

The Great Simplification

Nate Hagens (00:00:02):

You are listening to the Great Simplification with Nate Hagens. That's me. On this show, we try to explore and simplify what's happening with energy, the economy, the environment in our society. Together with scientists, experts and leaders, this show is about understanding the bird's eye view of how everything fits together, where we go from here, and what we can do about it as a society and as individuals.

(00:00:33):

Today's podcast was one of my favorite that I've ever done, possibly because it's on a topic I don't know a lot about, which is the metabolic health of humans as individuals, and what our food system is doing to change our health relative to obesity, metabolic syndrome, et cetera. My guest is Dr. Robert Lustig, who is a Professor Emeritus of Pediatrics, the division of endocrinology at the University of California in San Francisco. He specializes in neuroendocrinology with an emphasis on the regulation of energy balance by the central nervous system. You'll see during this podcast, there is a mapping or a parallel path of how our food system changes our individual behavior, mapping on to the global energy hungry Superorganism. This was a fantastic conversation. I look forward to hearing more about Rob's work and changing the food system. I hope you enjoy this.

(00:01:54):

Hello, Rob.

Robert Lustig (00:01:56):

Nate. My pleasure. Thanks for having me. This is delightful.

Nate Hagens (00:02:00):

Well, we have mutual friends and it seems the world is converging on multiple threats and risks to the human predicament. And I don't know a lot about your field, but I have read your book, Metabolical. I love the title and it's heavily marked up. You've put a lifetime of vertical and horizontal expertise and wisdom into this book. So my very first question is, what did you have for breakfast this morning? I'm curious.

Robert Lustig (00:02:34):

No one's allowed to ask what I eat. But I'll tell you that today, because it's Passover, I had whitefish salad on Matzo and a black coffee.

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Nate Hagens (00:02:45):

Matzo? Is there a lot of carbs in that or no?

Robert Lustig (00:02:47):

Oh, yeah. But, what else are you going to eat? It's Passover.

Nate Hagens (00:02:52):

Okay. I'm sure you've done this often. Can you give our listeners a two to four-minute overview of the main thrust of your new book, *Metabological: The Lure and Lies of Processed Food, Nutrition and Modern Medicine*?

Robert Lustig (00:03:10):

So I'll try to sum it up in a couple of simple, simple concepts. We are getting sicker and sicker by the day, and healthcare is going to hell in a hand basket and no one knows why. And everyone thinks that modern medicine should be able to solve all of these problems. Well, unfortunately, the chronic diseases that are chewing through all the healthcare costs ... So they are type two, diabetes, hypertension, dyslipidemia, cardiovascular disease, cancer, dementia, fatty liver disease, polycystic ovarian disease. This now accounts for 75% of healthcare costs. And none of them have a cure. And none of them actually even have a treatment. We only treat the symptoms of the problem, we don't treat the problem. So, for heart disease, we have high LDLs, we have statins. Well, it turns out the LDL is the symptom of the problem, not the problem.

(00:04:21):

For high blood glucose, diabetes, we have insulin and oral hypoglycemic. Well, turns out the glucose is not the problem. It is the symptom of the problem. For high blood pressure, we have antihypertensives. They are the symptom of the problem, not the problem itself. The endothelial dysfunction that causes the hypertension is still going on, and that's why we're all 40 years old with two stumps on dialysis waiting for our next stroke.

(00:04:53):

And that's where healthcare has gone and that's why social security and Medicare will be broke by the years 2026 and 2029. The reason is because all of these are the diseases of mitochondria. Mitochondria, the little energy burning factories inside each

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of our cells. And when our mitochondria working right, we'll be 110 playing tennis. And when our mitochondria are working wrong, we'll be dying a slow, miserable early death, and costing the healthcare system for 20 years while we're doing it. And we can't afford it.

(00:05:33):

And it turns out it's all about the food. And when you understand the science of the food, and you understand the science of nutrition, and you understand how those ultimately impact on this greater problem called metabolic health, then you realize the food's the problem. And, it turns out the food's a problem for the climate too, because of carbon dioxide production, because of methane production, because of soil erosion. Bottom line is the environmental crisis is the food crisis. So I would argue that food has to be part and parcel of any conversation around fixing the big problem. And that's why I'm very happy to be here.

Nate Hagens (00:06:25):

So, you mentioned mitochondria. I certainly remember that from biology class. But how does mitochondria relate to the human physiology and food and our health?

Robert Lustig (00:06:36):

So, mitochondria are where the chemical energy comes from that powers your cell. Mitochondria make this compound in your cells called ATP, adenosine triphosphate. And each of the phosphates, and there are three of them, each store energy. And that energy gets liberated and that's what powers the cell. If you don't make enough ATP, your cell's starving. And if your cell starving, it does things you don't want it to do. And it turns out, that's what's wrong in chronic metabolic disease, mitochondrial dysfunction.

(00:07:11):

So the question is, why? If we're eating enough, we're eating loads, why is our cellular powerhouse going down the tubes? And for that you have to understand the biochemistry of food. You have to understand what's actually happening. You have to understand how specific compounds in the food are actually interfering with mitochondrial function. The main one being this sweet molecule and sugar, fructose. Now, fructose wasn't always the bad guy. Fructose was a good guy before ultra processed food. Fructose actually helped our species survive winters, because we would

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eat all the fruit during harvest and we would lay down all this fat and we would live on it through the winter. Camels do it in their hump. Polar bears do it. Okay? This is actually what allows various species to be able to go prolonged periods of famine, was fructose.

Nate Hagens (00:08:21):

It's like a-

Robert Lustig (00:08:21):

But when we started going ... Sorry?

Nate Hagens (00:08:24):

The camel hump is like a Tesla battery. It's when, you know run out, you have a little storage there. Okay?

Robert Lustig (00:08:31):

You have storage. Exactly right. So, these were actually adaptive processes and fructose was a driver of this adaptive process for billions of years of our existence. I shouldn't say billions, millions of years of our existence. We weren't around for billions. But, only in the last 50 years or so, with the advent of ultra processed foods and the addition of sugar to those ultra processed foods to make them palatable ... Because, if the sugar wasn't in the ultra processed food, you wouldn't eat it. It would taste like dog poop. I mean, it would just be awful. And so, food industry knew they had to do something to make their food palatable. What did they do? They added the sugar. And then they learned, hey, the more sugar we add, the more they buy. So they added more and more and more. And so now, we are consuming 25 times the amount of sugar that our ancestors did 200 years ago.

(00:09:34):

That has to have metabolic consequences. Well, it does. It is affecting our mitochondria. It is causing them to, instead of burning that fat, it's causing them to store fat, especially in organs like the liver, which are then causing the liver to be dysfunctional, which is then causing the pancreas to make extra insulin, which is then causing problems all over the body, including the brain. So, ultra processed food is responsible for all of those diseases I mentioned at the outset of the program. It is

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responsible for all of the healthcare costs going through the roof, and it is responsible for our early decline. If you've noticed, lifespan in America has been declining for the last five years in a row. And it could be all traced back to mitochondrial dysfunction.

Nate Hagens (00:10:30):

So, if there are two people, person A doesn't eat any sugar, and person B eats the same diet as person A, but has a lot of processed foods that have added fructose and corn syrup and other things, how does the mitochondria differ in those two people? Like, what mechanically happens?

Robert Lustig (00:10:52):

So there are two enzymes in the mitochondria that can up its game. It can actually cause mitochondria efficiency. It can cause mitochondria to burn better. Okay? And that compound is called glucose. Glucose is in carbohydrate. Glucose is half of sugar. Glucose will stimulate two enzymes. One is called AMP kinase, which is the fuel gauge on the liver cell. So when AMP kinase is stimulated, the liver will make more mitochondria, muscles will make more mitochondria. We think the brain will make more mitochondrial, although we're not as sure of that yet. But in any case, AMP kinase is a stimulator of mitochondrial function. Also, there's an enzyme called HADH, hydroxyacyl-CoA dehydrogenase, which helps burn fat, so that you basically can utilize the fat that you've stored to generate energy. So these are good things. Glucose is, for lack of a better word, good. On the other hand, fructose, this other molecule and sugar, the sweet molecule and sugar, the addictive molecule and sugar, the molecule we seek, because glucose is not very interesting. You don't see people going around chugging Karo Syrup, do you? That's glucose. Okay? They're chugging soda.

Nate Hagens (00:12:15):

What's in like Gatorade? Is that glucose or fructose?

Robert Lustig (00:12:18):

Ah. Well, which Gatorade are you talking about?

Nate Hagens (00:12:21):

Oh, yeah there's a bunch of-

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Robert Lustig (00:12:21):

We're talking about the original Gatorade from 1965. So Dr. Robert Cade, okay? Physician at University of Florida Sports Program invented this oral rehydration solution back in 1965. And it was a combination of water, sodium and glucose. It's the same oral rehydration solution we give to cholera victims in India today. And, in 1972, the Florida Gators went on to win the sugar bowl against the Auburn Tigers and Gatorade made a big splash. And now everybody was interested in Gatorade, because national championship. Okay. If you ever tasted the original Gatorade, it was purchased by Stokely's from the University of Florida. Stokely's Gatorade. It tasted like tiger piss. It was awful, because can you imagine? I mean, glucose and sodium and water, it didn't have ... I mean, it was horrible. You couldn't get anybody to drink that, except maybe a dehydrated athlete.

Nate Hagens (00:13:26):

So, let me guess-

Robert Lustig (00:13:26):

Well, in 1992-

Nate Hagens (00:13:27):

... the modern formula of Gatorade is more tasty and less healthy?

Robert Lustig (00:13:33):

Exactly right. So in 1992, Pepsi buys Gatorade and they say, "How are we going to market this swill?" So what did they do? Two things. Michael Jordan and high fructose corn syrup.

Nate Hagens (00:13:45):

There's high fructose corn syrup in Gatorade?

Robert Lustig (00:13:48):

Of course! Absolutely!

Nate Hagens (00:13:49):

I'd never looked.

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Robert Lustig (00:13:51):

Well, go look.

Nate Hagens (00:13:55):

So there's so many parallels here to what you're saying, and my work. First of all, yet again, the trying to optimize for dollars, first and foremost, over health, over the environment-

Robert Lustig (00:14:11):

Always.

Nate Hagens (00:14:11):

... over other things wins in the short run. Well, not only that, but I think something like 25% of our GDP is the healthcare system. So, as people get sicker, it's good for the economy in a bizarro way. And then the other implication that I'm getting from you is, my work is about we are alive during the carbon pulse, where humans are drawing down fossil hydrocarbons, which are energy, 10 million times faster than they were sequestered. And we've created this ginormous cultural metabolism and we can't process it. I mean, energy is healthy, but too much energy messes up our institutions and our expectations and everything else. But you're saying that the fructose is doing the exact same thing to us as individual humans?

Robert Lustig (00:15:08):

Indeed. So energy is healthy in the sense that it powers things, but unfortunately we haven't yet figured out a way to establish an energy source that doesn't have a downside. Now, maybe fusion will. Maybe. But that's 20 years off, minimum, and possibly longer. But the fact matter is that burning of any energy on this planet generates carbon dioxide and generates other toxic byproducts that are ultimately harming the planet and actually interfering with our ability to actually burn that energy.

Nate Hagens (00:15:49):

So, you mentioned earlier that 200 years ago our ancestors had 1/25 of the sugar or fructose in their diets. What was the rest of their diet?

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Robert Lustig (00:16:03):

About five pounds a year.

Nate Hagens (00:16:05):

Five pounds a year?

Robert Lustig (00:16:06):

It was about five pounds of sugar, per year.

Nate Hagens (00:16:07):

And we have 125 pounds a year?

Robert Lustig (00:16:09):

It was fruits, vegetables, and honey. Right now we have 100 pounds per year. Yeah.

Nate Hagens (00:16:16):

The average United States-

Robert Lustig (00:16:18):

It was as high as high as 125. It's come down, because of the obesity epidemic. So now it's 100 pounds.

Nate Hagens (00:16:26):

That's two pounds a week.

Robert Lustig (00:16:29):

Yeah. Per person. That's right.

Nate Hagens (00:16:33):

Other than sugar and other than processed foods, is there any evidence that our diets are substantially different than those 200 years ago, as far as meat and protein and carbs and vegetables and other things? I mean, it's got to be somewhat different. Right?

Robert Lustig (00:16:49):

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Yeah. Sure. So, trans fats. Trans fats are the devil incarnate. So trans fats were first invented in 1902. The first trans fat Crisco was patented in 1911. And trans fats started being added to baked goods in around 1920. And, it went up from there. And at one point back in the 1960s, '70s, '80s, we were eating trans fats nonstop. In fact, we were told to eat trans fats, because trans fats were margarine. And margarine didn't raise your LDL. Remember? We thought LDL was the problem. And so, margarine was trans fats and it lowered your LDL. Yeah. It caused heart diseases even worse. But the reason we put trans fats in all the food was because the bacteria could not digest the trans fats. The bacteria are what make food go rancid.

(00:17:50):

Well, if the bacteria can't digest the trans fats, the food won't go rancid vis-a-vis the 10-year-old Twinkie. Well, turns out those bacteria are mitochondria. Our mitochondria are refurbished bacteria. We made a deal with the plant kingdom back in the Pleistocene period, where we basically just agreed to house them. Animal cells agreed to house bacteria in exchange for the bacteria generating the energy that we needed to power ourselves. So it's a symbiotic relationship. Our mitochondria are refurbished bacteria. Bacteria can't digest trans fats. They don't have the enzyme to break the trans double bond. Well, neither do we. So-

Nate Hagens (00:18:38):

Are you-

Robert Lustig (00:18:39):

When we eat trans-

Nate Hagens (00:18:39):

... talking about the mitochondria in the microbiome in our gut?

Robert Lustig (00:18:45):

Anywhere.

Nate Hagens (00:18:46):

Anywhere.

Robert Lustig (00:18:47):

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Anywhere. There are no mitochondria on the planet that can digest trans fats. Not in our gut, not in our-

Nate Hagens (00:18:52):

So what happens to the trans fats?

Robert Lustig (00:18:53):

Not in our skin, not in our liver, not anywhere.

Nate Hagens (00:18:55):

What happens to the trans fats?

Robert Lustig (00:18:56):

They just sit.

(00:18:56):

They just sit. And they make fat.

Nate Hagens (00:19:02):

And so if you eat trans fats, in five years and 10 years and 20 years, a larger percentage of your weight is just trans fat that you've eaten in the past?

Robert Lustig (00:19:10):

Yeah. And also it will precipitate in your liver. And now you've got fatty liver disease. It'll precipitate in your arteries. Now you have atherosclerosis. And you have metabolic syndrome. So-

Nate Hagens (00:19:20):

Oh, my God!

Robert Lustig (00:19:21):

We learned this. The first paper that reared the ugly head of trans fat was published in 1957 by a guy named Fred Kummerow. And he was completely laughed at and forgotten. And then, in 1988, people rediscovered the work and Kummerow himself helped do this. And over the course of the next 25 years, from 1988 to 2013, we learned

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more about trans fats and how they were the primary driver of chronic metabolic disease, to the point finally where the FDA, in 2013, agreed that trans fats were poison and that they banned them.

Nate Hagens (00:20:09):

So, there's no trans fats in foods anymore?

Robert Lustig (00:20:13):

Pretty much. It's pretty much gone, except the trans fats you make in your own kitchen, because you can take olive oil and heat it past its smoking point and you will take the cis-double bond of the monounsaturated fat and you will flip it and now you have a trans, unsaturated fat.

Nate Hagens (00:20:32):

Oh, man!

Robert Lustig (00:20:32):

You have made a trans fat in your own skillet.

Nate Hagens (00:20:33):

I've done that.

(00:20:35):

So, if you're using olive oil and you lose paying attention, or it's too hot and it starts to smoke you, that's not healthy.

Robert Lustig (00:20:41):

Throw it away. Throw it away. Olive oil is meant to be consumed at room temperature.

Nate Hagens (00:20:47):

Yeah. There's an odd thing happening here, Rob, which is I have a lot of guests on talking about climate and ocean and dolphin and fish, risks to our environment. And it's tragic and depressing. I'm going to have on Robert Lustig and just talk about health and metabolic system, no big deal. This is hard hitting for me, because, I mean, I have read your book, but this is a big freaking deal. I mean, we're all going through

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our life. We go to the grocery stores and this is culturally accepted how we eat and it's affecting everything. And it's probably affecting our judgment and our decisions and our health to be able to be our best selves and everything.

Robert Lustig (00:21:31):

No question. No question. And, to some extent, it's our own ignorance and to some extent it's actually corporate greed. An example of that, PFAS, polyfluoroalkylated substances. Teflon. Okay? We were told Teflon was the greatest thing since sliced bread. And everyone used Teflon pans to prevent sticking. For how long? For how many decades? Well, turns out Teflon is one of the worst obesogens. It's one of the worst mitochondrial toxins, and it's a forever compound. It ain't going away. So, Teflon's gone. But PFAS, in our system right now, doing damage.

Nate Hagens (00:22:18):

Martin Scheringer did an episode with me on PFAS in the water supply. You actually were recently at a conference in Racine, Wisconsin on obesogens, and you met some of my colleagues there. What is an obesogen? And why are you researching that, and why is that so important?

Robert Lustig (00:22:38):

So, an obesogen is a compound that generates weight beyond its calories. That's an obesogen. So there are plenty of things in our food that are calories, but they will generate a certain amount of weight based on those calories. If they generate more than that-

Nate Hagens (00:23:00):

So there's some emergent property that has happened within the body? Like, if you consume 500 calories of obesogen and you put on 700 calories worth of weight, something happened to make that happen?

Robert Lustig (00:23:12):

Exactly. Exactly right. And the reason is because of mitochondrial dysfunction. Because your mitochondria not working well. There was a paper that came out, oh, about 10 years ago now I think, that tracked body temperature from the Civil War to today. And all of us, everyone, at every age, throughout the entire United States has a

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body temperature that is 1.5 degrees Fahrenheit lower than we used to. Now, that cannot be explained by any change in our environment or air conditioning or physical activity or anything else. Why are all of us burning less energy to create less heat, to have a lower body temperature? It's because we have mitochondrial dysfunction.

Nate Hagens (00:24:12):

Okay. So again, I don't want to make this podcast about me. We're going to take this offline. But I've come to know over the last decade that my normal temperature is 96.7, two degrees lower than 98.6. So if I am 98.6, I have a fever. And I've never understood why that was.

Robert Lustig (00:24:32):

This is why.

Nate Hagens (00:24:34):

Holy crap! Okay. So there are various diets out there. One of them is called Whole 30, which the premise of that is, don't eat any processed foods at all. You can eat carbs, you can eat potatoes, you can eat Larabars, just no processed stuff.

Robert Lustig (00:24:59):

Well, Larabars are processed.

Nate Hagens (00:25:01):

They are? But there's no other ingredients in there. There's just dates and peanuts or something.

Robert Lustig (00:25:07):

Yeah. No. I know. But they're still processed. I mean, they had to macerate it to get it into the Larabar. So, it's not none. The point is-

Nate Hagens (00:25:17):

Okay. So, there is a definitional thing between processed? When I think of processed, I mean that there's chemicals added in things. You actually mean that it was formed into a product. It's not a whole food, per se.

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Robert Lustig (00:25:30):

Yeah. Exactly right. So, there is a classification system that was developed by my colleague Dr. Carlos Monteiro, who is a Professor of Public Health at the University of Sao Paolo, Brazil. And it is called the NOVA System, N-O-V-A. It doesn't stand for anything, just a new system. And the easiest way to explain it would be with an example. So, there are four classes in NOVA. Let's take an apple. So, NOVA Class One would be an apple picked off a tree. Class Two would be apple slices, de-stemmed, de-seeded, maybe de-skinned. Class Three would be apple sauce, like cooked, macerated, possibly sugar added and maybe some preservative. Class Four would be a McDonald's apple pie. Okay? Turns out, when you look at the consumption across the world of various foods, only that Class Four category contributes to metabolic disease. But that's where the action is. And that happens to be 63% of all the foods sold in America and 67% of the sugar that we consume.

Nate Hagens (00:26:53):

What! 63% of the food sold is in that Class Four category? What is like globally in other countries? Less?

Robert Lustig (00:27:05):

So, it's about 56% in the UK. It's about 60% in France. 63% here.

Nate Hagens (00:27:12):

What about in Africa?

Robert Lustig (00:27:15):

I don't know. I don't know about Africa. That's a good question. Probably less.

Nate Hagens (00:27:18):

Yeah. Probably less.

Robert Lustig (00:27:19):

They don't have enough money and importing issues and stuff. So I don't know about Africa. In the Middle East, it's about 90%.

Nate Hagens (00:27:30):

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90% is that category four?

Robert Lustig (00:27:33):

Yeah. And that's why they have 18% diabetes and 80% obesity.

Nate Hagens (00:27:38):

In the Middle East?

Robert Lustig (00:27:41):

In the Middle East.

Nate Hagens (00:27:41):

I didn't know that.

Robert Lustig (00:27:42):

In Kuwait, in Iraq and Saudi Arabia. Yeah.

Nate Hagens (00:27:45):

Well, there's some irony there with the carbon pulse as well. I didn't know that. So, people that do diets that are highly in the category one and category two or a whole foods sort of diet ... I did a whole Foods diet for a month. It was really hard for me, but I lost 25 pounds. And then I gained it back, of course. You know why it's hard for you? Because the things that you eat don't taste as good as the things that you gave up.

Robert Lustig (00:28:18):

Well-

Nate Hagens (00:28:18):

Except for hash browns. I had hash browns every morning.

Robert Lustig (00:28:22):

Okay. Well, they weren't plied with extra sugar. So, our taste buds have been desensitized. And there's a neuro physiologist scientist, neuroscientist at University of Michigan, Monica Dus. Very, very smart lady, who has basically demonstrated the molecular mechanisms of tongue desensitization. She showed it in fruit flies. Point is,

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you can actually get that back, but you have to reduce the substrate. So, our food has been so sweetened on purpose that we have desensitized our taste buds. And so, food that is whole as it were, natural, but came out of the ground doesn't taste very good anymore, because we have desensitized those taste buds to not be able to appreciate it. If you go off sugar for three weeks, a blueberry will taste like a balm in your mouth. I mean, it will just explode in with flavor.

Nate Hagens (00:29:20):

So sugar is a super normal stimuli to our evolved brains, the same way that pornography or gambling or video games are?

Robert Lustig (00:29:31):

There are chemical addictions, there are behavioral addictions there. We have both. So, anything that stimulates the nucleus accumbens, anything that stimulates the reward center in the extreme is addictive. So we have chemicals like heroin, cocaine, nicotine, alcohol, sugar. We also have behaviors. We have shopping, gambling, internet gaming, social media, pornography. All of these stimulate the same reward center in the brain. Every one of those has an "aholic" after it. Shopaholics, chocoholic, sexaholic, alcoholic, you pick it. The point is, we have a reward system and it is under fire every day, by not just the food industry, but by virtually any corporate entity, because that's how they get you to buy.

Nate Hagens (00:30:28):

I knew we were going to be like this on this call, because I talked to you a couple weeks ago and we started to get going. I'm like, "No. No. No. Rob, hold it off for the podcast, because I have so many questions." So is sugar then a possible contributing factor to poly addiction in our culture? Let's say no one is using cocaine or pornography or gambling or shopping, but they become addicted to sugar, because of processed foods in this category four, you said before. Is there a carryover effect that over time they will have a higher compulsion for those other behaviors that I mentioned?

Robert Lustig (00:31:06):

Absolutely. In fact-

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Nate Hagens (00:31:08):

Oh, God!

Robert Lustig (00:31:08):

Sugar's a gateway drug. I mean, that's the way to put it. And, I'm not even the one who said that. You know who said that?

Nate Hagens (00:31:14):

No.

Robert Lustig (00:31:15):

Eric Clapton.

Nate Hagens (00:31:15):

Huh. Wow!

Robert Lustig (00:31:18):

He was interviewed on 60 Minutes back in the late '70s by Ed Bradley. I actually have the clip and I can send it to you. You can edit it in, if you like. And Ed Bradley said, "So, how did all this start. Did it start with heroin?" And Eric Clapton says, "No. It started with sugar. When I was five, six years old, putting sugar on bread and butter, pouring sugar down my throat. I consumed sugar, because it changed the way I felt."

Nate Hagens (00:31:50):

Wow! So, there are certain things that don't directly have sugar, but they get processed in the body into sugar, like wine or something like that. Is that the same effect or not?

Robert Lustig (00:32:08):

So it turns out that fructose, the sweet molecule and sugar and alcohol are metabolized in the mitochondria the exact same way, and do the exact same things and generate that same liver fat. And this is why children today get the diseases of alcohol without alcohol. Type two diabetes and fatty liver disease used to be the diseases of alcohol. Now they're diseases of sugar for just the same reason, because our mitochondria handled them virtually identically. And this was my big "Aha!"

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moment back in 2006. I was asked to give a talk at the National Institutes of Environmental Health Sciences. They were celebrating their 100th anniversary. And so it was a two-day symposium and the first day was going to be on successes. So, lead poisoning, pollution and asthma. The second day was going to be on new challenges. The morning was going to be on obesity, metabolic syndrome, and the afternoon was going to be on ADD and autism.

(00:33:12):

And so they asked me to come to this symposium and say what I thought was the biggest environmental driver of obesity and metabolic syndrome. And they thought I was going to talk about PFAS or BPA or phalates or some chemical in the environment that would be easily removable. And I said, "Let me think about this." And I sat there and I said, "All right, look. Children are always the canary in the coal mine. They're always the most vulnerable. I'm a pediatrician, I'm a pediatric endocrinologist. I'm taking care of these kids. What are the two diseases that kids get today that they didn't get 40 years ago when I started practicing?"

(00:34:00):

"Type two diabetes and fatty liver disease?" And I said, "Yep. Well, I looked it up and those two diseases were the diseases of alcoholics." And I said, "Hm. Kids are getting diseases that alcoholics get." So I opened up my biochemistry text from 1974, from college, and I turned to the alcohol page. And then, I turned the page and there was fructose. And I traced the pathways and I went, "Holy shit! These are the same. They do the same thing. The mitochondria handled these the same way!"

(00:34:42):

And so I started pulling papers to try to figure out. And so, I went to this meeting at NIH and said, I think that fructose is the primary driver. And I gave my talk, and then was the bathroom break and nobody came back. They were all milling around outside. And I had to use the bathroom. So I went outside, they tackled me in the frigging bathroom, screaming at me. This is a bunch of toxicologists saying, "Oh, my God. Oh, my God. That's right. That's right. Fructose is a toxin. You have to tell the world!" I never saw a bunch of toxicologists get so worked up.

Nate Hagens (00:35:25):

That's an amazing story. My initial reaction is, how could all the smart doctors in the world miss that until 2007?

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Robert Lustig (00:35:35):

I truly don't understand it myself. I don't know.

Nate Hagens (00:35:43):

So, currently, are you retired or do you currently see patients, children? You're a pediatrician.

Robert Lustig (00:35:50):

I retired clinically in 2017, so I'm not doing any more patient care. I did my 40 years. They made it very unpleasant, between RVUs, relative value units and, basically, counting every minute you spent and figuring out whether or not you were actually justifying your salary. And then, when the electronic medical records showed up, that was the death knell. That was like, "I'm out of here."

Nate Hagens (00:36:19):

I could imagine. I can imagine. But, in your-

Robert Lustig (00:36:23):

So, I'm doing a lot of stuff, but it's not patient care.

Nate Hagens (00:36:28):

Oh, yeah. I know you are. But, the reason I ask is it in the last few years of your practice, did you see, was there a demographic of children, that either because of personal physiology or because of their parents, or because of their school environment didn't have the typical cultural access to sugar? And did you notice different things about them?

Robert Lustig (00:36:55):

So, what I would say is I only saw the kids who had the problem, not the kids who didn't have the problem, because I was the head of the obesity program, so they conglomerated in my clinic. But, having said that, what we learned was that sugar was not the cause of obesity in all of them. It was the cause of the obesity in about three quarters of them. The other quarter had other things going on. Could be hypotonia, so that their mitochondria were not working right from scratch, because of some neurologic problem. Could be because their pancreases were over releasing insulin in

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response to a glucose load, what we called insulin hyper secretion. And that required a very different treatment paradigm.

(00:37:47):

It could be from genetics. There were genetic disorders, called melanocortin-4 receptor deficiency in the most obese kids. So, what we learned was that obesity was a syndrome of multiple pathologies, and that in order to fix any given kid, you had to diagnose the proper pathology. Now, when we did that, kids got better. But the overwhelming majority, it was because of their food. It was because of their ultra processed food diet.

Nate Hagens (00:38:26):

So, how can mitochondria get better for a kid? And, can the same healing occur in an older adult, perhaps someone listening to this show?

Robert Lustig (00:38:41):

Absolutely. That's what it's all about. So, the question is how do you make new, fresher, better mitochondria?

Nate Hagens (00:38:51):

So, is it just like cells in your body that are constantly regenerating? We get new mitochondria all the time?

Robert Lustig (00:39:00):

Well, yes. So you have to recycle your mitochondria. So there is a recycling program in your cells, and it is called autophagy, self eating, autophagy. All of your cells make junk. Okay? They make toxic byproducts. And those toxic byproducts can affect proteins. So, you get protein aggregation, and now those proteins don't work right. You can get lipid peroxidation, so those lipids basically become inflammatory. These are all things that have to be cleared. They have to be gotten rid of. So, there is a recycling program. It's called ubiquitin. Ubiquitin is a string of amino acids that get put on a protein or a lipid and then get sent to, basically, the recycling plant of each cell called the proteasome. And it gets cut up into itty, bitty pieces and either get recycled into new proteins, or get excreted out of the cell entirely. So, basically there is a constant replenishing of the cellular machinery of each of your cells, every single day. And it is

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this process called autophagy. You need autophagy. Autophagy is good. You want that.

Nate Hagens (00:40:24):

And in the autophagy of mitochondria that were dysfunctional because of sugar and all the problems you've been talking about ... When they're chopped up and regenerated, does the dysfunction carry on into their new constituents? Or does it come out fresh?

Robert Lustig (00:40:46):

No. It'll come out fresh. And so the new mitochondria will work well, until of course they go sour also.

Nate Hagens (00:40:53):

So, in theory, you're just change what you eat and you could change how your mitochondria function, and reduce or completely eliminate metabolic syndrome?

Robert Lustig (00:41:06):

I think completely eliminate. So, there are a few things that we know will improve autophagy. One is change your diet. Number two, exercise. Exercise. One of the primary ways it helps is by contributing to autophagy. A third way that Valter Longo at USC showed is intermittent fasting. And so intermittent fasting is a great promoter of autophagy. Number four is reduced stress. Now, good luck with that one. We have a stress-filled world and it ain't getting any better. A fifth one is a compound that we are studying called spermidine. And spermidine is a component of food. It's also made in your cells and it helps contribute to autophagy. And we're studying a supplement right now to see whether or not it will actually promote autophagy.

Nate Hagens (00:42:00):

So autophagy happens on its own. Right? We don't have to do anything. Autophagy is constantly happening.

Robert Lustig (00:42:07):

It's constantly happening, but you can speed it up or slow it down.

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Nate Hagens (00:42:10):

Okay. And how does intermittent fasting help mitochondria autophagy and metabolic syndrome? What are the mechanics there?

Robert Lustig (00:42:22):

So, intermittent fasting means less food coming into the cell, which means that your ATP is going to be broken up into its components. AMP and those phosphates, that's liberating the energy to power the cell. Well, when your AMP goes up, that means your ATP went down. And this enzyme I mentioned earlier called AMP kinase senses the increase in AEMP. It knows that that means that energy levels are low. And so, it then stimulates the program for increased mitochondrial synthesis. So you make more mitochondria, and they're now fresh.

Nate Hagens (00:43:07):

And they're coexisting with unhealthy mitochondria, but the population percentage has changed and-

Robert Lustig (00:43:14):

Right.

Nate Hagens (00:43:15):

Yeah.

Robert Lustig (00:43:15):

That's right.

Nate Hagens (00:43:16):

So this seems to be, at least in theory, a pretty fixable problem. Why have doctors not caught onto this and taken it into practice? And, how much nutrition education of what you're telling me today, do doctors receive?

Robert Lustig (00:43:35):

So the reason that doctors don't know about it is, number one, there's no pill for that. Number two, there's no ICD nine or II code for that.

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Nate Hagens (00:43:47):

What's that?

Robert Lustig (00:43:48):

So, when doctors sit down with their patients and evaluate them, they have to generate a billing slip, in order to get paid. Okay? And the way you do it is with codes for what was wrong with the patient. Those are called ICD 11 codes, and then codes for what you did, which are called CPT codes. And it is the combination of the ICD 11 code and the CPT code that determines how much Medicare or Medicaid or the insurance company will reimburse the doctor for his or her work. There's no ICD 11 code.

Nate Hagens (00:44:26):

And sugar is not a box that-

Robert Lustig (00:44:32):

No. And autophagy is not a box you can check

Nate Hagens (00:44:33):

What if it were?

Robert Lustig (00:44:36):

What if it were? We would like that to be. Yes. What if it were? We're working on that.

Nate Hagens (00:44:44):

Well, I mean, like I said earlier, healthcare is the biggest industry in the United States. So, is there a point that the refined food industry and maybe the medical industry will recognize there's potentially more money in healthy living than sickly living? Or not?

Robert Lustig (00:45:03):

So, that's a really good question, Nate. And I'm going to tell you I don't know the answer to that. Let me tell you why I don't know the answer. In 1929 in Texas, Blue Cross was the first insurance that developed. And they appropriately said, nobody should go bankrupt dealing with healthcare. And so, they developed this thing called insurance. And then a lot of other companies came into the field, the space, because they saw that there was money to be made. And what they did was they developed

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the casino model. Pay to play, set the rates. Okay? The same way the casinos make money. They hand money to you, but they still make money, because pay to play set the rates.

(00:45:56):

And that is the model that the insurance industry has used, right up to 2013. And the reason that it changed is because of Obamacare. Now, you can think whatever you want about Obamacare, and I don't care if you like it or you don't like it. Irrelevant to me. There's one thing Obamacare did do. It capped profit at 15%. No insurance company could make more than 15% of its subscriptions, which meant that if they were charging more than that, they had to give the money back to the patient.

(00:46:38):

So now, the only way for the insurance company to make money is to keep you healthy. Before they wanted you sick, because pay to play set the rates. The casino model. Well, now it's not the casino model. Now they've got a cap-

Nate Hagens (00:46:53):

But we're still-

Robert Lustig (00:46:54):

And so now they've got to figure out how to get, right, they got to figure out how to make people healthy. They don't know how.

Nate Hagens (00:47:03):

Hm. But we've still gotten sicker since 2013, I would argue as a nation.

Robert Lustig (00:47:10):

Indeed. Indeed. And that's because the food hasn't changed.

Nate Hagens (00:47:15):

So is one's sugar intake listening to this program? Is it an issue of personal responsibility, as a lot of the diet industry has framed some of these health issues? Or is it really a much larger public health crisis, impacted by the growth mentality dictated in all of our economy?

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Robert Lustig (00:47:37):

Okay. So, I'm actually going to be giving a talk at a workshop on exactly this topic. Personal responsibility or public health? That's the title of my talk. So I'm very up on this, as it were. I'm going to shoot personal responsibility in the foot with one concept. We have an epidemic of obese newborns all over the world. US, South Africa-

Nate Hagens (00:48:06):

So the mitochondria and dysfunction transfers from mother to baby in utero?

Robert Lustig (00:48:13):

It does.

Nate Hagens (00:48:17):

Wow.

Robert Lustig (00:48:18):

So, we have obese newborns. Now, did they diet and exercise?

Nate Hagens (00:48:26):

Wow, no.

Robert Lustig (00:48:29):

Okay. Can they be implicated for personal responsibility? Well, that's your answer. So, there is a paper that I love, and you should become familiar and acquainted with this paper. It's from PNAS 2008. The author is Anthony Cashmore, the Head of Biology at the University of Pennsylvania. And the title of the paper is called The Lucretian Swerve, and it's about personal responsibility, free will and the criminal justice system. And the argument that this paper makes is that, the only reason we had free will is basically to punish transgressors. That it is purely a function of the criminal justice system. And the personal responsibility plays directly into this notion of free will.

(00:49:23):

If you have free will, then you can exercise personal responsibility, except it's not true. So, when you actually look at it's half your DNA, half your environment, with some random stochastic eventualities. Well, you can't fix your genetics. You can't fix those

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random stochastic eventualities. So, all there is the environment. So, our concept of personal responsibility is completely hinged on the changes in our environment that have occurred. And I agree with that. So, this is not something that is choice. This is something that is response to the environment. So how do you fix it? You fix the environment. And this goes for the carbon pulse, too.

Nate Hagens (00:50:12):

Right. I was going to say it's another corollary with my story, which is we have become an energy hungry super organism as a global culture. An individual behavior change isn't really going to change that until we change the cultural aspirations, the economic rules and the incentives, et cetera. So, in your field, how do subsidies and governance play into these issues? Especially for the corn industry? Is big ag involved in this? And would reducing processed food consumption again dovetailing into my story, necessarily require us to move back to more locally produced foods, due to the issue of shipping longevity and energy costs and some of those things?

Robert Lustig (00:51:03):

That's exactly what the problem is. So, in my opinion, and this is opinion. In my opinion, food subsidies are the problem. Now, food subsidies started as early as 1790, because that is ... The sugar tariff was the second oldest piece of legislation in the United States, and it is still there. Okay? 1790.

Nate Hagens (00:51:33):

How does that function? I've never heard of that.

Robert Lustig (00:51:35):

The sugar tariff. It was basically to keep sugar from other countries out so we could develop our own sugar industry. That was in 1790.

Nate Hagens (00:51:44):

We didn't need that much sugar. We only ate five pounds of sugar back then.

Robert Lustig (00:51:46):

No. Right. Exactly. Well, the point was to make more. Okay? And it was just particularly important? Because where were we getting our sugar from? We were

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getting it from the Caribbean, but now we just had the revolution and now we had this question about slaves and what have you. And so, we needed to help promote a sugar industry. And so, 1790 sugar tariff. Now, the real problem in terms of subsidies came in 1933 with the original Farm Bill. Now the Farm Bill, the first one, 1933, was in response to two things that we had no control over. One was the Depression and the other was the dust bowl. So, we had a destitute population in the southwest part of the United States that were dying of famine. And all the food was in the northeast and the Midwest. And we had to get the food from the northeast, Midwest to the southwest.

(00:52:52):

But the problem was if you just took whole food and put it on a railroad car, it would be rancid by the time it got there. So we had to induce. We had to provide subsidies to the manufacturing industry to process the carbohydrate, the grain into flour, into 10-pound bags of flour and 10-pound bags of sugar and put them on those railroad cars, so that they wouldn't go rancid by the time they got there. So they could then be baked up and we could feed a population in extremis. And that made sense all the way through World War II.

Nate Hagens (00:53:31):

So, processing itself wasn't just because it tasted better, or it made more money, but it was a necessity in the complexity of our growing population, and spread out everywhere and supply chains and all that? It was a requirement almost?

Robert Lustig (00:53:46):

Exactly right. And the Farm Bill was the thing that allowed for that to happen.

Nate Hagens (00:53:55):

And now fast-forward almost 100 years, the subsidies-

Robert Lustig (00:54:03):

We don't need the Farm Bill.

Nate Hagens (00:54:03):

Why not?

Robert Lustig (00:54:04):

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We don't need those subsidies. Those subsidies are a problem. So, we subsidize things that can be stored. We subsidize food into commodities. Commodities are storable food. That's the definition. And what are they? Corn, wheat, soy, sugar, all of which are bad for us. But that's what we subsidize. And so, we give-

Nate Hagens (00:54:25):

Is it just because of a momentum that we've always subsidized them and then there's been power and lobbyists and everything, and so it's like there's a momentum there. It's hard to break?

Robert Lustig (00:54:36):

That's exactly right. And the more we try to break it, the more they push back and exert political pressure on every administration since Eisenhower.

Nate Hagens (00:54:47):

Do you know offhand the dollar amount of subsidies that goes to processed foods and sugar in big ag, roughly?

Robert Lustig (00:54:56):

Yeah. Well, in 2015, the last time I looked, it was \$192 billion.

Nate Hagens (00:55:05):

And those-

Robert Lustig (00:55:06):

So it's probably higher now.

Nate Hagens (00:55:07):

Let's just say that that was removed. How would the food companies respond to that?

Robert Lustig (00:55:12):

Right.

Nate Hagens (00:55:13):

They would have to change some of their practices.

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Robert Lustig (00:55:16):

Well, that would be the assumption. So the Giannini Foundation at UC Berkeley actually did this modeling exercise back in 2007. They asked the question, what would the price of food look like if we got rid of all food subsidies? You'd have to get rid of all of them. And the reason is, because if you subsidize one thing, that means you're taxing everything else, because you have to make book. I mean, subsidies distort the market. That's what they do. Okay? So you want the market to work. I want the market to work. Okay? It's very libertarian. Let the market work. Well, the market's not working, because of the subsidies. So let's get rid of the subsidies. So, what would happen to the price of food? Now the betting man would say, "Well, the price of food would go up." It turns out the price of food would not go up. It would stay the same except for two items, corn and sugar. Those would go up. And that's exactly what we want to go up, because that's what we have to reduce the effective availability of, because they're the biggest problem.

Nate Hagens (00:56:24):

So, fresh fruit and fresh vegetables that are grown in California and shipped to Wisconsin where I live, that wouldn't change then, if the subsidies went away, because it's still going to be somewhat expensive to ship and whatever? That's already in the price. But, you're saying that the real bad foods for our mitochondria would go up in price, which would be a good signal to people to consume less? Yes?

Robert Lustig (00:56:50):

That's right. That's right.

Nate Hagens (00:56:51):

Are you working on things like that? Or are there people working on this?

Robert Lustig (00:56:55):

Now? There are people who are modeling it. The question is, is anyone working on it at a policy level? And the answer is, stay tuned.

Nate Hagens (00:57:06):

So, in addition to the subsidies would breaking up the monocultures in the United States, we're only talking about now, and adopting regenerative agriculture, which is

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more labor intensive, better for climate, better for the health of the people involved in it? Would that aid in the reduction of obesity and related diseases?

Robert Lustig (00:57:29):

Absolutely. No question. No "ifs," "ands," or "buts." It'll reduce obesity, because it'll allow for fruits and vegetables and fiber containing foods, which are necessary to become more plentiful and therefore less expensive. So people will be able to incorporate them into their diets, because they're less expensive and more available. And will also reduce the nitrous oxide and methane and carbon dioxide burden, which will have enormous effects on cellular metabolism. So-

Nate Hagens (00:58:11):

What is the effect of nitrous oxide?

Robert Lustig (00:58:15):

Well, nitrous oxide is a heat-trapping agent.

Nate Hagens (00:58:18):

Right. Right. Okay. I thought you might on an individual. On a climate standpoint, it would reduce that.

Robert Lustig (00:58:23):

Well, yeah. I mean, carbon dioxide is a problem too. People talk about all three greenhouse gases like their equivalent. They're not. You know this, I have no doubt. If you have three components to each greenhouse gas, that is parts per million, and then residence time and then heat-trapping capacity, you could develop a formula for how bad each greenhouse gas was. Now, turns out the one that gets all the attention, that gets all the press is methane, because they want to get rid of the cows. Okay? Here's the problem with that. Methane is actually the lowest in terms of parts per million. And it's also the lowest in terms of residence time. So, it is 25 times the heat-trapping capacity of carbon dioxide. I don't argue that. It is definitely more heat trapping than carbon dioxide, but there's less of it. And it has a lower residence time of only nine years.

(00:59:39):

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The nitrous oxide that you have to spray, that you have to spray nitrogen fertilizer on the crops, because there's no cows on the farm to carbon fix and provide nitrogen for the crops ... So you have to spray the nitrogen instead, which then forms nitrous oxide, which then goes into the air. It has the longest residence time of 114 years. And, it has a heat trapping capacity of 250 compared to methane, which is only 25. It's 10 times more heat trapping. So, us spraying nitrogen fertilizer on crops, because we took the cows off the farm, is basically truly shooting ourselves in the foot. It's like doing the absolute worst thing.

(01:00:34):

And, worse yet, we have the cows now in Kansas on these CAFOs, concentrated animal feeding operations where all the cattle are basically in pens and can't move. And so, they're all lying in their own excrement and they're eating corn, which is not high in legumes, is not high in some of the compounds that are needed for immunologic competency. So, these cows get sick very easily. And so what happens? The cattlemen have to give the cows shots of antibiotics. So, virtually all of the CAFO-treated meat that we consume in this country is all antibiotic laden. So, what are those antibiotics doing?

Nate Hagens (01:01:24):

Does that carry over into our gut microbiome and disrupt it?

Robert Lustig (01:01:28):

Absolutely. And it disrupts the cow's microbiome. So, it kills off the good beneficial bacteria in the cow's microbiome and allows the methanogens, the methane-producing bacteria to basically take over. So, each cow today is making six times the methane than they did in 1968.

Nate Hagens (01:01:48):

But it wouldn't have to be that way just because it's a cow and people eat beef. It's because of the way they fatten them up on the CAFOs with corn. Right?

Robert Lustig (01:01:57):

Exactly right.

Nate Hagens (01:01:59):

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So, let me ask you this?

Robert Lustig (01:02:01):

You have to unwind this whole thing together, to fix this.

Nate Hagens (01:02:04):

Well, you have to understand it first, in order to unwind it. So, thank you for explaining it so clearly. Let me ask you this. This is just my own personal sense, but you're an endocrinologist, so I get to ask you this. What is the impact of antibiotics writ large on our microbiome and our metabolism? It seems to me in some ways, antibiotics are one of the best inventions of human history. But it seems like we might have traded mortality for morbidity. Like, it's a great thing because we don't die, because we take antibiotics when we have a disease. But, at the same time, the antibiotics are weakening our response as individuals, because it's killing all the beneficial bacteria as well as the bad ones. Do you have any thoughts on that?

Robert Lustig (01:02:54):

I do. I have lots of thoughts on that. And you almost stated it correctly. It's not just morbidity, mortality. I mean, ultimately antibiotics kill ... I'm sorry, bacteria kill quickly. Okay? Pneumonia kills quickly. Various infectious diseases. The reason that our lifespan has gone from 47 years to 78 years are two changes in the 20th century. Antibiotics and, actually three changes. Antibiotics, vaccination, and hygiene. Okay? Sanitation. Those three things. Antibiotics, vaccination, sanitation. That's the reason we went from 47 mean age to 78 years mean age. Those three things. Antibiotics are good when you use them right. When you use them for the disease that you have in front of you. But that's not what we've been doing. Every kid who gets a viral otitis an ear infection? Okay? It's viral. We won't let them back into school until they're on an antibiotic.

Nate Hagens (01:04:15):

But antibiotics don't kill viruses.

Robert Lustig (01:04:19):

Exactly. Antibiotics don't kill viruses. Those viruses would go away by themselves. But, every kid gets an antibiotic for every ear infection. And in fact, every patient who ends

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up in the hospital ends up on an antibiotic. And the problem is, the more you use the antibiotics, the more resistant the the bacteria get. And so you have to develop new antibiotics and new antibiotics. And now we have strains of bacteria that are not even susceptible to antibiotics. So, we've created a legion of superbugs. In addition, we have sterilized our microbiome, and this is work from Marty Blaser at NYU, who's basically showed that the earlier antibiotics get introduced into a newborn's gut, the more likely that that gut microbiome will change and promote obesity going forward in the future.

Nate Hagens (01:05:15):

Is there any evidence of people in communities, rather than just someone living in their house with just their wife and two kids or something ... People living in communities cooking together, sharing, working together, that they're sharing each other's microbiome, because of interaction, and that's a healthy benefit? Or is that just speculation?

Robert Lustig (01:05:37):

I think it's speculation, but there is definitely something to microbial diversity. The more kinds of bacteria you have in your intestine, the better off you are. That's clear. Whether you get them from other people or not, is not clear.

Nate Hagens (01:05:52):

Do you take probiotic supplement-type things yourself?

Robert Lustig (01:05:57):

No. And I'll tell you why. Probiotics are live cultures. They are bacteria that are live. Okay. You want to increase your bacterial diversity, so you take a probiotic. Now, that probiotic goes into your intestine. It should take up space. It should grow, it should take, it should proliferate. It should be able to do that. And it should be able to do it with one dose. So, how come you keep needing it? How come you have to take it every day?

Nate Hagens (01:06:33):

Right. Yeah. Right.

Robert Lustig (01:06:34):

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Why is that? Okay? The point is, if the probiotic we're taking actually setup shop, you'd only have to take it once. But that's not true. And the reason the probiotic's not there in the first place, because the internal milieu of your intestine is toxic.

Nate Hagens (01:06:54):

Oh.

Robert Lustig (01:06:54):

It's not conducive to the growth of those bacteria, which is why they're not there in the first place. So, what do you think adding a probiotic to a toxic environment will do? Nothing. And that's what's happening. Nothing. What you have to do is you have to change that internal milieu.

Nate Hagens (01:07:12):

And how do you do that?

Robert Lustig (01:07:12):

You have to allow fiber.

Nate Hagens (01:07:17):

Fiber?

Robert Lustig (01:07:18):

Fiber is not a probiotic. Fiber is a prebiotic.

Nate Hagens (01:07:23):

So what are some things that contain fiber that are readily available at grocery stores or restaurants?

Robert Lustig (01:07:29):

How about all the produce?

Nate Hagens (01:07:33):

Okay.

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Robert Lustig (01:07:35):

That's what the produce is for. The produce is not for you. The produce is for your bacteria. You have to feed your gut.

Nate Hagens (01:07:44):

Wow! What a profound statement. So, people that were living on the person in Sao Paulo's scale of the category four ... If they would switch from that category four food to produce right there, it would start changing some reactions in their physiology, their gut, et cetera.

Robert Lustig (01:08:05):

In two days.

Nate Hagens (01:08:07):

Really?

Robert Lustig (01:08:08):

Two days.

Nate Hagens (01:08:08):

You would notice differences? Or a doctor would notice differences.

Robert Lustig (01:08:12):

Well, a doctor would notice differences in two days.

Nate Hagens (01:08:15):

How can this not be more widely known, Rob? I mean, you do read it out there in places, but not with this clarity.

Robert Lustig (01:08:24):

Because the food industry is very powerful and they have a very big mouthpiece.

Nate Hagens (01:08:32):

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I mean, you've been speaking about this issue for over a decade. Have you seen positive trends in the right direction? And, what will it really take to start like significant change on this?

Robert Lustig (01:08:44):

Yeah. So, really good question. So I actually have data and the food industry generated it for me. How about that? There's a public relations arm of the food industry called IFIC, the International Food Information Council. And they every year publish their annual report, and as part of the annual report, they ask the public a question. And, each year it's a different question. In 2011, they asked the question, what nutrient or food stuff is the greatest contributor to weight gain? And, at that time, 11% said refined carbohydrate and sugar. And 48% said, "A calorie is a calorie, or I don't know." In 2018, they asked the exact same question the exact same way, seven years later. And now 33% of the population answered refined carbohydrate and sugar. And the same number of people went down in terms of "A calorie's a calorie, or I don't know." In other words, those people had been educated as to what the real problem was. So, education does work. But, education alone is no match for any substance of abuse. You can't-

Nate Hagens (01:10:16):

I know that

Robert Lustig (01:10:17):

You can't un-addict somebody with education.

Nate Hagens (01:10:20):

Well, I'm somewhat aware of these issues, and to me it's the refined carbs have gotten the bad name. And, of course sugar, is a refined carb. But people try to low carb and all those. But maybe that's not the real danger. You had matzo ball for breakfast. That's carbs, but there's no sugar in that. So, maybe carbs are okay as long as there's no sugar or processed involved. Yes?

Robert Lustig (01:10:55):

Well, this is a question in the nutritional scientific community right now, is, is it carb restriction or is it sugar restriction? And I'll be very honest with you, it depends on the

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patient. For some people that require carb restriction. If their beta cells and their pancreas are exploding insulin, they need carb restriction. But if they have liver fat, they very well may just need sugar restriction. So, probably different modalities for different people.

Nate Hagens (01:11:27):

So, a few weeks ago I was at a Homeland Security conference and I met a gentleman there who knew you, or knew of your work, and we were talking. And I told him we would be on this call and he told me to ask you, is obesity a national and homeland security issue?

Robert Lustig (01:11:46):

Oh, absolutely. If I named him, would you be able to tell me if it was him?

Nate Hagens (01:11:51):

Sure.

Robert Lustig (01:11:53):

Dan O'Connor?

Nate Hagens (01:11:54):

Yeah. Dan.

Robert Lustig (01:11:57):

Okay. I had a feeling. And he knows the answer to that. He's the one who said it to me. Yes, of course it is. Two fat to fight? Well, if 93% of Americans have some form of metabolic dysfunction, and if the food at the PX and at the cafeterias are ultra processed, which they are, okay? We are basically fattening up our own troops, and we're contributing to their mitochondrial dysfunction.

Nate Hagens (01:12:36):

Well, to me, it's-

Robert Lustig (01:12:38):

That's not a fighting force that you want to field.

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Nate Hagens (01:12:41):

Well, troops and military aside, I think it's a homeland security issue for the viability of our nation, and our intelligence and creativity and health and discovery and innovation and everything. Right? It's sapping a lot of our potential. If people are-

Robert Lustig (01:13:03):

No question.

Nate Hagens (01:13:03):

93%? 93% of Americans have some metabolic dysfunction?

Robert Lustig (01:13:08):

Yep. According to Tufts, that came out last year.

Nate Hagens (01:13:10):

What would you speculate that the 7% of others, how did they luck out or how did they avert this?

Robert Lustig (01:13:19):

I wish I knew the answer to that.

Nate Hagens (01:13:20):

Okay.

Robert Lustig (01:13:22):

I don't know.

Nate Hagens (01:13:23):

Okay.

Robert Lustig (01:13:23):

I don't know.

Nate Hagens (01:13:29):

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Let me ask you one more question. I have so many questions for you, Rob, but we'll wrap this up soon. I have read in the climate lit-

Robert Lustig (01:13:36):

We'll have to do a part two.

Nate Hagens (01:13:37):

Yeah. We'll have to do a part two. I've read in the climate literature that warmer temperatures good for plant growth. But they grow the plants, but not necessarily the nutrition and that the micronutrients like zinc and things like that don't get assimilated. So, we might have a larger plant, but what humans actually eat from the plant is missing critical inputs. Have you looked into that? Have you heard of that?

Robert Lustig (01:14:13):

I have. I've not personally looked into it, other than writing about it in Metabolical. It's not like I've done research in it myself. But, there are two issues. One is soil versus dirt, and the other is selective breeding. Two different issues. So, soil versus dirt. What's the difference between soil and dirt?

Nate Hagens (01:14:40):

Soil has microorganisms and healthy micro cortisol function, et cetera.

Robert Lustig (01:14:48):

Soil has a microbiome and dirt doesn't.

Nate Hagens (01:14:50):

Okay.

Robert Lustig (01:14:51):

That's the difference.

Nate Hagens (01:14:53):

And dirt. If you're going to grow a plant in dirt, you need to add a whole bunch of nitrous oxide and other things.

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Robert Lustig (01:15:00):

Nitrogen. Right.

Nate Hagens (01:15:01):

Nitrogen.

Robert Lustig (01:15:02):

And you have to carbon fix. Right. Exactly. That's exactly the point. So, you can grow anything in soil. And the reason is, because the microorganisms in the soil, the viruses, the fungi, the bacteria are actually producing things the plant needs to be nutritious. So, the plant conglomerates those things, but the plant doesn't necessarily make those things.

Nate Hagens (01:15:25):

Mm. Got it.

Robert Lustig (01:15:27):

So, when you grow plants and soil, they are more nutritious, because of those microorganisms. When you grow plants in dirt, yes, you have to throw nitrogen on them. You have to throw water on them. Yes, it'll grow, but it won't have nearly the nutritional content that that same plant growing soil will have, because those microorganisms-

Nate Hagens (01:15:49):

That's scientifically established?

Robert Lustig (01:15:53):

That's scientifically established.

Nate Hagens (01:15:55):

Yeah.

Robert Lustig (01:15:55):

Second problem, selective breeding. People like sweet. And so, all the fruit and vegetable growers said, "Okay. Let's take our best hybrids and hybridize them

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together and make the sweetest possible apple, the sweetest possible pear, the sweetest possible tomato, et cetera, et cetera. Because, then people will like them better and they will buy them." Well, turns out, as you selectively hybridize, you actually reduce all of the things in the fruit and in the vegetable that were nutritious, because those things are bitter. They have a bitter taste. So the polyphenols, the flavanoids, carotinoids, all the things that actually contribute to the nutritional quality of the plant have actually been selectively bred out.

Nate Hagens (01:16:51):

Oh, my God!

Robert Lustig (01:16:52):

... so that the sweetness will show through instead. So, this is partly manmade by selective hybridization, and it's partly plant made, because of the soil dirt issue. But, yes. There's no question that our fruits and vegetables today are less nutritious than they were 25 years ago.

Nate Hagens (01:17:11):

And then it's a positive feedback, right? Because people buy those products. It has more fructose and less of the micronutrients, and it gets our taste buds more tethered away from tiger piss and dog poop that taste bad, but actually have nutrition in them. Well, from earlier in the podcast. Wow! I've learned a ton here. So, a few of closing questions. For people listening, what can people do right now in their control to minimize the risks that you discuss about metabolic disorder and mitochondrial dysfunction, and create more healthy baselines for themselves in the future?

Robert Lustig (01:17:53):

Three words. Eat real food.

Nate Hagens (01:17:58):

Okay.

Robert Lustig (01:17:59):

Eat real food. Now, that's hard to do. It shouldn't be hard to do, but it's hard to do. And the reason it's hard to do, is because we have food deserts through much of the

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country, where you can't even get real food. And also, the cost of real food is four times higher than ultra processed food, because of the consumer price index.

Nate Hagens (01:18:19):

Right. So there's an inequity aspect to everything you're talking about, because for people-

Robert Lustig (01:18:25):

Absolute. Yeah. This is the basis of social determinants of health. Right here. This is what it's about. Fix the food. Now, the question is how? How can you fix the food? Well, how about differential subsidization? Okay? Here's a concept. So, number one, get rid of all the food subsidies. But, if you're not going to get rid of all the food subsidies, how about tax the ultra processed food and use the money from the tax to subsidize real food? Zero-sum game to the government, not a money grab. But what you're doing is you're improving effective availability for the people who need it the most.

Nate Hagens (01:19:08):

Will they go for that, though? Because the healthier food isn't going to taste-

Robert Lustig (01:19:12):

Of course not.

Nate Hagens (01:19:13):

... as good. Yeah.

Robert Lustig (01:19:16):

Well, number one, yes, the public will go for it eventually, because money is money and price ... Everyone's determined the price is the most important thing. That's been shown 50 ways from Sunday. The problem is, will the food companies go for it? And the answer is they won't be out anything, because you still have to eat and you still have to drink.

Nate Hagens (01:19:44):

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I have so many questions for you. But the big thing that's like rolling in my mind, it's almost four o'clock here, is I'm wondering what the hell should I have for dinner tonight after talking to Dr. Lustig? So-

Robert Lustig (01:19:56):

Yeah. I know. I have that effect on people.

Nate Hagens (01:19:59):

Yeah. Well, it's a good effect. So, do you have specific recommendations for young humans listening to this, that are aware of climate change, aware of how messed up our culture is? Maybe they've learned some new things today from this discussion. What do you tell teenagers and 20-somethings who are learning these things?

Robert Lustig (01:20:20):

Right. So, the first thing is, education works. Okay? Think of it this way. All right? This is how I explain it to people. Okay? In the last 30 years in this country, we have had four ... Count them. Four cultural tectonic shifts in this country. And here they are. Ready? Number one, bicycle helmets and seat belts. Number two, smoking in public places. Number three, drunk driving. Number four, condoms in bathrooms. 30 years ago, if a legislator stood up in a state house or Congress or parliament or the Duma, or anywhere else around the world and proposed any one of those four items for legislation, they'd have gotten laughed right out of town.

Nate Hagens (01:21:14):

And now they're so obvious-

Robert Lustig (01:21:19):

Nanny state, liberty interest, get out of my kitchen, get out of my bathroom, get out of my car. Okay? Today, they're all facts of life. No one's belly-aching about any of those things. We're belly-aching about new stuff like vaccines. Right? But those things are settled. Okay? And if you don't click your seatbelt before you pull out of your driveway, your kids will scream at you. Now, how'd that happen? And why'd it take 30 years? Answer. We taught the children. The children grew up and they voted. And the naysayers are dead. That's why it's a generational tectonic shift.

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Nate Hagens (01:22:05):

Are you finding traction with educating young people with this message?

Robert Lustig (01:22:10):

Absolutely. Yes, we are. And we are teaching kids about food in kindergarten through 12th grade. Rainbow Chef's Academy, which I'm an advisor to. In the Mount Diablo Unified School District we have an entire food curriculum. We teach fourth graders how to cook in class, in the cafeteria. We use the cafeteria as an education center, so that when a kid goes into the grocery store with the mother and goes to the produce aisle and says, "Hey, Mom, there's an artichoke. Can we have that for dinner?" And the mom says, "Well, I don't know how to make an artichoke." And the kid says, "Yeah, but I do." And the kid becomes the positive disruptive force in the household.

(01:22:58):

Teach the children. You can do this. This can be done. We are doing this now. Now, there is a problem. It's called time. We have a clock. We have a drop-dead clock. We have a 1.5 centigrade temperature increase on climate beyond which there's the point of no return, and we have to meet it. And, that's the problem. We have to speed this education up. And we're going to have to educate the naysayers too, because we got to fix this problem fast. And that's hard.

Nate Hagens (01:23:35):

Yeah. Yeah. For sure. And we're going to have to educate politicians as well. So, I have three final questions that I ask all my guests. I hope you don't mind. They're a little bit on the personal side. What do you care most about in the world, Rob?

Robert Lustig (01:23:55):

Fixing the problem. It's what I do.

Nate Hagens (01:23:59):

I can believe that.

Robert Lustig (01:23:59):

Fixing the problem.

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Nate Hagens (01:24:01):

So if you could-

Robert Lustig (01:24:02):

There's nothing else. If you don't fix the problem, what else is there?

Nate Hagens (01:24:07):

Yeah. Yeah. The problem is we have multiple problems, but I am convinced that this one is at-

Robert Lustig (01:24:16):

Well, no. We only have one problem. Okay? The problem is the problem you have identified. The problem is the problem of over consumption.

Nate Hagens (01:24:31):

Yeah. A couple centuries ago, they had people dying from over consumption, which was a word for tuberculosis. But now it actually is ... It literally over consumption as a culture and as individuals. Yep.

Robert Lustig (01:24:46):

Yeah.

Nate Hagens (01:24:48):

So if you could wave a magic wand and there was no personal recourse to your decision, what is one thing that you would do to improve human and planetary futures?

Robert Lustig (01:25:00):

Get rid of the food subsidies.

Nate Hagens (01:25:03):

Okay.

Robert Lustig (01:25:05):

No "ifs," "ands," or "buts." Get rid of the food subsidies. There's no reason for them.

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Nate Hagens (01:25:09):

Excellent.

Robert Lustig (01:25:11):

They distort the market. Let the market work.

Nate Hagens (01:25:15):

And what is next for you? You recently wrote this book. I know you're speaking and talking to people in DC to try to change their mind. You're dedicating your wisdom and connections towards ... What are you doing now? Another deep scholarly book? Or, what?

Robert Lustig (01:25:33):

So, yeah. Right now, I've got a bunch of things on my plate. But I have an idea for a book that I'm going to write with my best friend in science, Dr. Elissa Epel. She is a psycho endocrinologist. She co-wrote the book *The Telomere Effect*, with Liz Blackburn, Nobel Prize winner about telomeres. She wrote the stress prescription, just came out recently. She and I are going to write a book about the amygdala. Ground zero for chronic disease, and why the amygdala is under assault 24/7, 365. And why that is the basic neurobiology of our problem of over consumption.

Nate Hagens (01:26:15):

I thought the amygdala's where we stored our emotional memories and trauma and things like that?

Robert Lustig (01:26:21):

It's the fear center.

Nate Hagens (01:26:23):

Fear center. Yeah.

Robert Lustig (01:26:24):

The place where we store memories is the hippocampus.

Nate Hagens (01:26:27):

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Right. Right. Right. Okay.

Robert Lustig (01:26:28):

The hippocampus actually feeds back on the amygdala. The prefrontal cortex is reason. That also modulates and temporizes the amygdala, but when the amygdala's about to go hog wild, that's when your brain goes from being a brain to being a lizard.

Nate Hagens (01:26:45):

And is food related to that?

Robert Lustig (01:26:48):

You bet it is.

Nate Hagens (01:26:49):

All right. Well, you're going to come back for that one. I really enjoyed this and I learned a lot. And, it's also given me the cognitive ability to trump my emotional needs in the present for sugary-tasting things.

Robert Lustig (01:27:05):

I hope so.

Nate Hagens (01:27:06):

And I plan to make some changes. So, thank you so much, Dr. Lustig. And to be continued.

Robert Lustig (01:27:11):

Been my pleasure, Nate. Anytime. Anytime.

Nate Hagens (01:27:14):

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