Nate Hagens:

You are listening to The Great Simplification. I'm Nate Hagens. On this show, we describe how energy, the economy, the environment, and human behavior all fit together and what it might mean for our future. By sharing insights from global thinkers we hope to inform and inspire more humans to play emergent roles in the coming Great Simplification.

One of the benefits of hosting this podcast is I become friends with amazing people that I wouldn't have met otherwise. Today it is my privilege to introduce my friend, Sandra Faber, who is an astrophysicist known for her research on the evolution of galaxies. Sandra has long taught at the Lick Observatory and as a professor of astronomy and astrophysics at the University of California Santa Cruz, where also she oversees an Earth Futures Institute whose mission is to inspire humanity to address the perils and potential of intelligent life on Earth on timescales of decades to millennia and beyond.

Sandra and I start at the Big Bang and come all the way to the present and have a wide-ranging conversation on humans and the universe and our role in what's to come. Please welcome my friend, Sandra Faber.

Professor Sandra Faber, great to see you.

Sandra Faber:

Great to be here, Nate.

Nate Hagens:

It is a long time coming that you are on this podcast, so thank you. For those who might be unfamiliar, can you explain what your work has been and what an astrophysicist does? What sort of a career and educational umbrella is an astrophysicist?

Sandra Faber:

Sounds important, doesn't it?

Nate Hagens:

It does.

Sandra Faber:

Yeah, right. My mother always liked that term. Astrophysicists are basically astronomers who use the techniques of physics to understand the cosmos and phenomena outside Earth: our solar system, our galaxy, the universe. Most of us have PhDs. We are faculty in departments of astronomy, physics, astrophysics at universities. We work at observatories. Many of us go into other fields: science, journalism, stock market actually.

Nate Hagens:

Can you give a brief explanation on the origins of the cosmos, which presumably is deep in the architecture of astrophysicists' work and what the universe might've looked like during that time, the unfolding of the Big Bang and all the way since?

Sandra Faber:

Great, yeah. Well, if you had said the history of the cosmos, I would be on firm grounds, but I'm being picky here. You said the origin of the cosmos.

Nate Hagens:

Well, please answer both. I'm curious about both.

Sandra Faber:

Well, I wish I could answer both. We really don't know what the origin is, and let's come back to that after I've said a few things about what we do know. Our reliable history of the universe starts remarkably early at something like 10 to the minus 35 seconds after the Big Bang. You referred to the Big Bang, okay. That was a time in which the universe was incredibly dense and incredibly hot. How hot? 10 to the 27 degrees Kelvin. I mean, that's just unbelievable. Here I keep using these 10 to the powers kinds of things. That's one of the tools of astrophysics is powers of 10. It began somehow in this very dense hot state. The origin of that, we just really don't know.

It was expanding. People wonder, well, why was it expanding? Well, if it was contracting, we wouldn't be here. Maybe only universes that expand actually make intelligent life later. There had to be a future. For there to be a future, the universe had to expand, so it was. This was a very special time soon after 10 to the minus 35 seconds or thereabouts, in which the laws of physics were really different, totally different, and the universe entered a phase of what's called inflation. It expanded faster than the speed of light. We're taught in school that going faster than the speed of light isn't possible, but actually if you're a universe it is possible.

For that reason, there was interesting physics that I'd like to come back to in a second, but the gist of it is it didn't last very long. 10 to the minus 35 to 10 to the minus 32 is the standard model. As a result of expanding faster than the speed of light, it developed in homogeneities, little fluctuations. What do I mean? If you were to fly through that early universe with a little meter that sensed energy density or something like that, you would see it wiggling. Those fluctuations, those wiggles were caused because the universe was expanding faster than the speed of light.

They had profound implications. Nothing really happened to them for quite some time, but after a few hundred thousand years they started to grow because they generated gravity. Picture a universe in which there are these little lumps. Lumps have more gravity. They pull in

stuff around them. They grow, the lumps grow. The spaces between the lumps lose matter or energy density onto the lumps, and we have a gravitational runaway, an instability in which the rich get richer and the poor get poorer. Sound familiar? Sounds like economics today.

Nate Hagens:

Is it a power law in space?

Sandra Faber:

Kind of. Yeah, you could say that. Hierarchical clustering is how astronomers refer to it. This is the origin of galaxies. This is where our Milky Way came from. My career, my personal study has been how these lumps evolve in time. They're just essential features of our universe to make us the way we are because there where stars formed. The stars generated planets. Who knows what's happening on all those planets? We'll come to that in a minute.

This whole process took 14 billion years or thereabouts. Started out incredibly hot and dense. Cooled as it went. Now it's only three degrees above absolute zero. It's an incredible story and more incredible that we know it.

Nate Hagens:

Right.

Sandra Faber:

Who would have thought? Could I have thought when I was in graduate school that I'd be talking about the universe at 10 to the minus 35 seconds? It's inconceivable, but it happened.

Nate Hagens:

It's all happening these centuries that not only did this happen, but we figured out that it happened. Same thing with Darwin and evolution and all of it. It's almost like a test for us to reach the next state of a conscious complex life form on a planet. As we'll discuss later, we're failing pretty miserably at the moment.

Sandra Faber:

Well, if you don't mind having a bit of a detour.

Nate Hagens:

I do not mind.

Sandra Faber:

We like to think, in this day and age, that we're smarter than people that came before, but I'm sure the theme of our conversation, as is so many of yours with other people, is that all we have is lots of energy at our disposal. Everything I've told you, none of that would've happened if modern science had not been able to exploit the wonders of cheap energy. We're not smarter, we just have energy.

Nate Hagens:

I'm going to ask you some naive questions throughout this podcast. As the universe was expanding, clearly the energy came from the sun and other suns in the galaxies everywhere. Where did the materials come from, the hydrogen, the helium, the minerals? There's some of Jupiter's moons rain hydrocarbons like methane. I mean, where did all this stuff come from?

Sandra Faber:

Well back at that time of 10 to the minus 35 seconds, there was an ore protoplasm that had within it all the seeds of all the stuff that you just mentioned today, neutrons, protons, electrons, the stuff of the periodic table, chemistry and so on. For a long time it was in some more primeval fundamental state because it was hot. But as the temperature went down, the physics changed and structures began to form. We got quarks made protons and neutrons. Later it cooled enough that the protons and neutrons could make atoms and so on.

Going back to a few hundred thousand years when the universe was only about a thousandth of its present size, it had a temperature of a few thousand degrees. At that time, it went from being ionized hydrogen and helium. Those are the two elements that originally came out of this incredible Big Bang pressure cooker. They went neutral and became gaseous hydrogen and helium, just like what we know today, nothing magic there.

They condensed into stars. Stars are the marvelous chefs of the universe that cook all the heavier elements out of which we are made. Stars get energy by putting hydrogen and helium together to make heavier things. This releases energy and at the same time it makes oxygen, nitrogen, iron, all the stuff that we're made out of.

Then stars obligingly die, some of them, and they spew their guts out into the interstellar medium, enriching it so that the next generation of stars and solar systems to form will have, they'll be enriched in these heavier elements. Astronomers call them metals. Anything heavier than helium is a metal to an astronomer. That's where we get planets and stuff. That's where we get all of our chemistry. That's what we're made of. We're made of this stardust.

Nate Hagens:

I know that, or I have read that and been told that, but it seems emotionally like a fantasy story because you all have these physics equations and telescopes and stories that are just emotionally distant to my life. Let me ask you this, a thousand years from now, assuming that

there are humans around and that somehow we have science, maybe our religious textbooks and other cultural artifacts might be totally different, but if a group of scientists had the same technology that you in your work had available, would they come to the exact same conclusions about everything you just said?

Sandra Faber:

Pretty much, I think. Yeah, mm-hmm. They might have better insights.

Nate Hagens:

This is replicated over and over in different-

Sandra Faber:

Oh, yeah. No, this is truth. This is how things are.

Nate Hagens:

Why is it important that people, the viewers of this podcast and our population generally understand this story?

Sandra Faber:

That's a really good question. Parenthetically, this is what I've spent the last 30 years of my career thinking about. When I was a kid, the constant refrain in my ears from my dad was, "Sandra, make yourself useful." It is fun studying about astronomy. It's fun telling people about it. People love to hear about it. It's interesting to ask that question, why do they love to hear about things that are so distant and so seemingly irrelevant? Maybe we can come back to that.

Nate Hagens:

Maybe it because it makes them feel special because we are special in that sense.

Sandra Faber:

Well, that is true. I would say it's a hunger to know who you are. That's really what I wanted to say.

Okay, so to get back to your question, why is this important? The first thing is that I didn't mention the word divine being in my story. We got here, maybe the Big Bang was inspired by a divine being. I wouldn't go so far as to say that's impossible, but the story after that unfolds according to the laws of physics, not miracles. That's the first thing to learn. We don't need a divine being to tell most of the story. Worse than that, or more important than that, we are prisoners of the laws of physics. We live within the laws of physics. There's just no evading

them. Conservation of matter, finite number of iron atoms on earth for us to exploit, these are numbers that transcend us. Those are my first two lessons.

But there's a third lesson, and that is if you want to understand who you are, you need to know where you came from. Let me give you an analogy. Supposing again a topic I think we're going to talk about, human nature. People fumbled, great philosophers fumbled around for thousands of years wondering about human nature, but to my taste, what we've really found out about human nature has come from Darwin and his descendants who have given us evolutionary biology who say we are who we are because we're animals that evolved with a certain strategy, a business plan. That's our nature. We are adapted to follow our business plan, and of course, to some extent vice versa.

Okay, so you cannot understand human nature without understanding that our ancestors were apes, chimpanzees. This is basic. In the same way, we can't understand the nature of Earth, its finiteness, what it offers and what it doesn't offer without seeing this big picture of the universe making galaxies, stars and planets.

Nate Hagens:

Are you still teaching, or not?

Sandra Faber:

Not in a classroom.

Nate Hagens:

I'm just wondering if the articulation that humans evolve from other apes and that has a bearing on our individual and social behavior, there was a time that that was not accepted. Then there was with the standard social science model, and then for 20 years it became obvious and accepted. But now it seems to be backtracking and that's threatening to some conversations that want to say that we're culturally capable of anything, we're not subject to the laws of biology and physics. Do you have any thoughts on that?

Sandra Faber:

Not really. Other than to say that's nonsensical. I have a human body. Cultural norms are not going to change that. Cultural norms are not going to be able to make me leap tall stories at a single bound. There are fundamental limitations about what we can do and who we are just by virtue of what we're composed of, how we're built, and what we think and feel.

Nate Hagens:

We're going to go down numerous rabbit holes and even wormholes perhaps on this conversation. What does cosmology, and then I'm going to ask you what does Sandra Faber have to say about the rareness of Earth-like planets in the universe?

Sandra Faber:

Well, this is one of the most exciting fields of astronomy today because starting only rather recently we've really detected other planets. We now know that there are other solar systems with multiple planets, some of them. We know that there are several thousand planets around other stars. We don't know too much about them. It's hard to discover small ones like Earth rather far from its sun and small. Discovering Earths is right at the limit of current technology, and hopefully in the next 20 or 30 years we'll know much more about Earth-like planets. We know that planets are frequent, but we don't know if Earth, per se, or planets like us are very frequent.

Nate Hagens:

How many galaxies are there? How many stars are there?

Sandra Faber:

We don't know what the total extent of the universe is. It's a little bit like sitting on the ocean and seeing a patch of ocean around you, you don't see to the other side of the Earth. In the same way, we can't see the whole universe. We can only see as far out as there has been time for light to travel. We can see 14 billion light years away. The universe could be 10 to the 10 to the 10 to the 100 times bigger than that. We don't know.

Nate Hagens:

It almost breaks your mind when you think about that. I mean, for me.

Sandra Faber:

Yes, that's true.

Nate Hagens:

I just can't even remotely conceive of it. I think that's part of the reason most people don't because it hurts to think about it, and it's constantly expanding. It's still expanding. Expanding into where and where did that come from?

Sandra Faber:

Okay.

Nate Hagens:

I'm just a podcast host.

Sandra Faber:

Okay, but I think really your question was we can see a small patch of the universe, how many galaxies are in the patch?

Nate Hagens:

Yep.

Sandra Faber:

The answer is about 100 billion.

Nate Hagens:

Wait, 100 billion galaxies of which we are one, the Milky Way, and that 100 billion galaxies is just a small patch of the observable universe.

Sandra Faber:

Yeah, that's right, a very, very, very small patch.

Nate Hagens:

If everything came from the original processes and that went everywhere, the odds of helium and hydrogen and argon and all the different things that came from the protoplasm that you mentioned are exceedingly high. One would imagine that there would mathematically be lots and lots of Earth-like planets out there.

Sandra Faber:

Yeah, and a lot of people believe that. I would say that's the standard view. That's not my view.

Nate Hagens:

What's your view?

Sandra Faber:

My view is that the Earth is really quite rare. How do I come to that? By the way, nobody knows. This is just my opinion.

Nate Hagens:

Yeah, sure.

Sandra Faber:

At one point I sat down and I wrote down all the unique things that I thought were really important to Earth as we know it. I had 17 things. I said to myself, and this is really reasonable for a lot of the things on the list, let's just assume that there's a 10% chance that each one of these is true and that they're unrelated. That's a big assumption.

Nate Hagens:

Right.

Sandra Faber:

Okay, so that means that's 17 factors of one-tenth, that's 10 to the minus 17. Now there are only 10 to the 11 stars in our galaxy. Already if we multiply those two things, we've got one chance in a million of our galaxy having an Earth-like planet like us. Of course, the whole point is to say what is us exactly. But, reasonable things like having a magnetic field that protects us from energetic particles from the sun, which otherwise would destroy chromosomes of living organisms on Earth. Or for example, we have to make that magnetic field. We have to have an iron core. Earth has to have the right composition. Punk composition of planets could be very different from place to place and so on. So I'm not doing any magic here, I'm doing reasonable things.

Nate Hagens:

When you unpack that, and I've heard other people do similar stories, it results in two feelings for me. And I don't know if viewers or you share this. The first one is, "Oh my god, to get through that 1 over 10 to the 17th, almost has to be some divine intervention because what are the odds?" And then my second feeling is, "Oh my god, are we making a mess of things?" And how precious is this one place? And we got to figure it out. Those are the two things that come to my mind.

Sandra Faber:

Yeah. So let's talk about the first one and then we can spend the rest of this podcast talking about the second one.

Nate Hagens:

Okay, please.

Sandra Faber:

Okay. Regarding the first one, the improbable can happen if there are a lot of opportunities for it. There are a lot of galaxies in our observable universe. So even though it might be

improbable to have an Earth, there were enough chances that there was one. Let me give you a little statistic that I think has come from astronomy that's really interesting. Okay? So we said before that each one of us is made of stardust meaning that anything heavier than hydrogen and helium in our bodies was synthesized in the interior of a star. All your carbon oxygen, so on, cooked inside a star. So here's a question. All of those atoms came out of supernova explosions. How many supernovae were you part of, Nate Hagens?

Nate Hagens:

No idea.

Sandra Faber:

Oh, about a million.

Nate Hagens:

Wow.

Sandra Faber:

Okay. And where were those supernovae in the galaxy and in time? Answer, all over. Take the atoms in your body right now. What is the probability that all those atoms which were dispersed over virtually the entire galaxy are now to be found in you today? Talk about improbabilities. I mean, it's a lot less than 10 to the minus 17, and yet here you are. And so am I. And so is that rock over there, which has its own atoms.

Nate Hagens:

I'm definitely going on a diet tomorrow. Starting tomorrow.

Sandra Faber:

Okay.

Nate Hagens:

So what is the Fermi paradox. And can you explain that and why is it important?

Sandra Faber:

Okay. So the Fermi paradox grew out of a conversation that the famous physicist, Enrico Fermi had with some of his buddies right after World War II. They were kind of a social club in the wake of the Manhattan Project and they were all having lunch together and sort of brainstorming about where the Earth came from and so on. And suddenly Enrico Fermi spoke up and said, "Where is everybody?" And the funny thing was, they hadn't been talking about

aliens, but everybody at the conversation realized instantly that's what he meant. Where are the aliens?

So what he was trying to say is that advanced civilizations would be like human beings with a proclivity to develop, innovate, and expand into new spaces. They would want to explore. They would invent interstellar travel and why aren't they here? Why haven't we seen them? And of course, some people do believe in UFOs and think they are here, but I think it's the consensus of most scientists that they are not here. Why not? So that's the paradox.

Nate Hagens:

Presumably, that if there were another Earth-like planet, it also would've had fossil carbon buried underground if it went through something like a Cambrian explosion of life and subsequent sequestration. Of course, there were a lot of one over 10 to the X's in that story too that we didn't have termites that decomposed the wood and other things. But presumably in order to get to outer space, you would need energy and complexity, which just standard sunlight is to diffuse to get that whole enterprise going.

So as someone who's observing the ocean and biosphere sink impacts of the human enterprise on this planet, I think other species to get to this level would've had to culturally navigate the carbon pulse without Venusifying their planet. And that's just fictional in my mind, but I think it's also somewhat of a truism. Any thoughts on that?

Sandra Faber:

Totally. I think your show and your thoughts have explained the Fermi paradox. So a lot of people like to say, "Well, the lifetime of civilizations is short because they destroy themselves with nuclear war or something like that." I think it might even be simpler. I think there's not enough energy in the form of fossil fuels on Earth-like planets to get you into outer space and really negotiate space travel. I just don't see that.

Nate Hagens:

Well, to be clear, coal, oil, and natural gas are inert on their own. And the real specialness of Earth is our oxygen commons where we can burn those things in the presence of oxygen. There are moons on Jupiter that are full of methane, but it doesn't burn because there's no oxygen. So maybe how many of these planets have oxygen in the atmosphere of this perfect amount? That's another hurdle to get over.

Sandra Faber:

Well, we know that that doesn't happen naturally. I mean, we wouldn't have an oxygen-rich atmosphere without life. Oxygen tends to combine with other minerals. And that would

happen if we got on our Earth that it would all combine with minerals in the crust in short order. So in most cases, I think people believe an oxygen-rich atmosphere is a sign of life.

Nate Hagens:

When you were studying all this stuff, did you sleep well at night? Was it this like a puzzle or a beautiful abstract art form that you kept coming back to every day at the office? Because this would sit with me. I mean, it's not totally relevant to the next few days of my life, but it's such a profound question. It's like this bee is buzzing in my head.

Sandra Faber:

Well, that's because perhaps you're an older, wiser person now. So you have the perspective to be struck by how weird and awe-inspiring, if I can use that term, these thoughts are. But when I was a youngster growing up in the society, the culture of my field, it was just one day at a time. And people talk about, "Oh, how can you understand these big distances?" But I have a map of the local super cluster in my head that's as familiar to me because I drew it on piece of paper and looked at other people's maps on pieces of paper. It doesn't look any different from a map of Los Gatos, which is where I'm sitting right now. It's a piece of paper and a picture on it.

Nate Hagens:

Do you have a favorite planet or star or galaxy or anything like that? Like a personal favorite?

Sandra Faber:

I do. The Sombrero Galaxy. It looks like a sombrero. It has kind of a round cloud of stars and then there's this disk of stars in circular orbit, and you can see a lot of dust in it. I like the dust because of stardust. That's what made Earth. When you see pictures of galaxies and you see these dark clouds superimposed silhouetted against the stars those are the dust grains that came out of the supernova that made the rocks on Earth and us. So we're actually seeing our origins when we see those dust clouds. So anyway, that's why I like the sombrero. It's very nice.

Nate Hagens:

I don't know enough about it. There was a John Cusack movie where they talked about Cassiopeia. That's about one of the only ones I know. So what can cosmology and geology tell us about the future of intelligent life on Earth, if anything?

Sandra Faber:

Well, I don't know if it can tell us about intelligent life on Earth. It can tell us about Earth. It can tell us about our cosmic prospects, if you will. And our cosmic prospects are bright. One of

the really most important things, if you're sort of deciding to settle into a solar system, say you're prospecting the galaxy for your new solar system, one of the things you would want to look at is whether that system is stable. And by that, I mean do the gravity of the various planets pulling on one another cause them to go into gyrating orbits and maybe even ejecting a planet and sending it out into very cold, inhospitable interstellar space.

Can you imagine turning on the radio or the internet one day and hearing the announcer say, "Uh-oh, astronomers have discovered that our orbit here in our solar system is going unstable. Mercury and Venus, they're taking their toll with tugs over billions of years. We're going unstable. And in a few years we're exiting and heading towards Pluto and beyond."

Nate Hagens:

I think the reaction was done in a movie that was meant to be a comedy, but was actually a documentary, which is Don't Look Up.

Sandra Faber:

Don't Look Up. Wasn't that a great movie?

Nate Hagens:

That's how we would respond. We would totally dismiss the people that were saying it and we would probably ignore it.

Sandra Faber:

That was so perfect.

Nate Hagens:

Well, I mean, in that particular case, there's nothing that could be done in that particular case. But in our current case, there are things that can be done, which is why I've asked you to be on the show to weigh in from an astronomer physicist perspective on this stuff. So keep going.

Sandra Faber:

Okay. So I digressed a little bit, sorry. What I was trying to say is that we have a very stable solar system that's going to be stable billions of years into the future. Our orbit is not in danger. That's good.

Nate Hagens:

I read that the sun was going to expand in around 500 million years and boil the oceans and all that. 500 million years, still a long time.

Sandra Faber:

Well, a couple things to say about that. First of all, yes, the sun has a finite lifetime. It's much more than 500 million years. It's a few billion years, but it will get hot. It's growing in luminosity and I am told... I'm not the biologist. I'm told that if we do nothing, we have about a few hundred million years here until it's too hot for photosynthesis.

So that seems to be the most urgent, looming danger. But friends of mine are talking about engineering the solar system, and you could imagine capturing an asteroid and reorienting its orbit, sending it between Earth and Venus so that Venus loses energy and gains angular momentum, or loses angular momentum. Earth gains energy and angular momentum and moves out. And so we could maintain our low temperature even though the sun was heating up. This is not physically impossible, believe it or not.

Nate Hagens:

I'm thinking about where I'm going to get potatoes in five or seven years. Not quite thinking about steering asteroids towards Venus at this point, but I'm sure those are fun conversations.

Sandra Faber:

Well, I guess what we're trying to say here, you and I, is that we do have the prospect of probably a hundred million years here. And that's a great segue to the rest of our conversation because the question then arises... Well, first fact, we're the first people to know this.

Nate Hagens:

The first generation to possibly know this.

Sandra Faber:

Yeah. And the question then is, "What do we do with it?" That brings up the ought? Should we, ought we? And that brings up the question of why is there any ought at all? Why is there any should? So suddenly astronomy has thrown us into a new regime of philosophy which has everything to do with what we value, human ethics, what we think is important.

Nate Hagens:

Why is there an ought? Should there be an ought? We ought to do such and such?

Sandra Faber:

I think there are two answers to this. The famous physicist, Steven Weinberg in his book, The First Three Minutes at the very end said, "The more we understand about the universe, the more it seems pointless." And that got him into a lot of hot water because a prevailing view

amongst many human beings for a long time is that we have a divine purpose or that at any rate human beings have a divine purpose. And that's where our oughts and obligations come from.

Weinberg was saying from a standpoint of somebody studying cosmology, that's not true. There's no evidence of that. And that's really what I was getting at a few minutes ago when I said the cosmic story doesn't have a divine agent in it, at least not after the Big Bang. And that's what Weinberg was trying to say.

Nate Hagens:

I think that if there's no divine agent, it makes the ought even stronger on us.

Sandra Faber:

That's what I was going to say. I couldn't agree more. So it's up to us to decide what our oughts are.

Nate Hagens:

From a cosmic perspective, what are the biggest cosmic dangers to life? Life on Earth, life on a planet?

Sandra Faber:

We spoke about the sun. That's the ultimate danger. It will die someday. Before that, a supernova might go off in our vicinity, but actually we're in a pretty good region of the galaxy for that. That probably won't happen. Another thing that everybody talks about is asteroids. That was what Don't Look Up was about. But actually we've done a pretty good job of mapping, and I think we can solve the asteroid problem with further thought and continuing to map even smaller bodies.

Actually, I think probably the worst thing is volcanoes. Volcanoes have been responsible for the biggest biological extinction in the history of Earth. I don't know if we're going to have huge episodes of volcanic activity in the future.

Nate Hagens:

Well, we're functioning with our Volvos and vacations, and all the things that we do, we're functioning as a much faster acting smaller volcano as a human culture, as you know.

Sandra Faber:

Yes. When you said what's the biggest danger to life on Earth? I think human beings.

Nate Hagens:

So what are the moral implications of these threats that we're powerless to? How does that change the way that we might think about manmade threats such as climate change and chemical pollution, biodiversity loss, things like that?

Sandra Faber:

Well, don't you think we ought to think about what's important or why we think things are important? So I'd like to return, before getting at your question at the moment, I'd like to return to where our values come from. First of all, you and I are talking about what we're going to do today that influences the future. So we need to think about how we value the future. I don't think our moral compass for the future is very well-developed as human beings because we haven't needed it to get to where we are now.

We've needed to worry about the future over the next few days so that we can eat the next few years so that we can raise our kids and maybe we care about our grandchildren. But beyond that, we really just don't deeply care by nature. And that I think is the fundamental problem.

Nate Hagens:

So I think I heard you in a lecture once state that humans are transactional beings. And I assume that's related to our optimal foraging, mammalian background, and that therefore there's nothing that the future can give to us, therefore there can be no transaction with the future. Can you unpack the logic and your thoughts about that?

Sandra Faber:

Yeah. Well, I think we're transactional mainly because we're social beings. And so this is part of our strategy for getting along with each other. I'll do something for you and in return, you do something for me. There's a little bit of future involved in that. I do something for you today on the hope that in the future you will do something for me. But nevertheless, you have a finite lifespan. I'm not hoping that you're going to do something for me a thousand years in the future because you won't exist. So even though we're transactional thinking about the future, it's kind of a near-term future.

Nate Hagens:

I wonder how many people... Of course you won't be able to answer this. No one could answer this, but I'm just asking your opinion. What percentage of the United States and the global population of humans care some non-zero amount about a thousand years from now on this planet?

Sandra Faber:

That's a very good question. I think actually there's a lot of care. So first of all, I'll tell a little anecdote. In the process of giving lectures recently before the pandemic when you could actually talk to people and see them, I would ask my audience at the very beginning, let's imagine the following hypothetical. It's a thousand years from now. The Earth is a smoking ruin, and humans were to blame, starting with our generation. Is this good or bad?

Nate Hagens:

I think most people would say it's bad.

Sandra Faber:

Yes. But, Nate, the question is why would they say that? Can we unpack that? I'd like to know what you think about that.

Nate Hagens:

Why would they say it's bad? Well, why would I say it's bad? That's the only thing I can confidently speak to because I hold the green lush forest and the cold oxygenated oceans, and the millions, possibly 10 million other species that all followed a trajectory of evolution, the same path that we did to get here. And that to me is the most profound treasure in the known universe. And for that to be handicapped or crippled, or dissipated, or worst, the most disappeared is the greatest tragedy that I could ever imagine.

Sandra Faber:

I totally agree. Don't you think everybody thinks that at some level?

Nate Hagens:

I don't know. I don't know. I don't think so.

Sandra Faber:

No?

Nate Hagens:

Because otherwise there would be a lot more people freaking out as to what's going on right now. There are people freaking out. Let's give a shout-out to those people that are aware of the pending mass extinction. But I think for most people, the future doesn't exist beyond their children and maybe their grandchildren and that to save the future of a thousand years from being, what was the word you used, a smoking ruin.

Sandra Faber:

A smoking ruin, right?

Nate Hagens:

If that requires any hardship at all today, it's not a transaction that they're going to sign up for.

Sandra Faber:

Well, I think it's an overstatement to say any hardship at all. I think everybody harbors the thoughts and love and yearnings that you and I have just expressed maybe to different degrees, but I think it is innate in human nature to worship nature. And gosh, that's where-

Nate Hagens:

I really hope you're right about that.

Sandra Faber:

That's where the first gods and goddesses came from. They came from human-

Nate Hagens:

Animism.

Sandra Faber:

Animism. Right. So I have a theory about this and my theory is that very deep in human values is the worship of low entropy. Now, what do I mean by low entropy? Entropy is a very elusive question. It's a concept that's hard to explain. But to try to make it as simple as possible, low entropy happens when you develop structure and organization in something. So, I'm looking in my office here, I'm looking around and the air is uniform density everywhere. The molecules have spread out uniformly. That's what entropy wants to do. It wants to increase, it wants to get smooth, it wants to lose its structure, its differentiation. Things basically want to smooth out and lose their organization. An example, drop a teacup. It started by being highly organized with all of its atoms in a particular way.

And by the way, it took work to do that. That didn't happen randomly. Somebody had to make that happen or some artificial process. We drop it and the atoms go all over the place and get disorganized and the structure is lost. So that's an increase in entropy. I think human beings intuitively understand that making something out of nothing, getting structure where there was none before is miraculous. And I think that's what we worship and we grieve when that is lost. You grieve when your relative dies because they're important to you, but I grieve because a human being dies and the structure and all the possibilities that were latent in that

remarkable thing is now lost because those atoms are going to disperse, they're going to go somewhere, and that thing will never exist again, that person, that being.

Nate Hagens:

Except all the persons and atoms that are assembled right now, that structure is crowding out future structures.

Sandra Faber:

This is true, and I certainly agree with that, but I just am making the point that I think human beings appreciate nature because it is constantly performing this miracle of making something out of nothing. And we can talk about why that is. It's because we have a sun, but nevertheless, there is respect there, there is joy, there is admiration. And if we could somehow get people to understand that better, maybe that's a germ of hope for the future.

Nate Hagens:

So on that note, do you differentiate the idea between planetary stewardship versus the planet being human's domain to control and do what we want with, and is it important to make such a distinction?

Sandra Faber:

Gosh, I don't know. When you use the word stewardship, it seems to me that has within it the notion of dominion and being in a commanding position, holding the fate of others in your hands.

Nate Hagens:

That's not how I intended. I think stewardship could be living within limits, knowing that we don't have all the answers with other species, a do no harm kind of thing.

Sandra Faber:

It's like the concept of gentleman. A gentleman is somebody who has lots of power and only uses it very occasionally when it's really necessary. I think we need to be gentlemen towards our planet and restrain ourselves for the good of its future.

Nate Hagens:

How could we do that? Is there a shift of a cultural, moral, ethical outlook towards planetary stewardship and is understanding cosmology and some of the things you started this conversation with critical to that happening?

Sandra Faber:

Yeah, I think we need a new religion. I think the religious impulse is very important in human beings and should be put in better service to solve these problems that you and I are talking about today. So I think we have this basic urge to serve a higher purpose. And if we could inculcate people from the very beginning to understand how wonderful Earth is and that our role as human beings, we do have a mission to protect the planet. And at the same time, continue its wonderful story of constantly evolving new and more wondrous things. The internet is wondrous. We do wondrous things. We're not bad.

Nate Hagens:

I think that religions are going to be legion in coming decades because as economic growth wanes, people don't like uncertainty and they're going to be attracted to charismatic, articulate people telling a story. And that story will be dozens of different stories. Of course, the one that is true, our cosmology, our biological and physical heritage isn't as compelling a story for immediate status fitness benefits. So I suspect it will attract certain followers, but I don't know that it will reach the masses in the way that you and I would like. Do you have any speculation or thoughts on that?

Sandra Faber:

Wow, I think that's a really great question. Everything you've asked me about, I've thought about before, but I've never thought about that one. So it's a hard question and it could happen. I think there are going to be many stresses and I guess there will be many leaders who will try to take advantage of them for less than admirable purposes. Beyond that, really can't say more.

Nate Hagens:

Could the religion of caring for the complex life and nature, as you said earlier, could that happen just one human at a time and then over time they find the others, and lo and behold, a quarter of the world population feels that way deeply?

Sandra Faber:

Well, that gets me onto another subject and that is how many people are going to survive and how many people should survive in the long run. I think one of the burning questions that I would like to understand is how many people can live on Earth or intelligent beings over cosmic time. And that's really a suitable subject for an academic study, but I'm sure it's nothing like 8 billion. My number is a hundred million, but I don't know.

Nate Hagens:

I'm sure there's been studies on that. Well, there have been over the next few centuries or something, and that number is probably higher than a hundred million. But over cosmic time,

that's a different question. And all of the low-entropy goodies will have been spent. And of course, it also depends on the boundaries of the analysis. If you truly don't want to impinge on other ecosystems and the evolutionary trajectory of lots of other species, then the number becomes smaller still, right?

Sandra Faber:

Yes, I think so. But I'm not sure that anybody has ever considered it from your point of view. And that is-

Nate Hagens:

Which is the energetics?

Sandra Faber:

Yes. What are the long-term prospects for useful energy supply for future civilizations? I don't know that anybody's studied that. One of my colleagues here at UC Santa Cruz is very interested in this question, Patrick Chuang, but I don't think that I've ever seen that addressed per se. And once you know what the planet can supply energetically, then you can decide do you have billions of people with low energy per person or do you have many smaller numbers of people with higher energy per person? And that, again, is a moral question that deserves thought, how do you want to live?

Nate Hagens:

Well, I think the default path is that we don't plan and strategize and have a governance and a rule about that. So the default path is, we will head towards 15 billion very poor and impoverished hungry humans rather than 500 million wise following the rules into the future. Of course, I don't know, but evidence would suggest that, I think.

Sandra Faber:

Well, I don't think 15 billion can survive very long.

Nate Hagens:

No, but it could happen for a short period. I think we probably hit 10 billion and there will be much, much wider poverty and chaos. Maybe not. Maybe we just hit 9 billion, but unless there's a nuclear war or something like that, I don't know why that's not going to happen.

Sandra Faber:

Large numbers of people are going to die because it gets too hot.

Nate Hagens:

That would be a reason.

Sandra Faber:

A larger number of people will die because we don't have fertilizer that triples the yield of agriculture.

Nate Hagens:

To me, the concept of a giga famine or billions of people starving on this planet is under my distribution, but it's backloaded after 2050 or so because I do think we're not going to have as much energy as we have today, but we have plenty of energy to have larger population and a poorer population for 10 or 20 more years. I don't focus a lot of time thinking about that, but I think, "How many people can live?" The place for billions of humans are spread out over time, not all at once.

So in some ways, I bring this up with my students, hypothetical, pro-social alien philosophers looking down on our planet right now, the fact that 8 billion people are alive right now simultaneously, which is around 10% of all the humans that have ever lived, is a tragedy in many ways. So can we even imagine what humans will be like or look like or act like, say, a million years from now?

Sandra Faber:

I think it depends on whether we maintain some high level of technology and evolving technology because if we do, then we have the capabilities of altering ourselves through genetic engineering or cyber matings with machines, et cetera. If we lose that in the coming poly crisis, then I think some of us will survive and we'll probably look like the normal descendants that would've occurred as a species naturally evolves into whatever's going to happen next on biological timescales.

Nate Hagens:

Of course, if it's a much hotter world, maybe we'll re-evolve in an adaptive sense towards homo floresiensis, the hobbit man because six foot 5, 260-pound hominids aren't going to do so well without air conditioning.

Sandra Faber:

Well, that's true. Another interesting point is, some people say that we've been domesticating ourselves already.

Nate Hagens:

Because we're outsourcing so many things to the cloud that we used to be jack-of-all-trades sort of people and our brains have shrunk on account of that.

Sandra Faber:

And I think maybe our testosterone levels have declined somewhat because huge testosterone levels are not very compatible with an intensely social situation. So maybe we will have the wisdom to do some active breeding to breed human beings with somewhat different tendencies and values that would be more compatible with long-term survival here. That would take real wisdom, wouldn't it?

Nate Hagens:

It would also take emeritus professorship status to utter such a thing out loud in today's universities.

Sandra Faber:

Actually, the virtue of talking about the future a million years from now is that it makes it abstract. So that's one of the reasons why I got into this game because I thought I could raise questions that people actually could think about constructively in a different way.

Nate Hagens:

That's brilliant. That's why I came up with the advance policy idea for how we're going to deal with the polycrisis with governance because the things that we're going to need to do cannot be socially or politically said today. So astronomy is kind of advance policy for a planet and a culture.

Sandra Faber:

Beautiful. That's great. I like that.

Nate Hagens:

So in your work, Sandra, you criticize the current economic paradigm that requires yearly growth by looking at it from a cosmic scale. Could you describe that, please?

Sandra Faber:

Sure. One of the things that astronomers are good at is math, and one of the things you learn about in physics is exponential growth. And you were talking about getting your mind around things, big numbers, so if everybody could understand exponential growth intuitively, that would be a big step forward to reorienting ourselves to understanding planetary problems. So exponential growth, an example is when something doubles every year relentlessly. That's an

example of exponential growth. So we have an economy here, capitalism, which I think is predicated on growth. I'm trying to get my economist friends to agree with this, and not everybody does, but it seems to be true.

So right now, we're at around a world GDP growth of something like 2.3% per year. Now, as it happens, that means that in a century, we grow by a factor of 10. And then in the next century, we're going to grow by another factor of 10. Well, you and I have been discussing the future of the world on a timescale of a million years. How many centuries are there in a million years or 10,000? So if the economy were to continue to grow at 2.3% per year, that's 10 to the 10,000th. That's 10,000 tens multiplying one another.

Nate Hagens:

Well, presumably, we would no longer be growing on Earth, but into the solar system that you mentioned earlier.

Sandra Faber:

Well, that's Fermi paradox kind of thing. That's right. Sort of presumed a civilization that could grow exponentially and spread over the galaxy. So that's not going to happen. And my feeling, and here I'm on very thin ice because I'm not an economist, my feelings we're bumping up against planetary limits and we have maybe a factor of two more to go, which is like 25 years, if that, and our whole financial edifice is going to collapse because it's built on growth and that's no longer possible.

Nate Hagens:

Well, I agree with you. This could be a four-hour conversation because when I was with you in person, we had late nights because we never ran out of things to say. So I want to ask you some more specific questions and then maybe have you back more than once because you have so much wisdom on this stuff.

So what do you see as some primary tools and actions that are necessary for us to shift our current trajectory towards what we're doing right now is effectively destroying life in slow motion on Earth? Could we change that so that we have a human place in the long-term on this planet? What do you think are some of the things that we can do?

Sandra Faber:

Well, I'm very pessimistic about the next 50 years. I really think each one of us is like a fly trapped in amber, or to use your analogy, we're stuck on the train and no way to get off. So I think there is going to be some massive rearrangement, whether it's simplification or something even worse, I don't know. So I'll tell you what I'm fixated on right now. I never forget that every day I work for the taxpayers of the state of California and the federal government,

the United States. My job has been educating the next generation. If I really focus on that task, I am worried about how to help younger people, and that's what I think needs to be done. We need to position our younger generation so that they can weather this coming storm.

Nate Hagens:

I used to teach, as you know, I taught for nine years at the University of Minnesota. And thankfully, to them, the people that hired me, understood the validity and importance of a Reality 101 type of syllabus and education, but it was in the honors college and it wasn't part of the siloed department like economics or environmental science or whatever. The academy, to me, feels like its own Superorganism that's driven by fundraising and research dollars and corporate support and such, and that has kind of become primary rather than preparing young humans. There's 240 million humans in college around the world. So how does changing our education system, changing college, what it even means, fit into a pro-future response given the cosmological and some of the energy and ecological limits we've mentioned?

Sandra Faber:

Well, actually, I can see this starting to happen amongst my colleagues. I think astronomers do have a different perspective. One of the things about us that's different from a lot of people is we are familiar with change. We know that the universe was different and can be different going forward.

Change is part of our DNA and having a bunch of people today who are aware that things can change, that's very, very useful. And I see some of my colleagues getting less interested in their traditional research and more interested in using the astronomical story to get attention and understanding the way we've been doing today, hopefully on this podcast, but also having the big picture perspective to share with their fellow human beings. I think astronomers, they're founding futures institutes, we founded one at UC Santa Cruz, the Earth Futures Institute, but there's the Future of Life Institute, et cetera, et cetera. There are these institutes around the world being founded by astronomers and sending the message of things can be different, let's get prepared. In the university, there's a lot of room for this. I really do think faculty would like to learn about this if they had time. We have to give them some time.

Nate Hagens:

If you're wildly successful with your Earth Futures Institute endeavor, what might that look like in three or five years from now?

Sandra Faber:

The very first thing I'd like to do with this institute is develop, say, an eight chapter podcast that's really modeled on what you've been doing, Nate. I just can't overstate the extent to which you and your guests have been influential in my own thinking here. Most people, most

faculty members, I'm emeritus, I have time, most of my colleagues cannot listen to your podcast every week. What I would like to do is develop something that is like mainlining injection. Eight hours, and you will understand the big picture and then you can decide what to do with your classes and how to talk to your students. That's my project at the moment that I would like to do.

Nate Hagens:

We have all these experts in a reductionist field like chemistry and biology and political science and environmental science and law and business and all this. But if they're just focused on their thing, maybe if they had exposure to this eight hours that you're mentioning and they're paid by the university to watch it or something, I don't know how that works, but all of a sudden they can apply law or ecology or business or chemistry to some of the larger questions that are going to face humanity and our earth in coming decades. That sounds exciting to me. I don't know how plausible it is.

Sandra Faber:

I think it's very plausible if resources are brought to bear. It's kind of the equivalent of... Money is the equivalent of energy in the university. People need to find time and the way you give them time is you provide money.

Nate Hagens:

But it has to do with incentive too, right? Who's creating the incentive to do the right thing for educating? Because right now, in a way, it's just a bottleneck to get young humans into the workforce to work at corporations and other things. The objective of society is not a sustainable planet as of yet.

Sandra Faber:

It is still true that the university has academic freedom, and you can do what you like by way of research. You need wherewithal though. This is a very big project, as you've described it. It takes people from all walks of the university, including philosophers and humanists, political scientists. There needs to be a forum, a venue to get these people together and give them some time to work together.

Nate Hagens:

Is this happening? I know you're doing this at UC Santa Cruz, but have you heard stories from around the world at other universities that faculty are recognizing that we live in a complex system where the parts and the processes fit together, and it's not just one subject. Recognizing at the same time that their bread and butter and their status and tenure and grant funding and everything comes from being an expert on one part of the system.

Sandra Faber:

I don't think it is really happening. I guess that would be my mission is to get that rolling. When you say we're doing it at Santa Cruz, a few people are talking about it, but the university as a whole has not made this transition. Far from it.

Nate Hagens:

It's such a beautiful campus you have there. I wish that I had more time. I would come there and do a semester of Reality 101 or something. I'm going to ask you some closing questions that I ask all my guests, but do you have any closing dream or wishlist with respect to universities and the metacrisis?

Sandra Faber:

Pretty much just what we've said. I do think the universities are a force for good and they have a lot of assets at their command. I think there's a great future to be had there if people can be lured off of their current course, which, gosh, our faculty work 60, 70 hours a week.

Nate Hagens:

But don't we need, ultimately, when those students graduate, don't we need jobs that pay back their loans and make the university investment worth it? If that's true, we need society to value either monetarily or with social status, regenerative agriculture, pulling carbon from the ground, living healthy, sustainable lifestyles, replenishing the soil. There's a whole list of things that would be in the plus column for humans living differently. Those things are not really rewarded in our current incentive system.

Sandra Faber:

No, I am not sure that it's possible for the universities to remake society in the major way that you've just said, but I think we both believe that forces are coming along that are going to reshape society, and we want a university that's well poised to assist with the transitions that are coming.

Nate Hagens:

What about the young people that you come across? Are they searching and seeking for stories and education about the broader cosmology and what we face? Or are they just looking to have a good time and get a rubber stamp on their resume and get a job?

Sandra Faber:

All flavors.

Nate Hagens:

That's a little harsh.

Sandra Faber:

All flavors. All flavors.

Nate Hagens:

All flavors.

Sandra Faber:

Yeah, but there's definitely a cadre of young folks who are concerned the way we are here. I would say there's a larger cadre, even the ones who are partying, who are worried. One of the things I would like to be able to do is to talk more to young people to find out what they would like from me. Do they want hard truths? Do they want small warnings? Do they want practical advice? What would be helpful? That's another project I have is to get to know the undergraduates at Santa Cruz better and find out what would help.

Nate Hagens:

That's a great idea. I'm not some older, wiser person. I'm going to tell you what you need to know. You know enough about what's going on in the world. What would you like from me? What would be most helpful? Keep me posted on that. If there's any, I really want to have more podcasts, roundtables with young people that understand generally these concepts and see what they're thinking. I do fear that mental health and fear and giving up is going to become more prevalent as this becomes more obvious to more people. I think the antidote to that is finding like-minded people who share your values and ethics and going through this with them to make it not so unbearable by yourself. I think that's going to be important.

Sandra Faber:

Very much. Yeah.

Nate Hagens:

Have you observed this as a teacher over the past 30 years that this dynamic is changing on how students are, and not only dealing with the polycrisis, but with social media and addiction and all that?

Sandra Faber:

Yes. I think the mental health of young people on our campus is worse than it's ever been.

Nate Hagens:

That's not just your college. I think that's most places.

Sandra Faber:

No, yep. Mm-hmm.

Nate Hagens:

Sandra, do you have any personal advice to the listeners of this show at this time of global upheaval, anxiety, climate change, economic problems, mental health? You've referred to it as the polycrisis or metacrisis. What sort of advice do you have to the people watching this?

Sandra Faber:

Well, the people watching this program are probably older, farther along in their lives and have a great deal of life perspective and life wisdom already so my remarks are directed to folks like that. I think my advice to them is to listen closely, observe closely, think, analyze, and think about the news every day through the lens that Nate Hagens and his guests are trying to provide and be the adults in the room. We do have a responsibility as older people right now with the greater perspective that our years give us. We need to be stable, we need to be supportive and helpful and promote low entropy in the form of harmony, social harmony.

Nate Hagens:

How would you change that advice for someone in their late teens or early twenties who are becoming aware of the economic and environmental problems with our current path?

Sandra Faber:

Some of it would be the same. That is, even though I'm obviously feeling quite pessimistic about the future, I might be wrong. There's a lot of speculation that's been going on in this conversation today. My advice to young people would be similar. Watch the world, read newspapers, think about news, think about what's going on in other lands, because today, someday that might have a big influence on you. You have to take more responsibility for what you know and how it's going to influence your decision.

Practically speaking, don't assume, worst case, that society is always going to provide for your basic needs. Don't assume you'll go to the supermarket and there will be food there. Don't assume that you'll have a car that you can use to drive to the supermarket. Think in those terms at least a few minutes a day and develop practical skills. Find friends, value the good, and find family and friends who will help you find the new path. There's something thrilling about this situation, and I think I would try to inspire young people by saying humanity is

about to undergo one of its biggest changes ever. You are going to see this. You can play a role. Gird your loins.

Nate Hagens:

What do you care most about in the world, Dr. Faber?

Sandra Faber:

Earth as a constantly flourishing, creating complexity, generating flourishing entity.

Nate Hagens:

I didn't know what words you would choose, but I kind of thought you were going to say something like that. You watch my podcast so you know what question is coming next. If you, Sandra Faber, had a magic wand and there was no personal recourse to your emeritus professor status or your reputation or anything like that, what is one thing you would do to improve human and planetary futures towards that Earth-evolving outcome that you just mentioned?

Sandra Faber:

Well, I'm going to abuse your question by saying two things.

Nate Hagens:

No problem.

Sandra Faber:

Okay, so the first one is that the opinion writers on the pages of the Wall Street Journal would watch The Great Simplification. I'm so serious about this. How can these smart people be so oblivious? It's a mystery to me.

Nate Hagens:

I can speculate as to why it might be. I think part of it is ignorance. There's a lot of people that have viewed the world from a technology and money lens and not from an energy and ecology lens. And so technology basically is energy with some ingenuity sprinkled on top so some of it's ignorance. I think a large part of it is cognitive dissonance because for the board of the Wall Street Journal or similar heads of some department at a university of political science or whatever, this story about the Great Simplification and limits to growth and ecological decay of our planet affects the identity and decisions and builds stories that people have of their own life. Unless you already have a foot in this realm, it's too threatening to your

status and all the current decisions in your life, I think. But I don't know for sure. What was the other thing? You had two.

Sandra Faber:

The other would be I would like to give people the gift, which I feel has been given to me, to have the big picture, to have this understanding of how it all began, how it's evolved, and how we fit in, culminating, and here's the key point, culminating in an understanding of human nature because I think we make a mystery out of human nature. We should be teaching young people where they came from and why they are the way they are and how things are going to work out for them in the future. We just make it a mystery. I would like to change that and make our situation clear.

Nate Hagens:

In the United States.

Sandra Faber:

Yes.

Nate Hagens:

In the United States we do, but in other countries in Europe, they do teach how humans got here and who we are to a greater extent.

Sandra Faber:

Not going to the jugular the way we've been doing in this conversation. What does it all mean? What are the implications?

Nate Hagens:

Yeah. I think I know what you're going to say to this, but I'll ask it nonetheless. Some people… This weekend I met some people on a hike. They were just talking about the Green Bay Packer game, and they just went to this big pizza thing and they bought a new stereo equipment, and they were just totally unconcerned of the things you and I are talking about. I wouldn't impinge on their happiness either, but it seems that a lot of people don't want to hear this, and once they hear it makes them miserable and depressed. My question to you is, knowing what you know now, would you want to go back and unlearn all these things about the big picture and how we got here because what that did is gave you angst about your children and grandchildren and the future 50 years because you've understood it all? But would you want to have that erased and start over on a different path?

Sandra Faber:

Great question, but I think the answer for me is no. That's just because I am driven to know things and want to understand things. The real question, you asked obliquely a while ago, and that is take the average human being, what does that person want to know, and how deeply does that person want to become engaged with these issues? Maybe that could be a cultural thing. Maybe with better training for youngsters as grownups, we'd be wiser and more engaged. Something to think about.

Nate Hagens:

We certainly do need the cultural equivalent of designated drivers though on these issues. I don't know that it's adaptive for those people to rise to that role, but somehow it's necessary. I don't have the answers. It's been so great talking to you, Sandra. We'll have to do round two. If I had you back next year, is there any discrete topic relative to the human predicament that you would love to take a deep dive on that one topic?

Sandra Faber:

Well, there are things that I'm very curious about and would like to understand more. I think the economic system and how it's likely to evolve in the next decades is something I'm very curious about. But frankly, Nate, do I have much to contribute on that subject? Maybe a three way with somebody who knows more about that? That's what I'm envisioning. I have lots of questions.

Nate Hagens:

Okay. I'll keep that in mind.

Sandra Faber:

Okay.

Nate Hagens:

Do you have any closing words of wisdom for being a planetary cosmic observer of the human predicament?

Sandra Faber:

I guess my final words would be to everyone, watch what's going on and read the tea leaves. Be alert, stay alert, and stay in touch with how the world is changing around you because you need that knowledge.

Nate Hagens:

Thank you so much, Sandra, and I appreciate all your scholarship, but particularly your zest for learning and contributing and teaching. So thank you.

Sandra Faber:

Thank you, Nate. It's been wonderful.

Nate Hagens:

If you enjoyed or learned from this episode of the Great Simplification, please follow us on your favorite podcast platform and visit thegreatsimplification.com for more information on future releases. This show is hosted by Nate Hagens, edited by No Troublemakers Media, and curated by Leslie Batt-Lutz and Lizzy Sirianni.