Nate Hagens (00:12):

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, and 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.

(00:42):

Today my guest is Dr. Shanna Swan. She is a world-leading environmental and reproductive epidemiologist, focusing on how endocrine-disrupting chemicals and other environmental exposures affect reproductive health and children's neurodevelopment. Shanna just wrote a book in 2021 called Count Down: How Our Modern World Is Threatening Sperm Counts, Altering Male and Female Reproductive Development, and Imperiling the Future of the Human Race.

(01:15):

She teaches at the Icahn School of Medicine at Mount Sinai in New York City. She's published over 200 scientific papers, various other book chapters. A big landmark study was the "Temporal trends in sperm count: A systematic review and meta-regression analysis", which was one of the most widely cited scientific papers in 2017.

(01:38):

Today, we're going to talk about a sperm count decline in humans and other species. What are endocrine disruptors and why are they important? And what can we do about plastics from a government regulation, behavior chain standpoint, and also in our own lives? Thank you.

(02:10):

Hi, Shanna. Good to see you.

Shanna Swan (02:12):

Hi, Nate. Good to see you too.

Nate Hagens (02:13):

Thank you for spending time with us. So on this podcast, we usually talk about the macro human ecosystem, how energy and money and debt and the environment and

climate change, all the big things that we see. And you've just written a book called Count Down, which is talking about the micro things that influence our environment and humans.

(02:39):

So let's just start with that. What is the main thesis of your research and your recent book called Count Down?

Shanna Swan (02:47):

So my main thesis is that the threats to human reproduction have become really severe now. That a large part of what is driving this is chemicals in our environment that have the ability to disrupt our body's natural hormones, and that the result is that we are finding it harder and harder to reproduce. And I think this is getting to be close to critical.

Nate Hagens (03:21):

So the thesis is that endocrine-disrupting chemicals are in utero, changing the baby's physiological structures, and then later in life, males who are exposed to these pesticides have drops in sperm count.

(03:40):

Aren't there millions of sperm per microliter or however they measure it, and don't you only need one sperm to get pregnant? How does that work out to be such a critical threat?

Shanna Swan (03:53):

It's true that one sperm is what it takes to conceive a child. However, the number, we have many more than we apparently need, and that's because there's a lot of requirements on the sperm to get the job done. So they have to be of the right shape, they have to be of the right motion, ability to move, not messed up chromosomally. And it's kind of a crapshoot, if you will, which one will actually make it. But you need a very large number to throw at that dart board in order to make the bullseye.

(04:29):

Right now, as in 2011, when the last time we looked, in Western countries, there was an average of 47 million sperm per milliliter. That is a lot. And people say, "Isn't that

enough? You just need one." And the answer is it's a distribution and that's the mean. And that means that a lot of those sperm are going to be less than 47 million per milliliter, and a lot are going to be more.

(05:02):

Now when you talk about what is the ability to get the job done? When you get above 50, it really doesn't matter how many you have. You can have 50 billion, 60 million, 70, a hundred million. It's all equally good. They're superfluous, the extra ones. But when you go down from 47, then rapidly you interfere with the body's ability to conceive the pregnancy.

(05:31):

So this meta-analysis that we published in 2017 went back to 1973. That's just what we could find in the literature. And in 1973, that number was 99. So on average, there were 99 million sperm per millimeter. That is a little more than double what we're seeing now. So that's right there should be alarming to people. That's two generations. Okay? And where is it going now? We're actually looking at that in a new analysis. I don't have the answers for you. But all of the data that I've seen suggests two things. One is that it's not just Western countries and it's not getting better. Globally, it is not getting better.

Nate Hagens (06:15):

And so the trend is we've been cut in half in 50 years, and the trend continues in that direction.

Shanna Swan (06:23):

Yes.

Nate Hagens (06:23):

But it doesn't have to go to zero to cause an end of conception because there's a difference between the mean and the median, right? If you take an average the same as wealth inequality, if you take an average of our wealth, it shows a disproportionate amount because there's a few billionaires that skew the results. So the median is much more important.

(06:48):

So what your work is suggesting is that the median, meaning the midpoint of half of the population could be under the ability to reproduce in the not too distant future. Is that correct?

Shanna Swan (07:00):

That is correct. And by the way, I should say it's not ever going to make it to zero because think what that would mean. That would mean negative sperm count, which is impossible. So what we can do is get come closer and closer to zero, meaning more and more men are being squeezed down there into 20 million, 15 million and so on, to below the level that the WHO considers infertile. And that's where we've been going. And I don't see anything that's going to change that.

Nate Hagens (07:30):

But it really hasn't changed the number of babies being born, which net births are still over 80 million per year for our species globally.

Shanna Swan (07:39):

Actually, it has changed the number of babies that are being born. So the fertility rate, which is the average number of babies that a woman has in her lifetime, has also dropped by 50% in the same time period. So 1960 worldwide, there were 5.2 babies born per woman. In 2018, there were 2.4. So that's cut in half. Now, are there lots of reasons other than chemicals and other than declining sperm count? Absolutely.

(08:15):

However, for a number of reasons we can talk about, I believe that chemicals and low sperm count and threats to other measures of reproductive function like miscarriage rate and the number of eggs a woman has as she ages and endometriosis and testosterone and erectile dysfunction, on and on and on, all of these measures of reproductive function have declined at about the same rate, and it's 1% per year. That's a rough way to think about it. I call it the 1% effect.

Nate Hagens (08:53):

Well, there's a lot of things that are going on in our world that are kind of death by a thousand cuts that we don't pay attention to. Insect biomass is declining by 1% to 2% a year. We don't think about that, but in a century, most of our insects would be gone at

that current trend. So these are things that it's like the boiling frog, oh they're interesting, but I don't think about it because it doesn't affect my daily life today.

Shanna Swan (09:19):

That's right.

Nate Hagens (09:20):

I will get back to the actual Count Down and sperm decline. But let's take a step back first. What is an endocrine disrupting chemical? Where do they come from and why are these important? And we don't hear about them much in the media.

Shanna Swan (09:40):

So endocrine-disrupting chemicals, think of the three words, endocrine, disrupting and chemicals. So endocrine, that's hormone, that's our hormone system. Disrupting, messing up, interfering with...chemicals. So these are chemicals that have the ability to alter our body's natural hormones.

(09:59):

And I'm particularly interested in these chemicals because I study reproduction primarily. And reproduction depends heavily, as people know, on testosterone, on estrogen, on other hormones. So when you interfere with those basic drivers of reproductive function, and particularly when you do that early in pregnancy, when things are just developing, you can really mess it up. And that's what's been happening.

Nate Hagens (10:25):

The impacts that you're talking about before, on inability to become pregnant due to sperm count, is that because of exposure during the life of the male and the influence of the endocrine disruption on his testes and sperm? Or is it because of something he inherited in utero from his mother who was exposed to things during her pregnancy?

Shanna Swan (10:48):

I would say all of the above are possible. So when you have changes that occur in utero, alterations, say to the germ cells, which will grow up to be the sperm or the egg. When you interfere with those, those changes are lifelong, you cannot fix them. If you

change things when you're an adult, you can fix it. So if a man has a low sperm count and he's a smoker, smoking lowers sperm count, and then he stops smoking and his sperm count comes back, well then you know that was his smoking that was responsible and not his mother's or his father's, by the way. The father also can damage his sperm through endocrine disrupting or other exposures just before he conceives the pregnancy.

(11:37):

So the man can contribute, the woman can contribute to the fetus, and the adult or child, actually, could get an exposure after birth, which is fixable. So that would be one experiment you could do to tease those out.

Nate Hagens (11:52):

But what if it's not fixable? What if it is inherited from the mother or the father chromosomally, then does it continue for a third generation irrespective of how healthy and non-smoker and staying away from chemicals during the lifetime would be?

Shanna Swan (12:10):

Yes. Because when that boy is in utero, he's getting exposure from his mom. So she's exposed, he's exposed, and then he's carrying germ cells for the next generation. So they're also going to be messed up. By the way, once he's born, he will continue to get exposures. So he'll have the inherited, if you will, they're not really inherited in that sense, not through the gene, but that he gets from his mother, and then he'll have his own exposures that he might get through his food or his toys or what he's playing with.

(12:49):

And then as he grows up, his own smoking and so on. So it's this cumulative exposure across generations that causes the decline. Otherwise, you'd reset it each time. Otherwise, you'd get an exposure, but then if you weren't exposed as a child or an adult, then you'd just come back to normal. But that's not what happens. We see a continuing decline.

Nate Hagens (13:10):

So I have some naive questions. First of all, why did it take you as a maverick scientist after all these decades...I know some of our mutual friends like Pete Myers were

writing about these things 20 or 30 years ago, but why isn't the EPA and FDA all over this for the last 50 years?

Shanna Swan (13:33):

Well, first of all, I don't want to say something stupid-sounding like things take time, but things do take time. And if we think about lung cancer and smoking. Smoking was known as a cause of lung cancer in 1964. The surgeon general says that. And you think about how long it took to deal with cigarettes. And they were not done with them, of course. So things do take time.

(13:55):

But in addition to that, there's a lot of resistance to change, pressures from manufacturers and regulators who are used to doing the same thing they've always done that do not want to change their methods to reflect the needs of the current science. And then I think people, specifically in this area of reproduction, it's a pretty sensitive area. People don't talk about their reproductive problems. You know, you might go to the doctor and get your cholesterol tested and your blood pressure tested and talk about that at the next cocktail party, but you won't talk about the low sperm count you found out at the doctor, right?

(14:33):

So reproduction is kind of closeted. It's not a topic for discussion. And on the female side, women are, of course, very embarrassed by the fact that they can't conceive or they can't sustain a pregnancy. So this whole area has been kept under wraps. And in fact, it's one of the few major areas of development that doesn't have an NIH Center. So you have 38 NIH Centers for all kinds of things, and none of them are reproduction.

Nate Hagens (15:04):

I think it's also part of the broader issue that you and our peers are struggling with, is the cultural objective of our society is growth and comfort and convenience and novelty and status. And we are not looking at the externalities. It would be that famous movie in the 1970s, The Graduate where the father of the love interest of Dustin Hoffman said, "I have one word for you, son: plastics." And could you imagine that the one word would've been the impact from plastics? It wouldn't have sold, it wouldn't have been a popular movie.

(15:41):

So we have our eyes set on the distance and we don't look at the quicksand that we're building around us. So here's what I understand from our friend Pete about endocrine disruptors and like the FDA and EPA. Is they do, of course, study the toxic impact from chemicals. But what they study is if we get above 20 parts per billion, then we have to have regulation because that's not safe. But what they don't do is study low doses, like under 10 parts. I'm just making this up because I don't know, under 10 parts per billion. And what happens is at very low doses of some of these chemicals…at high doses, there's another gene that gets switched on and acts as a protector, but at low doses, this other protector gene doesn't get switched on. And so they never tested for low doses of lots of different chemicals on our endocrine system. Do I have that partially right or what can you say about that?

Shanna Swan (16:48):

So I think the issue of low dose testing is really important. And that is one way in which chemicals are not tested at human-relevant scenarios. So human-relevant scenarios are what we're exposed to. And so you'd like to know what they do in the laboratory. And like you said, what they typically do is they test at very high doses. They do that because it's costly to have a very large study. And if you have a low dose, you're going to have to have a very large study, right? Because they won't have so many effects.

(17:27):

So they do these relatively quick, I don't want to say dirty, but quick studies with high doses for relatively few animals, and it tells you the risks from those high doses. And then they say, "Okay, well let's just drop that down a factor of 10, a factor of 100, and make that the no observable effect level and then goodbye. Then we're done. We know that.

(17:51):

But in fact, as you pointed out, there are risks at low doses, which may be different, and it isn't necessarily different genes turned on. It may be different mechanisms that are affected. We all understand this question of different effects at high and low doses. So think about just exercise. So if you're going to exercise very hard, over exercise, if you can think of that. Say a woman who exercises, runs a lot, a marathoner,

she won't menstruate at all, right? She has amenorrhea, exercise amenorrhea. So that's a risk for reproduction, over exercising. If you don't exercise at all and you're a couch potato and maybe overweight and so on, you will also have decreased reproductive function, decreased fertility.

(18:39):

And in the middle there's a sweet spot, which is you do some exercise, but you don't overdo it. That's an example of a U-shaped curve. It's not monotonic. It doesn't just go in one direction. It's not like more exercise is better or more exercise is worse. And that's a really, I think, simple example, how different things can go wrong for different reasons at two ends of the spectrum.

(19:01):

There's other ways that they're tested that are not relevant to us, because those chemicals typically are tested one at a time. And we know from the CDC and from our studies that people are exposed to hundreds of these chemicals at a time. And animal testing has shown that you can have very low dose exposures to say, seven phthalates, which are my favorite chemicals of study. We can talk about those. Chemicals that make plastic soft and flexible. So you have seven of these, you expose the rat to it. Individually, they don't do anything at that dose.

(19:37):

So individually, no effect on rat male rodent development, male development. And then you give all seven at once also at low doses, and together they cause the general defect called hypospadias. Okay? So in order to understand what these chemicals are doing to us, we really should look at them all together. That's extremely difficult and the methods are being developed to do that, but it's definitely not what's done by the National Toxicology Program or EPA or anything like that.

Nate Hagens (20:08):

Well, the funding necessary to do all the necessary tests would just grind our economic system to a halt. So we have to do the broad brush things like you're doing just to notice, oh my gosh, sperm count is declining linearly, exponentially, and this is a real problem.

(20:25):

So what sort of things do we find endocrine-disrupting chemicals and phthalates, where do they come from? You said things that make plastics flexible. What else? I mean, do we know the reason that sperm count is declining? Is it from phthalates or just a wide range of chemicals or-

Shanna Swan (20:43):

There's a wide range. So we know that phthalates in utero can affect the size of the genitals, which we can talk about if you want. And that size, a certain measure of the genital size is related to reduced sperm count. And we see that in men. Adult men, you measure the genitals using this measure called the anogenital distance. You use that measure. And they have low sperm count if that's short. And they have high sperm count if it's long. It's pretty linear.

Nate Hagens (21:14):

But that had nothing to do with any of their habits during their life. That was only a product of their biology from when they were born?

Shanna Swan (21:20):

Probably. Yes. That distance seems to be something you're born with. It develops in utero, you're born with it, and it doesn't change for your body size. Of course, when your body grows, everything in your body grows. But proportional to your body size, it's with you for life. So if that's short and it's been messed up in utero, then you'll have problems with your sperm count. You'll also have less fertility. And we just recently was published that you'll have higher regs of testicular cancer.

Nate Hagens (21:50):

If you knew nothing about a group of a hundred men and just measured their anogenital distance, you could make a strong hypothesis of the correlation between that and their sperm counts?

Shanna Swan (22:05):

Yes, that's what we did. That's exactly the study we did.

Nate Hagens (22:10):

Wow. So what are the products that are the big culprits here in our lives?

Shanna Swan (22:17):

Well, I studied phthalates and that's what I know very well. And particularly the class of phthalates that have the ability to lower testosterone. Another place you could get them is in your personal care products. So stuff you put on your face after you shave or deodorant. Anything with smell contains phthalates, any face cream, women's makeup. But basically, everyone is exposed to phthalates.

Nate Hagens (22:44):

So here's a really difficult and scary line of inquiry for my work to you. I've read that in the Mariana's Trench at five miles under the ocean, there are little shrimps there that have 10 times the toxic chemical measurements as in a Chinese river that's polluted. I've read that the ice on the Arctic, you can measure phthalates on the ice surface. I've seen papers showing that ant colonies in the middle of the Amazon that have no exposure to local factories or whatever, that the ants have measured phthalate exposure, presumably because phthalates of some type have become airborne.

Shanna Swan (23:34):

Right.

Nate Hagens (23:34):

And so my question is, I fear to voice this question, but you've studied all this on humans, but what is the impact of our industrial chemical supply chain on the endocrine and reproductive capacity of our nieces and nephews and cousins in nature, the 10 million species we share this planet with?

Shanna Swan (23:58):

Very bad consequences. Last week or few weeks ago, we just heard about 22 new species that were extinct. And I just recently looked at the U.S. Fish and Wildlife Service criteria for endangerment, and huge numbers of species are endangered, including, by the way, homo sapiens.

Nate Hagens (24:23):

The main reasons of course we're losing species at significant factor more than the background rate. But presumably, that's because of land degradation, encroachment, poaching, hunting, ecosystem destruction, things like that.

Shanna Swan (24:40):

Here's some examples. Do you know Louis Guillette's work? Louis Guillette studied alligators in Florida, Lake Apopka, and he noticed the smaller numbers of fewer eggs that were being laid. And he went out and caught those alligators and brought them back to the laboratory. He was big, strong guy. And unfortunately, not living anymore. But he showed that the penis, the size of the penis of those alligators had shrunk relative to another lake which did not have runoff from pesticides.

(25:18):

So he showed the decline of that species in terms of their ability to conceive and the number of eggs they were laying. Okay? That's one example. Tyrone Hayes, atrazine, similar story. There are many, many, many stories where wildlife biologists have gone out and shown in the wild and in the laboratory, by bringing them back, that these chemicals do decrease species preservation. They do decrease the fertility and the reproductive capacity of these species.

(25:49):

So habitat encroachment, yes, but also the action of endocrine-disrupting chemicals.

Nate Hagens (25:55):

What about dogs and cats and cows and things that are part of our domestic supply chain? I'm going to guess the answer to that is presumably it impacts them too, but who has money to test all that?

Shanna Swan (26:09):

That's right. There's not a lot of work on domestic animals. There are some studies on dogs showing decreased sperm count, but here's this difficult part here. Those species tend to be bred selectively. So they select good breeders, they select horses and cows and dogs and so on who are very successful breeders. So you're going to keep maintaining the sperm count and other things to be high. We need to go in the wild where this thing is not controlled by breeders to really look for these trends.

Nate Hagens (26:44):

So what's the ultimate answer here? Removing the most egregious endocrine-disrupting chemicals from our economic supply chains? Changing our individual consumer preferences? Taxation? Regulation? What is that answer? What do you-

Shanna Swan (27:00):

All the above. All of the above. I think what we have to do, first of all, is to be aware of the problem, which my talking to you, and my talking to other people, and my writing a book hopefully helps somewhat with. But basically you mentioned Joe Rogan at the beginning. When I told Joe Rogan about this, he was shocked, I think genuinely. And he said, "How come we don't know about this?"

(27:22):

And this to me is a major part of the problem. We don't know about it. And because it's not talked about. So that's what problem number one. Problem number two, you alluded to the how we all want the newest shiniest things. And plastic is very nice for making new and shiny things. And plastic is made from petroleum byproducts. So it's very convenient that plastic production would increase with the oil and gas production.

Nate Hagens (27:54):

Even if we developed the technology that was low carbon and affordable to replace all internal combustion cars with electric cars, even if that were true, let's just assume that would happen, that doesn't reduce our demand for oil at all because a barrel of oil, only 40% is gasoline and the rest is diesel, heating oil, all these chemical inputs to thousands of different products that still have a demand, that we would still need to produce unless those markets also went away.

(28:34):

It's easy for me to imagine us getting rid of some products, but plastic is so ubiquitous in distributing food to our population. I mean, I'm skeptical that we could rid ourselves of plastics. Are there any that are just over the top that we need to stop using because of your research? Or is it too wide of a list?

Shanna Swan (29:01):

I think we can think about ways to make plastic out of other sources.

Nate Hagens (29:08):

Bamboo or something like that.

Shanna Swan (29:09):

Right. So bio-based plastic is a possibility. I'm not a chemist. I think you should have a good environmental chemist to talk to about this on your program. I think that'd be great. If the demand is there, I believe we can do it. The demand is not there because people are not upset. So it is a kind of vicious circle. People don't know about this. They don't get upset, they don't demand anything different. And so we go on as business as usual.

Nate Hagens (29:33):

Well, on that note, you're speaking to the choir because my class is called Reality 101. There's tons of things that are happening that our society is not aware of, and we are ecology blind, really, for what's going on.

(29:48):

So let me ask you this. Let's assume that someone doesn't have faith in our government's ability to understand and regulate this, but they're very concerned about it either because they definitely want to conceive in the future or because they just want to live a healthy life. What are a couple, three top level things that an individual can avoid or do to minimize their exposure to the most egregious endocrine-disruption chemicals?

Shanna Swan (30:18):

I would say it's not difficult to go through your kitchen and take out plastic containers, anything of plastic. So glass is good, ceramic is good, metal is good. You're safe right there. If you can afford it, you can go to a farmer's market and you buy unprocessed food. The processing of food introduces huge amounts of chemicals into the foods. They did a very simple study in Eastern Europe where they looked at the phthalates that were contained in cow's milk that was milked using a milking machine and hand milked, and there were no phthalates in the hand milked milk and lots of phthalates in the milking machine milk. And that's just one example.

(31:02):

Anytime you have a soup or a sauce or any food that's been processed, it's gone through plastic, it's come in contact likely with the bisphenols. And so if you could be very primitive and go to the farmer's market and just buy your products and put them in a cloth bag or whatever, you will not contact these chemicals.

Nate Hagens (31:24):

So, I mean, that would be a good recommendation for lots of reasons. So can someone test how full of phthalates or endocrine-disrupting chemicals there are? Is there some way to get tested?

Shanna Swan (31:41):

Well, that's an interesting question .we were just talking about this this morning, actually. There are lots of labs that we use for scientific purposes, of course, and the CDC is the biggest one and the best known, Centers for Disease Control. But as far as individuals wanting to get tested, there is a new company formed recently called Million Marker out of UCSF, or connected with UCSF, San Francisco, which does testing.

(32:08):

And I think there will be more of these. I think as the demand grows, more and more laboratories will step up. Just as we saw with 23andMe, there's more and more companies offering DNA testing. I think there will be more companies offering testing of environmental chemicals. Testing urine is easy because the non-persistent chemicals like phthalates and bisphenols are excreted in our urine really quickly. So that's relatively easy. You pee into a cup, you send it off to the lab, no problem. But the persistent chemicals are in our blood, and for that you need a blood draw. And that introduces a whole other level of complexity.

Nate Hagens (32:46):

So if I am just a horrible consumer and I eat a lot of processed foods and everything I put in the microwave is plastic and things leach out into my food and I'm doing everything poorly as far as your concerns, can I get religion and buy food at farmer's markets and only use glass and those other things and will it decline then over time?

Shanna Swan (33:10):

Very quickly, four to six hours is the half-life of most of these chemicals that I've been talking about.

Nate Hagens (33:16):

Well, that's somewhat hopeful.

Shanna Swan (33:18):

Yes, it is actually hopeful. And Pat Hunt showed in an animal experiment that in three generations you can actually clean up your reproductive health, you can restore it. If you are not exposed and your child isn't exposed and your grandchild isn't exposed, that grandchild will recover full reproductive function. So we can do this, but it takes time.

Nate Hagens (33:40):

Well it takes time and like you say, it takes awareness and fear and civic engagement on this. So just to be clear, I know that you can't test what's going to happen in the future, but you're a world expert on this. So what would be the best case and most likely case with respect to human sperm count in the next 30 years? Your educated guess based on your research and looking at the trends. Assuming that world governments don't make any dramatic changes with the phthalate and plastics supply chains in the way that we live our lives.

Shanna Swan (34:22):

So I predict that we will continue to decline. Sperm count will continue to decline, but not greatly because we're pretty close now to zero. We can't reach it--

Nate Hagens (34:38):

We're already close to zero as a median?

Shanna Swan (34:41):

We're 47. If you think about from 99 down to 47, half the population is now subfertile. Below 40, you're considered subfertile because it takes longer to conceive a pregnancy.

So a large proportion of... You asked me for the future. So I don't see this turning around-

Nate Hagens (34:59):

Yeah, like 20, 30 years from now.

Shanna Swan (35:00):

Yeah. So I don't see this turning around very quickly. So I would say we're going to approach closer. And then I think if we take action, we can pull those numbers up again. And Denmark is a really good example because in Denmark, they took a lot of action to... There's huge amount of information about this and action about this in Denmark. And it looks like in a very long term study that's been going on there, that that decline stopped and may actually be slightly improving.

Nate Hagens (35:30):

Denmark also has the Do it for Denmark campaign that's funded by the government where they advertise and support people going on sexy vacations in order to have more sex so that they have more babies because they have a... That's the other problem here, Shanna, is our economic system requires babies.

(35:53):

Yes, we have a global overpopulation relative to sustainable levels. We have a population of humans and we have a population of things like refrigerators and planes and cars, but we need babies in order to pay for diapers, then toys, then plumbers and teachers, and ultimately pensions. And so that's why these countries like Japan and Italy and Denmark that have very low fertility rates are trying to actually get people to have more children because of the economic risk, which is unrelated to what you're studying, but not totally unrelated.

Shanna Swan (36:34):

Right. And by the way, Denmark is not that low, but I mean 2.1 is a replacement.

Nate Hagens (36:41):

Right. Can you briefly explain why that is, 2.1 as a replacement?

Shanna Swan (36:45):

Because a couple, it's for the couple, and each person replaces themself and a little bit extra for early death. So it's 2.1. And most of the developed countries now are below two. But places like Japan and Singapore and South Korea are very close to one. They're extremely low. And so these countries have, as you said, given incentives, given people money for childcare and paying them to have children and building houses for couples with children.

(37:23):

And here's the thing, it's not working. It's not working because what Denmark does in addition, they in addition, worry about the exposures. So the countries in Asia that are merely paying people to have more children are not succeeding. I believe that countries that will control their pollution, their toxicity will succeed eventually.

Nate Hagens (37:50):

So are you kind of forecasting like that movie Children of Men, I think that was the name of the movie where you couldn't even have... there were no human babies born because of... Did you see that movie?

Shanna Swan (38:05):

No. I believe I'm... Yes, I know the book and no, I'm not predicting that because I have great faith in assisted reproduction, and I think that's going to get better and better. More and more people are using assisted reproduction. And Israel, the only country in the world that really fully supports it. You can keep trying until you've had two successful pregnancies paid for by the government through assisted reproduction in Israel. And if you look at their numbers, it's huge. So I think more countries will start paying people to use assisted reproduction. I think that is already happening.

Nate Hagens (38:41):

What does that mean? Not the same biological mother and father as the couple?

Shanna Swan (38:44):

There's a lot of ways to do that. It depends on what the problems are. There can be a surrogate mother, but that's not the most usual. You can have IVF, you can have ICSI

where they insert a sperm into the egg directly and so on and so forth. There's many, many ways to do this. But the point is-

Nate Hagens (39:05):

Oh, so even if I was measured that I had a low sperm count, they could take some of my radically reduced sperm count and directly put it into an egg.

Shanna Swan (39:16):

Exactly.

Nate Hagens (39:17):

So it's just the conventional way of procreating is got problems on the horizon.

Shanna Swan (39:22):

Exactly.

Nate Hagens (39:22):

And then in a real sci-fi sort of future, and this is just me just speculating after listening to your expert thoughts and connecting the dots, is maybe 20, 30, 40 years from now, only one man in 20 will have the super amount of sperm that's able to impregnate people, and those people will be in high demand?

Shanna Swan (39:45):

I mean, I'm sure you've read in the paper of these people who learn they have 20 and 30 siblings because their father was a donor who was used by the program over and over again. So that's already happened in a way.

Nate Hagens (40:02):

It happened a long time ago in a different way. Isn't it true that Genghis Khan now like 12 to 15% of men on the East Coast have his particular Y-chromosome from back in the day? Now it's happening in a different way.

Shanna Swan (40:19):

I don't know. I don't know.

Nate Hagens (40:19):

Yeah. No, that's true. So what are you working on? What are the on the ground hopeful things that you are planning on working on to make a dent in this?

Shanna Swan (40:31):

I'm trying to work on how we talk about the science, and I'm trying to get people involved in the science that matter to them. So an example might be if you have a preemie baby that's sitting in the NICU, you might care that that baby is being infused with phthalates through the tubes that's delivering the food to that baby. And the nurses will care as well.

(41:00):

So what I'm trying to do in that kind of a situation, that's just one example, get people to understand the problem, to care about it, to be involved by talking to them and asking them, "Would you participate in a study in which we swapped out the tubing and gave your baby food through a phthalates-free tube and shown their levels go down? Would you be interested in that?" "Yes, of course." "Would you participate in that?" "Yes."

(41:28):

"Will you help us?" And that kind of a study where the participants care about the answers will be the kind of study that will make people care more broadly about the answers. Because they'll go on YouTube and they'll go on social media and they'll say, "I went through this experiment. I can tell you that we have to get this stuff out of our children." Somebody saying that who's experienced that will help get this heard. And that's what my goal is right now. Get this message out there to people. Get people involved, get them caring about it, get them going to their legislatures, and so on and so forth.

Nate Hagens (42:09):

Do you have any closing comments of warning or hope for our fellow citizens who are trying to learn about all this?

Shanna Swan (42:17):

I would just say, please read about it. Please talk about it. Please share it with your friends and colleagues, because I'd like to get a lot of buzz going on this of the way we now have for climate change, which is great. I think this is the next buzz we need to get going because I think this is a problem, which is perhaps even as serious as that and deeply connected to it.

Nate Hagens (42:39):

Thank you so much for all your work on this, Dr. Swan. I'll talk to you soon. Thank you.

Shanna Swan (42:44):

Okay, thanks Nate. Thanks for having me.

Nate Hagens (42:47):

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