When we do work on shows and films, we always start with signals in the present and think through the plausible next order outcomes. Again, given what we know to be true today, and we try to calculate acceleration.

This is super important because the shows that resonate most with people, like the reason that Black Mirror really captivated everybody and why I happen to think The Expanse is one of the best sci-fi shows ever made is because-

Dave:

Agreed.

Amy:

Yeah, it's because, first of all, the technology doesn't get in the way. That was one of the problems with the first Bourne Identity ... The Bourne movie. It was like, there was so much janky, ridiculous tech that made no sense that it almost became an additional character and a distraction.

So, likewise, when it to science and tech, or hacking yourself or improving yourself, it has to be plausible, because if it's not plausible, then everybody's going to get so distracted by this janky, ridiculous tech or science that they lose sight of the story.

Now actually the same thing applies to business and to government. You have to start from the realm of plausibility, at the places where ... In my observation, the VC community. The VC community does this thing where everything is possible. The IT community is like nothing is possible. We will start by saying no.

Dave:

IT and lawyers are the same that way.

Amy:

I know, right? So my job VUCA. So I operate in VUCA space, which is volatility, uncertainty, complexity, and ambiguity. There's still data, there's still decisions to be made, but we are comfortable with some ambiguity. That's a little challenging sometimes for people in fintech or people who are used to looking more at concrete datasets one to three years out.

But if you can get comfortable doing both, that's really the best of both worlds. I think the best scenarios and the best foresight comes from that intersection of being able to use plausible ideation to figure out what's next over a longer time horizon, but tether that back to reality, because ultimately this work can be really useful.

In our case, there's multiple millions, sometimes billion-dollar decisions that are being made based on the work that we're doing. So you want to be as right as you can be given that there is no way to predict the future. It's mathematically impossible.

Dave:

So many people want certainty, and all you can do is say it's going to go north. But if it's five degrees off, you better be able to course-correct. That's why even in biology, systems are designed so individual units of a complex system can course-correct, like a mitochondria or one bacteria in a colony in a kombucha. It's going to make its own local decision that's going to change the whole system of it.

If it breaks off and finds itself in someone's stomach, it's going to do whatever it does without being able to communicate with the home Scobey as the case may be. I think that's why it's hard to predict what synthetic biology creations will do as well, though, isn't it?

Amy:

Yeah, totally. That's definitely what some of the ... Some of the criticism and concern is exactly that. Biology tends to self-sustain and we cannot possibly predict every single plausible way that something might evolve over time. But just because we can't predict the exact evolution doesn't mean that that should stop us from at least being curious and investigating what can be done.

I don't think that we are living in Elon Musk's simulation. Andrew might. Andrew's a big fan of Elon Musk. I don't [crosstalk 00:05:34] free will.

Dave:

I didn't ask him, but I should have.

Amy:

What's that?

Dave:

I said I should have asked him, but I didn't. Oh, what'd you say about free will? You said we do or we don't.

Amy:

Well, I go back and forth on this a lot.

Dave:

Well, you can prove we don't have free will, except that we do.

Amy:

Exactly.

Dave:

That's messed with me since I was 16. I don't know how to fix that one.

Amy:

Yeah. This is the kind of thing that ... I don't know if you ... Sometimes I lay up all night long thinking about this, and it's really hard to unhook myself. I get into weird rumination loops, and this is one of them, where it's like we do or we don't have free will.

On a cellular level, I don't think we do have free will. I think there's a lot of automation. I mean we are, after all, just squishy robots. I like to think that I'm in control of my own thoughts to some degree, but I also have had a lifelong ... I've got pretty serious OCD. And so, part of my cognitive behavioral therapy training over the years has taught me that I'm actually ... You can't control. You have to just observe and be, and that [crosstalk 00:06:33].

Dave:

Does having OCD make you a good futurist?

Amy:

I think it does. It took me a long time to figure out ... It actually took a pretty catastrophic panic attack to figure I was wrong. But everybody just thought I was wound tight as a kid. I had chronic insomnia. I had a digital clock. I don't think people have clock radios anymore, but I had one. I used to do math and count the numbers and the different combinations of the little segments.

But the part of my brain that's very good at recognizing patterns sometimes goes into overdrive. So sometimes it sees patterns that aren't there, and that leads to catastrophizing. I'm real good on risk, like real good. Sometimes I have to try a little harder to do the opportunity scenarios or the growth scenarios. But risk, I'm best in class.

But sometimes I have to be careful that I'm not seeing patterns. Sometimes I have to check myself and what I'm-

Dave:

You're kind of like 20% A Beautiful Mind level, aren't you?

Amy:

Oh no. No. No. The math quickly got too hard for me in college. No. Actually one of the first panic attacks I had ... This will prove out that I'm very much not A Beautiful Mind. I took cosmology courses in college because I was like maybe this is what I'll do. I got super interested.

The professor, who was amazing, really early on in the course is going through all the math and trying to explain to us that the university ... That the universe, oops, is big in expanding, which like weak rock. But when you see that actually played out in numbers, I got so overwhelmed. I got so overwhelmed that I passed out. I had a panic attack. I blacked out.

Dave:

From cosmology courses.

Amy:

Yup. When I came-

Dave:

We totally have to be friends. I think you're awesome.

Amy:

Well, when I woke back up, I was obviously humiliated, because I was a freshman and whatever. It turns out I am not the first person to have passed out in that class. So there's something about-

Dave:

Wow. So the bigness of the universe was just overwhelming.

Amy:

It was. It was.

Dave:

I love that.

Amy:

It still is. I don't know. I'm both super excited and it almost also makes me nauseous to think about what the James Webb Telescope is going to start returning. It's going to reframe how we think about reality. We actually address some of that in the book, because there's a link between space and biology, too.

Dave:

It's a cool book. So, all right, did we come onto this planet from the panspermia theory? You think that we came from a comet or somebody hit the planet and brought us some complex aminos and lightning struck us or something? What's the deal?

Amy:

Yeah. So I will say I have absolutely no ... Can I curse on the show? I probably shouldn't.

Dave:

You can curse all you fucking want.

Amy:

I would say I have no fucking idea where we came from, man. I don't know. How would I know? Did you read Avi Loeb's book about-

Dave:

What was it called?

Amy:

So he used to be the head of some ... It might have been cosmology at Harvard. But he's got a theory that our universe was created by level three beings. If we're level one beings, these are beings that-

Dave:

Oh yeah. Absolutely. I'm familiar with that work. Yeah. Our civilization just hasn't reached the ... Was it like the [Gasimov 00:00:10:00] scale or something?

Amy:

Well, I mean-

Dave:

I think he got it from there.

Amy:

Probably. I think the fact that he was a tenured Harvard professor saying all of this stuff suddenly made it very real. But, yeah, I mean we don't know. I think it's plausible. I mean it's very plausible. But the string theory stuff and maybe we're just two-dimensional holograms. Again, I'm literally getting queasy as I'm saying this out loud. I love to think about it, but it also makes me sick to my stomach.

Dave:

Yeah. I really want to throw your brain into my neuroscience company and rewire the nausea, because it could be like, "Oh my god, curious excitement," or it can be like, "Oh my god, I'm scared shitless." But they're both the same thing, right?

Amy:

Maybe. I don't know. I think that humanity, especially recently, in this country at least, we've lost our sense of awe and wonder. I think it's good to remember that it's cool that we don't have answers. I think we're just really ... And especially as it relates to biology. I just think that we have to remind ourselves that it's okay not to have answers.

It's titillating. I mean the nausea that I feel is similar to the nausea that I get on a roller coaster just as we're cresting, the very first pill. It's that excitement. But you also feel a little bit sick, but you're mostly really excited.

Dave:

It took me a long time to come to grasp with the fact that ... I'm from a family of scientists. My grandfather wrote for Encyclopedia Britannica under the general heading of chemistry, like super nerd family.

Amy:

Oh wow.

Dave:

Worked for national labs and all that stuff. Then to realize that the world is both simultaneously rational and irrational at the same time. Then I can go see a shaman, then they do weird stuff that I can't explain, but it works and it shouldn't. And that I can be logical at the same time. That took me several years of ruminating. I guess they both exist simultaneously, and it doesn't really make sense, but it still exists. So the deep comfort with uncertainty was part of my progress.

Amy:

Yeah. Yeah. Have you ever lived overseas?

Dave:

I've traveled extensively but not lived ... Well, I mean Canada. Is that overseas?

Amy:

Yeah. I mean technically, right? The border [crosstalk 00:12:16].

Dave:

I'm on an island in Canada, so technically, yeah, I'm overseas there.

Amy:

No, I lived in Japan for a long time.

Dave:

Oh, neat. Neat. Okay.

Amy:

And also China. But my experience in Japan ... I now have a bunch of friends obviously, but I've got a friend there who's a Zen Buddhist monk. I spent a ton of time studying Zen Buddhism and visiting temples. He told me this really cool story about sitting with uncertainty.

He's in Kyoto. He shows up for the first day of Zen school, preschool. They take him to a room and they sit him down. He sits down in front of a corpse and they leave him for the night. That's his first task.

Now in Japan, and in many religions, it's part of the tradition to sit with the body, which is a wonderful thing to do. It's also a really hard thing to do. He explained that mortality is the ultimate uncertainty. Confronting that uncertainty, having no answer, and having to sit with that feeling of being uncomfortable is the beginning of that training.

It's always just really ... I don't know. It really resonated with me because just not something we do a lot. We distract ourselves. We don't have to just sit with uncertainty. I think, again, we cover this a ton in the book, but as it relates to your biology and your neurochemistry, it's like we want all the answers all the time. Sometimes we don't know the answers, or sometimes the answers are just not what we thought they were going to be. It forces us to change our mental models, which is hard.

Dave:

Well, let me take this right into synthetic biology. You've got a syringe of some modified virus that can rewrite something in your body to give you a superpower. You're pretty sure it's going to work. Do you do it?

Amy:

So my next question is it heritable or not heritable? So is it germline?

Dave:

See, I like the way you think. Let's say it's not heritable, so you don't have to pass it on to other kids.

Amy:

Totally. I would absolutely do it.

Dave:

So now I understand how your brain works, which is really cool, because you have to have a very different brain to write The Genesis Machine and to be able to pair up with Andrew, with the geneticist sort of thing. It's interesting because what you came out with was a book that I think has your stamp all over it, but also has the deep knowledge there, which is hard to do.

So as an author, I'm going to be a little bit selfish and I'm going to ask you one question, how did you guys partner to do that? Because it's really difficult.

Amy:

It totally is. So this is actually my fourth book. The last one was on the futures of AI and the one before that was on ... It was my methodology for foresight. So this is the first time I've done something with a co-author. I actually started writing this book while I was working on the previous book called The Big Nine, about the futures of AI. That sounds weird. But the reason was because as I'm doing these deep dives into how is this field going to evolve ... I have a couple of research area, and that's one of them, for the past 15 years.

It just was weird. I kept coming back to some of the same companies like Microsoft. Microsoft is doing all this crazy work in DNA storage. It's also doing some pretty amazing work in agriculture and figuring out ways to think through synthetic biology and CRISPR and sensors on plants. Then Google has spent all this time, effort, and money, as have some of the people who are part of the greater Google ecosystem. So I'm like why do I keep seeing this, in the US, in China? So that began my wheels turning.

I've had some health issues. My family's had some health issues. I've always been interested in this is the one machine that I own that I don't entirely understand how to operate.

Dave:

That's why we've got to biohack them, right?

Amy:

Yeah. Or where I started. I got to a point where I was like ... I don't know. I've spent a lot of time researching this stuff, but I think there would be better depth if I had somebody who worked in the field. So that's how it happened.

Dave:

You couldn't go deep enough by yourself in this field, because even if you focus on AI, there's too much other bio here.

Amy:

Yeah. I mean I could go pretty deep-

Dave:

Yeah, I get that.

Amy:

... but I don't want to get anything wrong on this one. This is important stuff in this field. I believe in this field, I believe in the people who are working in it, and I believe their story needs to be told. So what I wanted to do was focus on the people and their stories so that every ...

This is a book about science, but I did not want to write a science book. This is also a business book. It's an understanding your own body book. So I figured if, with Andrew who ... And we've got a mutual connection, that we might be able to accomplish both, and I think we have. But it was the first time I'd ever written with another person before. So that was different.

Dave:

See, the problem is that when you're as smart as you and Andrew, it's so easy to write a book that very few people can read. As an example, Stephen Wolfram's A New Kind of Math. Oh my god, that's world-changing stuff, and almost no one can digest it unless you already have a PhD in math.

But you guys didn't do that. You have a very readable book that I think if someone's listening to this and you're like, "I don't really know much about AI. This sounds like it's above my head," this book is going to get you to the point where you can think about it coherently and have a picture in your head of what it is.

We already defined synthetic biology in the last episode for people. So I don't want to spend time doing that for people right now. But I do want to ask you, with your futurist hat, are you hopeful that a hundred years from now people will be around?

Amy:

So a hundred years sounds a long time, but that's actually three generations.

Dave:

I'm going to be around then.

Amy:

Yeah. So that's actually not a lot of time.

Dave:

Yeah.

Amy:

Am I hopeful that people will be around? I think that it's plausible, given what we know to be true today, that some people will be around. If I gave a probabilistic overview on how comfortable we will be at the moment, I don't know that I would answer favorably. There's too many things working against us.

We have sunscreen that exists. We don't have climate cream. So as environmental conditions worsen, how are we going to be outside? If I try to do a 50-mile ride on the weekend, realistically, if we keep seeing these crazy temperature changes and everything else, am I going to be able to ride in a hundred-degree heat?

Now what's interesting is that one application of this technology could be that we mitigate some of the climate damage. We can engineer leaves. Did Andrew talk about this at all?

Dave:

We didn't talk about engineer leaves. No. Tell me, what are you thinking about?

Amy:

Yeah. I mean it's plausible that we could engineer leaves. There's some research underway. Basically hack, ground cover so that the leaves suck up, let's say, 10X more CO2. If they're able to suck up that .... Like make them super fat, then they would excrete natural fertilizer.

So we've got a topsoil problem already. We have a runoff problem. So this potentially solves a couple of different things, and it sucks more CO2 out of the air. There are enzymes in development that can eat up plastics in new ways.

My point being we're probably never going to align ... Like the world leaders are never going to align on drastically restricting CO2, because the two biggest economies that create the CO2 emissions, India and China, currently rely on factories to support their growing economies. It just doesn't make sense for them to yank that offline.

So if that's true, here's another solution. We may decide to engineer ourselves, make our skin a little bit thicker so that it's resistant to burn. Maybe we're more wind and cold-tolerant. I know that stuff sounds scary, but I also know that we already are having a hard ... Keep looking this way. That is a window. We already are having a hard time managing the tiny changes that we have in climate. That's just going to keep getting exacerbated.

Dave:

It's interesting. I was one of the very first people who funded and actually gave the speech that probably got Elon Musk's carbon capture XPRIZE funded.

Amy:

Oh, nice.

Dave:

So I was a corporate sponsor of the XPRIZE. Elon eventually said he'd put $100 million behind it. I wrote the first $50,000 check to get the ball rolling.

Amy:

Nice.

Dave:

We have to get the carbon out. But to your point, maybe we don't. There's nothing that says that you can't just modify Krebs cycle in your cells in order to be quite happy with more carbon dioxide. You don't need a space suit because you built one in.

The question, though, that I have is it's about timeframes, because Andrew says, well, why don't we just do it before you're implanted, which obviously has the most leverage. I want to grow that blue skin that can change shape right now. I don't know about the boobs, but I'd try it on if I could shape-shift. So how soon are we going to get to change ourselves instead of looking at changing the next generation?

Amy:

Yeah. So we get that question a lot, and the answer is I don't entirely know. It's probably not going to be just a big switch that flips things on and off. I think what's plausible instead is that the current supplement regimen that I'm assuming you're still ... Are you still doing a lot of supplements?

Dave:

I do more than a hundred a day. There's epigenetics in there and there's just repair stuff. It seems to make sense. It actually seems to work because my biological age, according to Horvath's latest work, I'm 37.5 years old. I'll take that.

Amy:

Yeah. Who wouldn't take that, right?

Dave:

Right.

Amy:

I mean you clearly look amazing. I think we're about the same age, and I do not look you. I work out a bunch, but I'm not taking all the supplements. So the question for you would be is there a near-term future where maybe you're not taking a hundred things orally, but instead maybe you're taking a few and the rest are some other types of tweaks? That's-

Dave:

Give me some mRNA injections that cause my cells to make more spermidine. Let's hack some gut bacteria so that the postbiotics they make are all the stuff that I take and save me a ton of money in opening bottles. I'm down for that. I just can't buy it yet, right?

Amy:

Right. No, no, and that's right. So the messenger RNA thing is interesting. Kind of a long story short, but I was scheduled to be on this very late talk show last week. It was the middle of the night and we're talking about the book. A lot of people mostly wanted to talk about COVID and whether or not the body could manifest whatever defenses it needed to fight the virus on its own. They preferred that over a vaccine.

I finally was like ... I think partially it was 2:30 in the morning. I am not somebody who does two hours of sleep. So I was a little loopy at that point, but I was like-

Dave:

I could teach you how. It's not a problem.

Amy:

That would be amazing.

Dave:

Modafinil.

Amy:

I actually drank ... I have on and off had Bulletproof in my coffee.

Dave:

Oh, wow.

Amy:

The problem is I don't ... Well, separate for another conversation.

Dave:

All right. We'll hack your biology.

Amy:

At any rate, so Zelda, Legend of Zelda. I finally explained this relates to messenger RNA. I used to be a time millionaire. I could play video games all day long. That is not my current life, so I don't get to play as often as I would. My family, however, doesn't have their own characters. So they keep taking my version of Link and playing Link when I'm busy.

So long story short, sometimes I'll sit down to the game and I encounter a new blob. I don't know what the blob is. Sometimes the blob is food. Sometimes the blob is a mortal enemy that can kill you. Now I probably have the tools in my little quiver because my family members have picked them up along the way, but I don't recognize those as tools and I have no idea how to use them because what I'm missing is the set of instructions.

So that's analogous to our current situation with COVID. It's a virus. It's out there. Our body doesn't understand what it is. Is it food? Is it problematic? We don't know. We've never seen this thing before. I may or may not have something in my biological quiver. But if I don't know what that thing is and I don't have the set of instructions, I don't know what I'm supposed to do. The messenger RNA is the instructions. That's all.

I wish somebody would've explained it that way to folks at the very beginning of all of this. I think we would've had less resistance. But-

Dave:

The propaganda engines did a terrible job this time.

Amy:

Totally.

Dave:

For the amount of money they spend on advertising/propaganda, hey trashed this one.

Amy:

Yeah, it's not good. It's still not good. But, yeah, I mean messenger RNA, what other instructions might I have? Might there be a messenger RNA set of instructions or something like that that does other things. We've got zombie cells floating around in our bodies. They're not quite dead. We can't get rid of them. Is there a way to maybe suck [crosstalk 00:26:44]?

Dave:

Mine are all named Trudeau. Is that normal?

Amy:

I'm sorry?

Dave:

All my zombie cells are named at Trudeau. Is that normal?

Amy:

Five people got that joke, but I got it.

Dave:

Yeah. There's only five people living in Canada. It's okay.

Amy:

But, yeah, I mean ... I don't know. I think the answer to your question that you asked 150 minutes ago, before I started my tangent that I'm on, is that there are therapeutics, there are going to be applications on the nearer term horizon. But this is long horizon stuff. This is decades. We have entered a new biological age, so we should recognize that and start having meaningful conversations.

My greatest fear is that this is all going to get politicized yet again and it's going to hamper the progress that we know that we can make. It's going to make it harder to have the hard conversations about actual risk and creating guardrails that we also need to have.

Dave:

Yeah. Let's talk a about that a little bit. Andrew and I got into it a little bit earlier. I am a computer hacker by training. My last job when I was starting Bulletproof is I was VP of cloud security for a publicly traded computer security company. So I get the emerging threats and emergent stuff and all of that. I look at ownership and I look at enforcement mechanisms from tech and look at it for bio.

I'm most concerned not about some runaway thing that a kid down the street's going to make in his garage that might escape and turn me into the swamp thing, which might be interesting. It's more about the fact that Monsanto is going to make something that I accidentally pick up when I scratch

myself. Then they're going to claim ownership over my body because there's patented genetic code that I didn't even want.

How are we going to upgrade our regulatory frameworks for something that doesn't give two craps about borders? Do you think COVID cares whether you're sitting down or standing up wearing a mask in a restaurant? Maybe it cares. But I can tell you for sure that all life doesn't recognize international borders.

So if the law in Canada is that you're allowed to biohack and the law in the US is that you're not, it's just going to come over. What does that future look like?

Amy:

Yeah. So the regulatory framework, as I'm sure Andrew explained, is a mishmash of insanity. It doesn't make sense. It doesn't even make sense within the United States. We use something called the coordinated framework, which is actually three different agencies' frameworks.

For the most part, in the US, the regulation is on the end product. Nobody wants to regulate the process, which I get because we don't want to hamper innovation. However, it does start to raise some gnarly questions when we're talking about alternative uses or different uses for some of these technologies, or cross-border use. So what makes sense in the US does not actually apply in Germany or in France.

So there's some alignment globally on what's called germline editing, which is when you edit the genome to make it heritable. So whatever that is passes on. At the moment, just about 190 countries, I think, have aligned that they don't want that to happen. But outside of that, there's a lot of confusion.

To your point, yeah, I'm not super worried about an individual biohacker person. What I'm more concerned about is somebody ... We've got a great story in the book about golden rice, which is a real heart-wrenching story of a couple of scientists, one of whom grew up during the Holocaust and didn't have food and had to escape and wound up the rest of his life trying to figure out how to help people who were starving.

Rice is a grain that gets eaten all around the world. You can thank Confucius, who became a foodie at the end of his life and decided that the best white rice is the purest white rice. In some memoirs that he wrote at the end, it was like the greens looked the best on pure white rice. So from that point forward, everybody stripped out the nutritional elements and left the starch. At any rate ...

Dave:

Yeah, and the arsenic and the phytic acid and the lectins.

Amy:

[crosstalk 00:31:07].

Dave:

They took those right out. Why would they do that?

Amy:

Yeah. Well, but that's what most of the world eats. In some cases, that's it, that's all they have access to.

Dave:

It's not adequate. You're totally right.

Amy:

Right, from a nutritional standpoint. So these scientists were like, "Maybe we can hack this rice." And so, they set about trying to change and infuse the genetic makeup of the rice to have more nutrients in it. They were tinkering around with different things and they settled on basically trying to improve eyesight just as a starting point. Anyhow, they made some mistakes.

So the science was good. It was going to take a while. In the process of creating this rice, they wound up using patents from many other people. Now IP in the food space is horrific, because everybody's got a patent on everything at this point. So by the time that this rice was ready and proven, they couldn't ... The whole point of this was to give it away. They were going to give this away to everybody so that they could grow more nutritious rice. They weren't allowed to release it because they were going to get sued.

So in comes a big agricultural company, big corporate agropharma company. They're like, "We're going to help you out. Here's what we're going to do. We'll make your legal troubles go away. However, you're going to let us co-brand. We're going to bring you into our fold. We're going to market this stuff and we're going to call it golden rice."

The scientists at this point probably should have held out and just been patient and waited, but they didn't. They made the agreement. That started this cascade of misinformation. It got to the point where in the Philippines, they're finally ready, they've planted their crop, it's ready to harvest. On the day that they're supposed to harvest it, these protesters who were really hired guns from Greenpeace and some other places, but pretending to be farmers, destroyed the field. All of this is because ... Monsanto, some of those companies did do pretty horrific stuff.

Dave:

Monsanto's destroyed our soil more than any company on the planet. There's war crime things out for some of their executives. It's not a good company. That doesn't mean that modifying food to be better for us is a bad thing.

Amy:

Right. But this is the problem that you, I think, really smartly brought up, which is that we do have examples of companies that have done bad stuff. We've got scientists who are trying to do good stuff. We can't conflate them. They're not necessarily the same thing.

Dave:

They're not.

Amy:

This IP stuff is not going to go away. The question is who should own the IP to a living organism? What happens if somebody else has your DNA? Do you have some rights over it? It's not a crazy question. If you have given your DNA to a commercial enterprise, like 23andMe, you should check the terms of service, because they have the right to sell your anonymized and hopefully de-identified data to third parties, and you don't have a say in that that I know of.

Dave:

I gave a talk in the very first conference on what we ... Well, what was then called big data, about this exact problem, that you need the ability to maintain control of your data. It turns out blockchain can do that for us. But funny enough, 23andMe and the other DNA companies aren't blockchaining any of that. They aren't interested in you maintaining rights to your DNA. This part of their business model is to sell it and make a ton of money.

I'm not sure I'm even that opposed to it. But if they had something that cured people's diseases that was made from some gene of mine that I didn't even know, I don't think it's a problem, unless they applied the Monsanto business model of suing everyone who might touch it, even though they sprinkled it on them. That would be evil. So I mean ...

Amy:

Yeah. I mean, listen, I think we should-

Dave:

... we could worry all night, but it's just not worth it, right?

Amy:

I think we should all be sequenced at birth. I mean I think having those data makes sense. But I think-

Dave:

So you like Gattaca? That's your thing?

Amy:

Yes. That's exact ... I'm a [eugenicist 00:00:35:18]. Are we at that point of the conversation? I'm not. Please do not take what I just said out of context. Don't make memes. No, I mean the conversation always gets to this point, right?

Dave:

Yeah.

Amy:

Gattaca, eugenics. No. Listen, the book opens up with Andrew and I both trying to start families separately and both of us having problems for different reasons. But we had problems. My mom's birthday would have been yesterday. She died pretty young because of a rare cancer that just ...

It's interesting, the way that we name cancer is for the location that it impacts, not the type of it is. So you get liver cancer, right? There's no other ... The flu is the flu, but somehow it's liver cancer because we don't know a lot. We don't have other ways to describe some of these things. So why not give everybody more information, but also give them the ability to opt out of that information being used by others?

Estonia, the tiny little country in north central Europe that has four million people, I think, does a great job. They have created a national database, but it's all opt in. Before you opt in, you go through classes. There's some version of digital literacy, but for your biology. It really is actual informed consent.

What they're doing is trying to build a giant database, because somehow we don't actually have enough data. So a lot of companies are creating synthetic datasets, which creates their own problems.

So if we can create a system where people opt in, we know that those data are not being used by law enforcement, especially without our knowledge, or guardrails, [crosstalk 00:37:03].

Dave:

Yeah. Well, they already are using it without your knowledge with 23andMe, or without your consent. It's crazy, right?

Amy:

Yeah. Yeah.

Dave:

So guardrails ... Are you hopeful? I mean it seems like it's too late for that. The governments already have got their little piggy hands all dirty with our genetic data and it's not going back in the cookie pot or cookie jar, or is it?

Amy:

So, again, literally nobody who's ever met me has called me an optimist. Most people are like, "Somehow you just showed me an apocalyptic hellscape, but I'm still optimistic for the future." I would say that I am hopeful that we will make good decisions, but I'm also very practical. What would it take for us to make good decisions? We all have to be better informed.

Amy:

But I'm also very practical. What would it take for us to make good decisions? We all have to be better informed. Dave, I think you're one of probably 0.0001 people on the entire planet who really understands how they're ... You've taken the time to understand your body and you've learned.

Dave:

It's algorithms and patterns. Yup.

Amy:

But the majority of us don't do that. We don't collect ... I mean I would be curious to know if we did in the United ... In the lower 48, if we did have some type of national healthcare system, how many people would actually show up for preventative yearly checks? I bet you the number is not super high, because a lot of people don't want to know what's potentially wrong with them.

Again, this is uncertainty. We have to be willing to accept that we don't know everything, but that knowledge can be power. So anyhow.

Dave:

It can be power. Well, let's assume that most people are never going to go to the lengths I've gone to understand my biology, or understand the human biology, because they probably won't be as sick and as trash and have the genetic weaknesses and the epigenetic problems that I do.

By the way, just for commonality, my wife and I couldn't have kids either. I used epigenetics for that. That was our first book was what do you do? We had kids at 39 and 42 without needing IVF, just through modifying environmental variables.

It's one of those things where you go, wow, all this stuff is possible, but it was so much work. I mean I spent a couple million bucks on my own biology that I shouldn't have had to spend, because it should have been built into our lighting systems and our food supply and all that.

I worry with synthetic biology that, well, we're going to believe the garbage we believe, like you should have a whole food plant-based diet. So we're going to engineer that with synthetic biology, and it's actually a diet that doesn't work for humans. A lot of our core beliefs are not well borne out in science, or they're done with epidemiological stuff. We don't understand causation.

So how do you know that you don't just go out there and say, "Well, everyone knows that canola oil is good for you because omega-3s," ignoring the omega-6 content, "So let's engineer canola oil that comes out of your nostrils"? I'm really worried about that. They're going to build foods that make people infertile and weak because we believe cornflakes are good for us and they're not.

Amy:

Yeah. So I don't know. I honestly don't know. But the thing that I do know is that the more research we do, the better ability we have to triangulate what does make sense and what doesn't make sense. So that's happening alongside the emergence of existential threats like climate change and insecurity in our global food supply and lack of fresh water or, in some cases, way too much water.

So I think this is the case where synthetic biology gives us optionality. So it doesn't give us answers. It gives us options. It gives us some ability to cope with the external forces over which no one person has control. I also think that's the goal of most of the people in this field. It's to engineer optionality.

Dave:

I love the idea of having choice. So if I want to take the Mystique injection, I can get it. That's one of the three buckets that you talk about in the book. You talk about medicine, how we have the ability either now, or real soon, to get rid of cancer, how you can do lab-grown tissues and really make onboard, whether it's medicine or just biological, changes that stick around. So then you're done.

When that happens, though, isn't that going to disrupt, I don't know, big pharma and I'm going to call it big doctor, like all the medical licensing boards?

Amy:

Well, I think [crosstalk 00:42:03]-

Dave:

Are they going to let that happen or are they just going to crush it like they usually do?

Amy:

I think it's going to disrupt big chicken first.

Dave:

[inaudible 00:42:12] can go itself. Sorry.

Amy:

Yeah.

Dave:

You guys are bad.

Amy:

So we just had the Super Bowl, something I ... It's not my thing. But there was a big game where people [crosstalk 00:42:23].

Dave:

You mean a legend of Zelda fan doesn't like the Super Bowl? I can't imagine. Sorry, go ahead.

Amy:

What's the correlation between Zelda and the Super Bowl? Are you being sarcastic?

Dave:

Venn diagram does not overlap.

Amy:

Yeah, yeah. Does not intersect.

Dave:

Got you.

Amy:

404. So in the United States, Americans ate 1.45 billion, with a B, chicken wings. That is a staggering amount of chicken that American humans consumed on a single day. 1.45 billion chicken wings is like 700 million some thousand chickens.

All those chickens had to come from somewhere. Most of those chickens were not heritage chickens freely roaming a countryside and doing whatever chickens would normally do. These are chickens in commercial farms that are bred specifically to get fat fast and to be okay, enough to be able to sell. That requires hormones. That requires antibiotics. That requires some pretty inhumane conditions.

So what if five years from now, instead of needing 1.45 ... Or whatever, 750 million chickens grown on these commercial farms, that instead we were able to grow chicken meat in what's called a bioreactor. A bioreactor looks like a giant pressure cooker. It's like a giant, metallic, warm womb is the way to think about it, but shiny.

Dave:

There's no matrix here. Don't even look there. Keep going.

Amy:

Yeah. Yeah. So, again, I hate the fact that people call it lab-grown chicken, because I mean it connotes something that it's not. So this is the same exact process that would naturally occur, except that it's much better, because you could start with heritage chicken cells, stem cells, you put them into a bio

reactor with some delicious amino acids, the same wonderful nutrients that would've been in that mother hen, and you let it incubate over time, a couple of weeks.

You don't need those hormones. You don't need the antibiotics. A lot of commercial firms, you have to walk them every single day to pick up what's called dead kill. So there's just a whole bunch of dead chickens you got to scoop up and discard every day. You don't have any waste.

In a couple of weeks, you get meat that looks like chicken, it tastes like chicken, and it didn't require any of the other stuff. What's cool about this is that it's already actually gone on sale.

So in Singapore, it took two years to pass through the regulatory process. But Singapore's actually put this meat now on sale. The portion sizes are a little smaller and the fees are a little higher. So it's $17 versus whatever, 10 cents per wing. But this is early days stuff. It's very plausible that pretty soon we might have bioreactors, several bioreactors, in every community.

The freshest sushi you'll ever eat in your life could come from a bioreactor down the street from you in Saskatchewan or in Lincoln, Nebraska versus off the coastal waters of Japan. You don't have the cold chain issues, you don't have the supply chain issues, and you've got control over how that meat was created.

I don't actually eat a ton of meat because I don't agree with commercial farming, a lot of this commercial stuff, and I don't want that stuff in my body. But I would absolutely be the first person in line to consume bioreactor-grown, clean tissue.

Dave:

Let me ask about this. I'm a bit of a skeptic here. I live on a 32-acre organic farm. I grow all the animals I eat. When I'm at restaurants, if it's not grass-fed, grass-finished, I don't eat it because it's bad for me and it's bad for the soil. I don't participate in industrial agriculture because it's just nasty. Why would you do that? So I'm with you there.

I also calculate deaths per calorie. In the entire supply chain of a pound of grass-fed steak a day, it's about 0.3 to 0.4 kills per year, including insect kills, unless the cow stepped on a frog, because there's no habitat destruction. This is on land. That's still natural land. They're grazing. Yeah, you can argue, well, there's enough space for everyone to do that. I'm not so sure about that. But whatever the deal is, it feels like I'm down low.

When we look at fat-grown meat, where do all those aminos come from? How much habitat was destroyed there? How many chemicals are sprayed on the soil? How clean are they? Where's my collagen? Where's my tendons? Where's my fats, the right fats, that are actually the most precious part of meat?

It feels we're making more of a problem because we're assuming that the white meat from chicken is best for you when really maybe you should be getting chicken made with tallow or cooked in butter or something. I don't know.

Amy:

Yeah. So what I would say is we're at the minimum viable product stage. So, again, this is long-term, long-range tech. The analogy that we use in the book is telecommunications, which I know feels a little disconnected. But at the turn of the century, Alexander Graham Bell is in New York, at Chickering Hall, standing on stage with a crazy-looking wooden box. He picks up a receiver and suddenly there's sound. The sound seems to be coming from somewhere. The audience doesn't know. Maybe it's from behind the curtain.

They're incensed. They demand to be taken behind the curtain to see some proto version of the Wizard of Oz. There's nobody back there.

This is the beginning, right? This is the invention of the telephone. It so disrupted the mental models that people had based on what they knew, that it was literally not to be believed.

Now it took a couple of decades to get from that demonstration to the wiring and the infrastructure and all the work that Ericsson did to build relay towers, like all the pipes stuff that had to get built to get to the point where we had telephones in homes and eventually transatlantic wires, and eventually satellites and the internet and the modern telecommunications infrastructure as we know it today.

There is no way to put a valuation on what the global telecommunications ecosystem is. It's too vast. It just is at this point. It just exists. The only way to calculate the total value of it is to do it in the reverse. How much would we lose if we took it away?

Synthetic biology, the chicken in the reactor, we're at the Chickering Hall phase. We're at the chicken in the hall phase. Very, very early stage stuff.

So in the next two years, are we going to get the sinew and the collagen? No. Could we be there in five to eight years? Maybe. Do the opportunities start opening up the more research that goes into all of this? Totally. Do I think that 20 years, we're going to look back at this moment in time and think that humans alive in the year '22 were barbaric for having children through sex, like getting pregnant with sex, or having meat from an actual animal? Yeah. I think our hearts and minds are totally going to start to change, for sure.

Dave:

I'm not so sure on the sex one. I think that's pretty deeply wired even subcellularly. People are still going to have sex and be like, "Oh, look, there's a pregnancy that came from it." But I could be wrong on that.

Amy:

I mean I think some people will. My hope for the future is that we have a ton of sex, and then it's awesome. But that we have the option to choose IVF because it's the better way to make a baby. That's what I hope.

Dave:

Got it. I think there are some unforeseen consequences around egg selection for the environment that we may be missing out on.

Amy:

How so?

Dave:

Well, inside your ovaries, there's a hundred thousand mitochondria per cell, whereas inside your heart and brain, there's 15,000, and in the rest of the body, there's a few hundred, a couple of thousand. Mitochondria are environmental sensors, as well as energy and manufacturing plants of all kinds of chemicals, hormones, and proteins. So they send something, do something.

What they do in the ovaries is they look at about ... And some of this is conjecture, but it looks accurate. They look at about the previous three months and say, given the stress environment, the

nutrient environment, the toxin environment, the sunlight environment, the heat environment, the safety environment, I'm going to put the eggs in the chute to drop that are most programmed to survive in that world. That's why you can use epigenetics before pregnancy to have a healthier baby more likely to thrive versus be in defense mode.

So when you're doing IVF, I don't know how the body chooses which eggs to drop, because if you're doing IVF, you only get some eggs and the eggs are not all the same.

Amy:

Well that's now, right?

Dave:

Right.

Amy:

So I guess what I'm saying is I'm not ... So I'm saying in the next couple of decades, by the time maybe my daughter is ready to have a baby, we'll know more. Those screening processes ... Obviously we're not going to be omniscient. There are some, on a cellular level, decisions that are being made that we don't understand at this point, but I'm hoping that we are moving towards that understanding.

And so that the selection is made so that ... Yeah, I mean I hope there's a thousand embryos that get created with every pregnancy and we are using selection to figure out which ones have the greatest probability of surviving and also thriving.

Dave:

I'm actually more in alignment than some listeners would probably guess. Although I'd rather just take one and say let me make these tweaks on it. Here's the upgrades that I want attached-

Amy:

Yeah, well, genetic surgery, too.

Dave:

... here's [crosstalk 00:52:12] cystic fibrosis and all that kind of stuff, and there you have super humans. A lot of people say, "But that's evil. You can't do that. That's messing with Mother Nature." Guys, that cat's out of the bag. We messed with Mother Nature a long time ago and she's messing back with us through this thing called extinction. So either we do it or we don't.

But I think it's on us as a species to improve our own species, but not through doing acts of evil. We've got to figure out how to do that in an ethical, safe way that keeps the planet healthy and keeps our future generations healthy, because right now, if you do the research on fertility, it's plummeting globally. We're less fertile and our children are really not very healthy.

And so, we've got to fix that. I'm working on it. Maybe synthetic biology ... In fact, I'll take away the maybe. Synthetic biology is the only thing I can think of that's going to let us fix the world we live on well enough to make it so we can keep living on it, because we've already broken it with non-synthetic biology, things like spraying chemicals everywhere, antibiotics everywhere.

So it's worse than people think. But it's reversible because of exponential technology. That's why I wanted to have you on because your book is awesome about that.

Amy:

Thanks. I mean I don't want to take the romance out of life-

Dave:

You already did. come on.

Amy:

... but I mean we're just containers for code. I mean that's it. All of our code is pretty much the same. If we have the ability to gain ... So I don't mean to make a super heady computer analogy here. But if we suddenly have right-level permissions to our own code, don't we want to take advantage of that? Why would we not want that? I don't think this is about playing God. I think this is about playing editor.

Dave:

So you want a type chmod 7777 for all of our genes and all of our biology that unlocks right-level access and execute access to everything?

Amy:

Yes, and I would like guardrails to make sure-

Dave:

[crosstalk 00:54:14].

Amy:

I'd like guardrails to make sure there's no Konami code secretly-

Dave:

What's that?

Amy:

[crosstalk 00:54:20].

Dave:

This is where I'm really running into deep thinking problems I don't know how to fix yet, and that's whenever that kind of power gets out there, it's always sociopaths and psychopaths and power who corrupt that.

The internet is that way. I was there when the first browser was made. I look at how we stripped anonymity away, how the world's last anonymous remailers ... You could send an email to someone without knowing where it came from was in Finland. Of course, attorneys came after it and the guy's like, "Fuck you," and deleted the whole thing so no one could ever do it again. How you can't get an account on Google without giving up huge amounts of info so they know who you are.

So we've stripped all that stuff away. Now we're using it to do bad things to people. So you can't cross a border without an internet machine learning thing. What are the bad actors going to do with synthetic biology, stuff that we don't want them to do? Because we've got to guard against that first.

Amy:

Yeah. There is a pretty big section of this book that just goes through risks. We actually identify nine of them.

Dave:

Yeah, it's good.

Amy:

I'll just maybe caveat this by saying that with every new technology, any new science, there was always the possibility of dual use. Always. Honestly, any ... I've got a pen sitting on my desk. This pen is a deadly weapon if I stab it in your neck, hard enough. This is just old technology that this is [crosstalk 00:55:47].

Dave:

The TSA took a pen away from me because they thought it might be dangerous.

Amy:

Are you serious?

Dave:

I'm serious.

Amy:

What kind of pen was it? Was it a fountain pen?

Dave:

It was just a nice executive pen. I'm like, "You guys are clowns." We're going to all have soft papier-mache pens just to be safe.

Amy:

Well, I think that's actually ... Right. So in as much as TSA is security theater at this point, this is an area where we don't want to have security theater.

Dave:

No.

Amy:

We want to have security. So some of the risks involve some things we already talked about, IP. We've got conflicting regulatory frameworks. We have some confusion. We don't have enough staff to enforce any of the mechanisms. In the United States, we have no long-term policy for science or tech. We've got absolutely no funding. So we have some sort of systemic, very high level problems that are risks, that I'm very concerned about, that we need to solve for.

We also have some potential dual-use challenges that fall within the realm of something called gain-of-function research. This is not done very often, but there have been cases-

Dave:

Wow. You're sucked into it here.

Amy:

No, I know. I know what you're thinking. I know what you're thinking.

Dave:

We would never do that. Keep going.

Amy:

We will never do that. We don't have any proof that that is what happened. But over the past 20 years, there have been a couple of instances where researchers have used off-the-shelf mail order DNA and off-the-shelf chemicals and publicly available genetic information and have successfully reproduced smallpox and horsepox.

There was a researcher in Europe who said that he successfully mutated H5N1, which was the bird flu virus, and made it transmissible from birds to humans and then between people. In his words, he mutated the hell out of it.

Now I understand that there's part of the research community that believes that intentionally mutating viruses, it's a way to study how they might actually mutate in the wild. If we know that, then we could theoretically develop therapeutics in advance or some type of action plan. But the reality is DeepMind, which is Google's AI division, has just cracked the code on protein folding for every known protein.

We live in an age when you can run simulations that are probably going to get you faster results than a research team screwing around with a pipette in a lab. There's just no reason ... I mean there's one reason at this point to do gain-of-function research and that's bioweapons. So we should not be doing it at all, [crosstalk 00:58:34].

Dave:

Yeah. Gain-of-function research for progress is like masturbating while playing Russian roulette. Nothing good comes out at the end. It might feel good at the time and you might die. So it's just not worth it.

Amy:

Yeah. It's not worth it. I mean it's expensive. So, again, if we've got systems that we can start to model, then we don't need to do that research. So we shouldn't. That should not be an application of synthetic biology, but that is a risk. We don't have universally agreed upon regulations or guardrails. Some funding still exists. And there's not a lot of transparency. That is a problem.

Genetic surveillance is another big problem. The United States, in 2019, was trying to pass some legislation that would've mandated anybody caught at the southern border to have their DNA scraped and put into a database. Then at some point, even non-criminals, anybody coming across the border, to have their DNA scraped. This is pre-COVID, of course.

In China, the government there, I think, has done now 10% of the adult male population. So that's a huge number of people, around 70 million people. Is that more than that, though? Anyhow, in number, 700 million people-

Dave:

[crosstalk 01:00:01].

Amy:

... which supposedly means that they can now identify anybody, basically, from those data. Again, why would you mandate scraping people's DNA if they haven't committed a crime? The obvious answer is because they're surveilling the Uyghurs population, the ethnic minorities, and because they're trying to gain social control.

So these two models are probably not great. Then we have the added issue in the US of people not realizing that they're opening themselves up to genetic surveillance because they're submitting their DNA to different services. Then COVID happened and we're desperately trying to get back to some sense of normal life. To do that, we have tests, which we should have, but ...

I had to go to a meeting about six months ago. In order to get into this meeting ...I'm triple-vaxxed. In order to go to this meeting, I had to also show a PCR test and they wanted me to go to a guy in a van. I mean this is next-level crazy stuff. A guy in a white van who wants to swipe my nose. I have no idea who this is. I have no idea where the data are going to go. I told him I had a latex allergy. He didn't understand what that was. I'm like, "Are you even a trained medical technician?" So there's a lot of risks.

Dave:

There are a lot of risks there, and I love it so much that your book says we're going to stop gain-of-function research. That's amazing. But you also talk about creating biotechs's Bretton Woods. You're actually the second Bretton Woods member that I've known.

But most people don't know what Bretton Woods is. Can you talk about what Bretton Woods is for economics and how you would make that work? Listeners, this is actually how we're going to solve the problems for this whole industry. So walk through what it is and how you would change it for this.

Amy:

Yeah. Okay. So I don't want to get into a super, super wonky explanation.

Dave:

You don't want to be yourself? I mean, come on. You can be wonky here.

Amy:

Okay.

Dave:

It's a safe place.

Amy:

So basically, following World War II, the war was over, which is good, but the financial ecosystem was perilous. It was potentially going to collapse. So we had all kinds of problems. A bunch of ally countries got together, so US, Canada, parts of Western Europe, Australia, and Japan. They all got together and decided to form a group.

The idea among the group was, first and foremost, let's not do this global war thing again. This turned out to be pretty bad. Second of all, if we do wind up having some type of problematic situation again in the future, we will support ourselves.

So in the 30 years that followed, out of this came the World Bank and the International Monetary Fund. The idea here was everybody's going to pay in. If some country winds up having an economic problem, the other countries are going to make sure that it's stabilized.

The point of this was to balance out the emerging global economy, to make sure that no one country wound up on the brink of potential horrific inflation or terrible collapse or something like that. The benefit to the member nations was that in paying in, they created this sense of balance. So everybody paid in and everybody reaped the reward.

So the system ended in the early 1970s and here we are today. It didn't need to last forever. It took a while for things to stabilize.

So in the year 2022, we need some type of system where we can bring different countries to the table in some type of alignment around how genetic data specifically gets used, gets scraped and gets used. So what if there was a system where everybody had to pay in with data, but we did so with guardrails, we did so thoughtfully, and we made it so that no one country was going to go on its own and do genetic experimentation or research that fell outside of what the other member nations thought was important or ethical or good?

Dave:

Wait a minute here. You studied game theory.

Amy:

Yeah. Well, okay. [crosstalk 01:04:45].

Dave:

Everyone who's a member's going to say, "Oh no, I would never look at biological weapons," but they're all doing it.

Amy:

Well, again, the other model might be the IAEA, except that I don't want to equate synthetic biology to an atomic weapon. Part of what we're suggesting here, there has to be some level of trust, but there has to be accountability. So this is, believe it or not, where blockchain technology's come in handy.

If we have some type of public accounting, public ledger for what has been sequenced, who has access to those data, how ... I mean it's more complicated than this. It takes a long time in the book to explain it all. But who's ordering what genetic materials?

It's not a turnkey thing, but it's a start. My concern is that most of the time everybody goes their own way until there's a problem. Then the answer is punitive. The punitive pathway doesn't work.

This is true also for AI. We're now trying to break up the big tech companies. They're going to fight if you try to break them up. If there was a way to economically incent them to make better choices, we might have better luck. I don't want us to be in a situation 10 years from now where the conversations we're having today about breaking up big tech are the conversations we have tomorrow about breaking up big bio. I mean that would be, on a planetary scale, really bad.

Dave:

Yeah. This is one of the problems with our species' wiring. It's that to do certain things like go to space and solve really big problems, you have to have huge, huge infrastructure at scale. As soon as you get that, the algorithms that you put in place for companies to survive, even when individual employees come and go, ultimately they're not about making the planet or the species better. They're about enriching themselves. So the bigger the company, the more it can do, but the more it has power to do bad.

Those seem like fundamental constants without some overseeing injection of different ethics, which I think has to happen at a very foundational level for each person in the company, but isn't the company-wide problem.

That's why I want synthetic bio. I wanted to fix our species so we can be less dickheads to each other, because that would be really nice.

Amy:

So that's one of the cool things that I'm observing in this space, which arguably is new. Some of the bigger companies in this space are pretty awesome. I do believe that they are making decisions at the moment with the public good in mind. So those would be Ginkgo Bioworks and Twist Bioscience. So Ginkgo is making engineered custom microbes and things like that. Twist is a lot of the infrastructure and the processes. These are two huge companies that are making good decisions, I think.

Dave:

Wasn't Twist formerly DoubleTwist? Isn't that the same company?

Amy:

DoubleTwist? It might. This is Emily Leproust and that whole crew.

Dave:

Ah. Yeah, DoubleTwist held Craig Venter's DNA in the very early days. I'm betting it's the same. Anyway, I helped design some of their infrastructure years ago.

Amy:

Got you.

Dave:

Wait, maybe that's the same thing.

Amy:

Yeah.

Dave:

I bet. I could be wrong.

Amy:

Yeah. But I mean these are two ... I just highlight this because, again, this is early days stuff. Sometimes companies start taking outside investment. The investors get a little antsy. We've really outsourced a lot of the development of all of this to the private sector in the US, because, again, we have not devoted the amount of resources that we should have. And there's been a lot of political misalignment around how and when and if to use stem cells. So we're stuck.

I think we have some smart people making decisions today who we should support. I also think that we're going to have to figure out how all this plays out, because, again, I would hate for some of the problems that we've got now in AI to mirror problems that we might have in synbio. The stakes are so much higher. So much higher.

Dave:

Let me ask you this. Is there any government on the planet that has enough intelligence to write regulations around synthetic biology?

Amy:

Again, I go back to Estonia a lot. I think they're-

Dave:

Estonia.

Amy:

I know. I know. But like-

Dave:

I like Estonia. Their vibe is very hacker. It's pretty cool.

Amy:

Estonia, they're badass. They're doing some cool stuff. They've had digital ID and digital infrastructure and government systems since the very early 2000s. They do really long-term thoughtful planning.

Now, to be fair, it's a teeny tiny little country. It's not fraught with some of the same problems that we have. But, yeah, they are totally models. Is it perfect? No. It is very different from our approach.

But you mentioned game theory earlier. Most of the time what winds up happening in the US is that we have this three-sided prisoner's dilemma situation, where you've got lawmakers, you've got the street, so your investment community, and you have the tech companies, or the biotech companies. Each one of those three believes that they are the holder of all the power and believe they can win when, in reality, if the three could collaborate, they're all going to benefit. But they just have such a hard time seeing it that way, and that's really a shame.

Dave:

It is a shame. I do think there's some hope in the future, and I think synthetic biology is the biggest one. But it's like, okay, governments, you're probably not going to get this right because you don't even understand it. But you should read the book anyway because there's a lot you could do to understand it.

The judges I know, and I'm very fortunate to know one of the state Supreme Court judges well enough to sit down and actually learn what they do, and their job is to learn really, really deeply, like

you do, to write a book about a subject when they're ruling on something where there's a problem in the law. These are not criminal judges. These are Supreme Court-level things. It's super cool and fascinating. They might be able to pull this off.

But if you're a congressperson or a senator or in the executive branch, you're not going to fit all this in your head. So then you've got to look at are you going to get advice from the people who wrote you the biggest checks or the people who know the most?

Amy:

So this is why-

Dave:

So at least read The Genesis Machine.

Amy:

Yeah. I mean actually we have a really good story of how that plays out on a local level in the book. In Florida, there's an experiment underway with engineered mosquitoes to try to curb the spread of malaria, West Nile, and other diseases.

Ultimately, the decision got kicked down the road until it landed on the doorstep of the local Key West city council members. These guys are retired real estate agents. I mean these are totally not people who have any background in any of this stuff. It's not to say they can't learn, but they they're being saddled with a ridiculous amount of responsibility, I think, in a very unfair way.

We keep seeing this happen in governments all around the world. The leaders at the top levels don't want to make people upset, so they say, "We're going to let the states or the provinces figure it out." Then the governors, the heads of those provinces and states, are like, "Oh, it should be a local issue. We're going to let the local people figure it out."

That's unfair, whether that's a mask mandate or a vaccine rule or determining what to do with genetically engineered mosquitoes. Every government should have some version of a national office of strategic foresight.

I actually wrote a paper and have been presenting it to different state federal government-level leaders. We need a nonpartisan, or bipartisan group, that has very long term. The group should be responsible for doing the really long-term planning, so that regardless of who's in the White House or who's in your ... Wherever you happen to be in your local government, whoever's in power should still be adhering to this long-term vision and this long-term plan. Absent of that, we're just going to keep paying attention to right now. I mean we're all nowists. We need to be thinking futurists.

Dave:

Oh, I love that. We're not nowists. We're futurists. Very cool. This Genesis Machine is, I think, a foundational book. If you're listening to the show, there's a reason it's called biohacking. It's because hackers, we don't just get into systems maybe that we aren't supposed to. We learn how to change and control our own systems the way we want to.

But also we create tools. These are tools like open-source code, like creative commons licensing which lets people say, "I don't want anyone to have rights to this." Everyone can have rights to this. We create things that let us look at the code so we know what's going on. That's the positive side of hacking.

When you realize a synthetic biologist working for a big company can do something that might be good for you, or might be bad for you, having that knowledge is really important and powerful for you, because then you can choose what to do. But if instead they just do it and you never even know it's possible, and you don't have the tools to do it yourself, then you're at an inherently less powerful position.

My job is to make you more powerful, make you more knowledgeable, make you more energetic. That's why I think you want to read this book. It's particularly important. It's called The Genesis Machine.

Understand what's happening, because if you're worried about EMFs, which do have biological effects, or you're worried about glyphosate, which does have biological effects, synthetic biology is a million times more powerful for good or for bad. That's why you need to know about it and that's why it's part of the world of biohacking. So read the book, make sure you're informed. Thank you, Amy, for a really fun interview.

Amy:

Yeah. I'm so glad I got to meet you, Dave. I've had your products in my body, but it's cool to be able to talk to you. So yeah.

Dave:

Nice.

Amy:

Yeah. All right. Take care.

Amy:

It was super great to meet you. Thanks.

Dave:

Thank you so much.