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You probably don't think about it, but every day nature is trying to kill you. We as humans place constant pressure on our natural world. And in response, nature fights back to balance the scales. Nature has been adapting and reacting to the presence of human developments, just like we've been adapting and reacting to nature. And nature is telling us we are on an unsustainable path. It is time to course correct. This does not mean abandoning technology, but it means harnessing the power of biology itself to reconcile the creature comforts of human civilization with the natural world.

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Some of you may be thinking, "but I recycle" or "I don't eat meat" or "I take the bus" or "I grow my own food." And in fact, you may be doing your part to live sustainably. And if you do, good for you. In my view, though, it's impossible to exclusively rely on an individual effort to make the changes we need. We have to make the changes at the global scale to truly make a difference, and that requires rethinking what modern global sustainability looks like and a new kind of environmentalism.

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To be clear, when I talk about sustainability, it's not just about the environment. While it's an important piece, sustainability is about much more. Modern sustainability is the integration of the environment, people and the economy. Each of them is needed to thrive. You cannot have one without the other. Therefore, the practice of sustainability recognizes that everything is connected and requires a different approach.

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So do we both individually and collectively change what we're doing today? I believe that technology and innovation, specifically biological innovation, is the key to answering that question. Biological innovation will enable harmonious coexistence with nature for humans today and in future generations, while still enjoying all of the creature comforts we've come to expect. If we do it at the global scale, we will get back in balance with nature, which will be great for humanity and will also improve the health of the planet. So how do we do that?

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The answer is synthetic biology. Now, some of you may be thinking, "Synthetic biology? That sounds like an oxymoron at best and dangerous at worst." How can something biological, which

is based on nature, also be synthetic, which implies not natural at all? Well, synthetic biology is the engineering of nature to benefit society.

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The core component of synthetic biology is my favorite molecule, DNA. DNA is the code of life on Earth. It contains all the instructions for animals, plants, humans, microbes, bacteria, fungi and so much more. By embracing the power of DNA, we will be able to achieve both comfort and sustainability.

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Over the last millennia, our ancestors have pursued this in basic ways, for instance, by improving milk production from cows and making a wild grass called teosinte into edible corn. But it took thousands of years. Over the last 70 years, what our ancestors did in the field, without even knowing they were doing genetic engineering, we started doing in laboratories. And as a consequence, we now have the scientific knowledge and technological know-how to harness the power of DNA for the better. A true biological revolution.

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So how can DNA and synthetic biology help? Well, we can affect change in three critical areas: health, food and materials. In health, an early health and economic success is recombinant injectable insulin to alleviate diabetes, a disease that affects 463 million people worldwide. Today, we can make insulin from either yeast or bacteria, instead of extracting it from the pancreas of pigs and cows. This allows for the massive production of insulin at a fraction of the cost and without killing pigs and cows. This means that there are no longer any factory farms needed to put insulin on your pharmacy shelf.

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Today, using the power of genetics, we can reduce or even eliminate mosquito-borne diseases, such as malaria, Zika, and even treat dengue with gene drives. We are doing this by harnessing mosquitoes' own genetics to wipe them out.

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It's becoming a reality to correct defective genes in patients with inherited diseases, such as severe combined immunodeficiency, you may know it as the bubble boy syndrome, and sickle cell anemia. We can diagnose disease faster and more cost-effectively by writing and reading

DNA. And already we can add pieces of DNA in the cell of the immune system to identify and kill cancer cells in patients. Thanks to advances like this, in the future, even terminal cancer will become chronic diseases.

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One major change that is enabling these incredible advances is the ability to read and more importantly to write DNA at scale. Over the last 20 years, the price of writing one base pair of DNA has dropped from 10 dollars to nine cents, more than a hundredfold decrease, drastically reducing cost and unleashing the imagination of scientists worldwide. This ability to write DNA at scale also impacts food and material.

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So speaking of food, DNA-based synthetic biology techniques today can engineer bacteria to deliver nitrogen at the root of plants, eliminating the need for fertilizers, which you may or may not know are produced from either coal or natural gas that is extracted from the ground. That is a triple win: more food, lower food cost and no need to extract fossil fuel from the ground to grow food. While this may seem futuristic, companies are working on it now, with field-testing already underway. We can control crop-destroying pests using environmentally-friendly methods, essentially using the bugs' own scent to prevent them from mating and laying eggs, while also protecting birds, bees and other animals. These methods are expensive today, but costs will come down. We can protect bananas and papayas today, two crops that are threatened by deadly pathogens. By engineering them to be resistant to this pathogen, we can ensure that commercial scale production continues. It is true for bananas and papaya, but it's also true for many other plants that are coming under similar attack from nature.

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Third. Let's talk about material. Everything we touch today comes from oil or natural gas extracted from the ground, and that is just unsustainable. And we can do better using fermentation. We all know about fermentation. You feed sugar to yeast and it gets bigger. Or, in France, where I come from, we call it champagne. Today, by using the same cells, like yeast, algae and bacteria, you can engineer them to ferment sugar or other biomass to produce chemicals. These tiny cells are the equivalent of exceptionally efficient manufacturing facilities. And it's amazing. You can make the same chemicals that are made from oil and you couldn't tell the difference. That includes directly producing plastic, flavor, fragrances, sweetener and so much more.

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For instance, the production process to make blue dye used in the fabrication of blue jeans, is a massive polluter of the environment. Through fermentation, you can make the same dye much cheaper and without the environmental impact. That is guilt-free jeans.

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Another method we use to produce chemicals to enable our comfortable life is to extract them from nature. And that is also unsustainable. For instance, squalene is a key ingredient of moisturizer. And I get it. We all want bright, beautiful hydrated skin. But did you know that shark livers is a major source of squalene? Sharks are apex predators and a critical component of our ocean ecology. So using sharks to make face cream just doesn't make sense. Instead, we can now make squalene by fermentation of cane sugar, and it's even available on Amazon.

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I'm not just talking about replacing current materials with more sustainable ones. We are talking about making better chemicals that you could never make from oil and that will change your life in the future.

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For instance, spider silk is an amazing material. It's way stronger than steel and super light. The problem is that you cannot make spider silk from oil and you cannot farm spiders. You put a million spiders in a room. You come back a week later, you get one spider, they eat each other. By using synthetic biology, we will be able to produce spider silk at commercial scale and avoid spider-on-spider violence. In the future planes and maybe even flying cars will be made by synthetic spider silk instead of carbon composite material. They'll be stronger, lighter and use less fuel.

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So this all sounds fantastic, but it gets better. It also makes economic sense. Yes, synthetic biology will give us health, sustainable food and sustainable material, but it's also a lot cheaper. And let's be honest, a lot of people do not care about the environment, but everybody loves a deal. So we humans get health, food and materials at a lower cost and nature gets sustainability for free.

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And an additional bonus is all the millions of jobs that will be created through this modern vision of sustainability. These are not menial jobs. These new jobs will be dignified and meaningful, and they'll be spread globally to ensure that humans live more virtuously in nature.

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So synthetic biology is the key to making civilization sustainable and will also prevent nature from killing you too. In conclusion, we don't have to choose between either human benefits or nature. We can move towards balance and have both in harmony. It's not that we could do it, it is that we should do it. We have a moral imperative to do so.

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Thank you.