AspenIdeasToGo_IsaacsonDoudna

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SPEAKERS

Tricia Johnson, support message, Walter Isaacson

S support message 00:00

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T Tricia Johnson 00:35

It's Aspen Ideas to go from the Aspen Institute. I'm Tricia Johnson. The molecule RNA is in the spotlight because of its role in the battle against COVID-19. Pfizer and Moderna are using RNA in their vaccines to help people form antibodies to fight the virus. The molecule wasn't as famous when biochemist Jennifer Doudna began researching it. But she cracked the RNA code, says Doudna biographer Walter Isaacson,

W Walter Isaacson 01:02

Jennifer Doudna is able to figure out the structure of RNA. Because if you're doing a detective story, and you're trying to figure out how something works inside of a living thing, the shape of a molecule often determines what it can do.

T Tricia Johnson 01:19

Today Isaacson talks about his latest book "The Codebreaker: Jennifer Doudna, Gene Editing and the Future of the Human Race." Aspen Ideas To Go brings you compelling conversations hosted by the Aspen Institute. Today's discussion is from the Society of Fellows at the Institute. Doudna's research on RNA laid the foundation for CRISPR, a tool that has the power to transform the human race. She helped pioneer the gene editing technology and won the 2020 Nobel Prize for it. And while CRISPR has the power to cure diseases like sickle cell anemia, multiple sclerosis and cystic fibrosis, it also raises important ethical questions. reproductive cells can be edited with CRISPR to create designer babies, should we as a human race decide what genetic traits we want in our kids. Walter Isaacson, who has written books about other innovators like Albert Einstein and Steve Jobs, talks about Doudna and how she's helping usher in the next great innovation revolution. He decided to write a book about Doudna after interviewing her at the Aspen Ideas Festival. He says he asked her about the genetic editing tool that she helped create.

W Walter Isaacson 02:26

And that's when I realized that this was going to be the next great innovation revolution of modern time. And that I certainly wanted to write a book about it. There have been three great innovation revolutions. And I've tried to write about them over my career, especially show them at the Aspen Institute. The first and whenever I first came to the Aspen Institute, we did an Einstein celebration, celebrating the anniversary of his miracle year. And it was because I was writing about Einstein, as the person who had launched the physics Revolution, the physics revolution, begin with those 1905 papers on relativity theory and quantum theory done by Einstein. And that brings us into a revolution that encompasses the first half of the 20th century of revolution, that brings us everything from atomic weaponry and nuclear power, to space travel to GPS, to all the things that physics brought us in the first half of the 20th century. I then realize that the second half of the 20th century was a century that was shaped by a new revolution. And that's the digital revolution. It comes from the realization that all information can be encoded in binary digits, or bits. And that you can use circuits to help process Yes, no questions that will do logical sequences based on those binary digits or bits. And with that, you get the three great inventions of the digital revolution, the computer, the microchip, and the internet. And when those combine, it really does form an information technology revolution, that pretty much dominated the period of 1950s to 2000, the second half of the 20th century. And I addressed that in the biography I did of Steve Jobs, and also a book called the innovators that begins with Ada Lovelace coming up with the concept of the computer algorithm, and goes all the way to social networks, sometimes referred to it in the shorthand is the digital revolution, from Ada to Zuckerberg. And of course, we spent a lot

of time at the Aspen Institute, discussing this digital revolution. There are actually three fundamental kernels of our existence that got discovered at the beginning of the 20th century. The first was the atom. That's what I talked about with Einstein. The second was the bit, that's what we just talked about in the digital revolution. But the third was the gene, the notion that there was a fundamental kernel in our bodies that passed along genetic information from one generation to the next. And it occurred to be around the year 2000, was going to be the beginning of the third great innovation revolution of our time. And just like the physics revolution, helped shape the first half of the 20th century, and the digital revolution, the second half of the 20th century, the first half of the 21st century, will be and is being shaped by a life sciences revolution, a genetic revolution, a revolution of biotech, rather than infotech of physical tech. And our children learn to code by coding digital technology, and we all try to get a sense of the microchips and how they work. Now, they're going to have to be joined by people who understand genetic code, and we'll connect it to the digital revolution, because molecules are the new microchip, as part of this revolution. This revolution began with the sequencing of the human genome, which happened right around the year 2000, which is when I say this revolution began, it was a sequencing of the DNA of the human and other species, to find out exactly what the code of life was, that actually began in the 1950s. When James Watson, Francis Crick, Rosalind Franklin, and others, helped create understand DNA as being the molecule that helped create the transmission of that genetic information we call the gene. But DNA was a pretty important breakthrough, but it didn't get us very much in 2000. When we finally sequenced the human genome, we could read the human genome, but we couldn't do too much with it. If we take another step, to be able to rewrite or write or to use or to make use of some of this genetic material. And that brought me to the person we're talking about Jennifer Doudna. Now, it's not simply a biography of written of Jennifer Doudna. The book that codebreaker is about Jennifer Doudna as a central character, but it's about gene editing. It's about Coronavirus, and it's about the future of the human race. She's the central character. And the story begins. When we talk about DNA. It begins with her when she's in sixth grade. And she comes home one day and find that her father had left on her bed. And there's a story she told us an aspect of father had left on her bag, a paperback copy of a book, most of you all know, the double helix by James Watson. And Jennifer thought at first, there was a detective story. She loved paperback detective stories. She thought her dad had gotten another detective story. And she put it aside to read when like on a rainy day, but a couple of Saturdays later, he was raining. And she picked it up. And she found she was right. In a way. It sort of was a detective story. But it wasn't the usual detective story. It was about two guys, James Watson and Francis Crick, who were in a race to find out how things work, how molecules work, how life works, how our genetic trends are handed down from one generation to the other, and how the cells of our body know how to produce everything we need all of our everything from our hair to our neurons, and how the genetic code nobody helped shape who we are. When Jennifer read

the book, she noticed in it, that there was a character named Rosalind Franklin, who didn't get a whole lot of credit, was sort of treated in a dismissive way by James Watson who calls her Rosie, but she's the scientist who does the images that allow Watson and Crick to figure out this structure of DNA. And she decides Jennifer decides that that's really cool. And she told me, she didn't really know that women could be scientists. I mean, she maybe she said heard of Marie Curie or vaguely into that. She was, but she didn't really she always thought of scientists in our textbooks, as older men in white lab coats. And it never occurred to her that she would want to grow up and be a scientist. Now, I love the fact that that book inspires you to want to do this. And I hope my book in a way will be put on people's beds to inspire them to become scientists. But she went to her school counselor, and said, I want to be a scientist. And she was growing up in Hilo, Hawaii, a small village, on the Big Island of Hawaii. She was a bit she felt like a misfit because he was a tall, lanky blonde girl whose parents were from the mainland, but all the rest of the class were of Polynesian descent. And so she felt a little bit of an outsider. And she decided that she wanted to understand how things work, how we fit into this universe. Always she was curious about things like, why does the sleeping grants curl when you touch it? or Why do those seashells curl the way that they do? So she tells her guidance counselor, she wants to be a scientist, and the guidance counselor says, girls don't become scientists. Fortunately, Jennifer Doudna is a persistent and stubborn person. And that made her want all the more to become a scientist. So she decided she's going to study chemistry and biology. Yeah, I grew up here in New Orleans. And the same thing, in some ways happened to me, my dad left on my bed once or left, or at least bought from me a copy of the double helix. And so when I was in middle school, I read it. I just went back to our library here in New Orleans. And I found it and it would be worth something was actually a first edition, except for all my little notations or in the margin defining words that I didn't understand right away like biochemistry. But unlike Jennifer, I became interested in science, but I didn't become a scientist. I kind of think maybe that was a path I should have taken. But anyway, Jennifer decides she's going to become a scientist, a biologist, a chemist, she goes to Pomona College, and does well enough there and chemistry that her father says why don't you go to graduate school, something she never really thought of? And she said, okay, and she's going to apply to the University of Hawaii and maybe University of California. And they said, Why don't you apply to Harvard? Today, I really believed in him strongly when she said, I'll never get in. And he said, You definitely won't get in if you don't apply. She applied. And you got in and became a graduate student at Harvard, and then at Yale. And all of the men at that time in the early 1990s are pursuing this discovery of Watson and Crick DNA. And they're doing the human genome project that I just mentioned, they're trying to sequence all 3 billion pairs of letters in the human genome. And it was a very male activity. We know some of the players are still famous today, Francis Collins helped lead it, James Watson helped lead it. Eric Lander, who's the new chief science adviser to President and Biden helped lead. But

women were not very involved. It was kind of an alpha male crew, including Craig Venter, and others. And so Jennifer Doudna, along with some other women, as well as her advisor at Harvard jack show stack, decided to focus on RNA. Now, DNA is the famous man we kill DNA gets his picture on the cover of magazines, DNA becomes a metaphor like it's in our society's DNA. It's in the company's DNA or meant to rewrite the DNA. But DNA is a molecule that actually stays in the nucleus of ourselves. And it encodes all the genes of 50 1000s of genes that make up our genetic makeup. But unlike a lot of famous siblings, DNA, doesn't do much work. It doesn't it just curates this information and stays in the nucleus of the cell. The molecule that does most of the work is a lesser, famous molecule, RNA, a very similar nucleic acid that's in ourselves. And what RNA does is it takes the coding, it takes the information that's been encoded in our DNA, and it takes a copy of a particular gene or something that it is important and goes to the manufacture. During region of our cell and oversees the building of a protein. In other words, it does the real work. It takes the information and it turns it into proteins. Now, we're pretty familiar with that trait of RNA because RNA has now become the molecule of the year. I got the Pfizer vaccine a few weeks ago, I was in the Pfizer clinical trials. And the Pfizer and the moderna vaccine make use for the first time in a vaccine of this talent of RNA, which is to be encoded with the instructions for how to build a particular protein. In the case of the Coronavirus vaccine. It's encoded with the instructions to build part of the spike protein of a Coronavirus so that our body gets to know what those spike proteins look like. And they form antibody. So we become immune, if the real Coronavirus attacks us. So now RNAs become famous for when Jennifer Doudna was doing it. It was not very famous. And she does what Rosalind Franklin did for DNA, which is Jennifer Doudna is able to figure out using imaging techniques and all sorts of experiments, the structure of RNA, in other words, not just the chemical components of RNA, but how it twists and how it folds is an molecule. Because if you're doing a detective story, and you're trying to figure out how something works inside of a living thing, the shape of a molecule often determines what it can do, how it interacts, how it connects with other things. And so she determined the shape of certain types of RNA, and discovered along with her thesis advisor when she's a graduate student, how certain types of RNA can replicate themselves. In other words, make copies of themselves. It hadn't been thought that RNA could do that in the central what's called the central dogma of biology is that you know, DNA gets transcribed into RNA, which makes proteins. And it helps the whole system replicate and create new cells. But the notion that RNA could all on its own replicate itself was kind of new. And it led to the answer, or what is the probable answer of one of the biggest questions of life on Earth, which is how did life begin. And Jennifer Doudna, and her advisor jack show stack, came up with a notion that if RNA this molecule, pretty simple molecule could make copies of itself, then maybe in the primordial stew of three and a half billion years ago on this planet, there were these chemicals sloshing around. And they came when they came together into this molecule of RNA, it began to replicate itself, even before DNA existed even before proteins existed, it

would replicate itself, and that RNA was the beginning of all life on this planet. Well, that's really cool. And Jennifer becomes pretty well known for having cracked the code of what RNA can do.

S support message 18:38

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W Walter Isaacson 19:39

Doudna goes to a variety of places and ends up at Berkeley with her husband who is another biochemist. They end up in Berkeley, California because she wants to work at a public institution and she's studying RNA out at Berkeley. When she gets a phone call from another woman who cared about RNA and is working on in Berkeley, a researcher professor there named Gillian Banfield, Jill Banfield was looking at weird organisms, weird bacteria and other organisms like that, that were found in extreme environments like the really hot springs of Yellowstone, or the run off of a copper mine near Sacramento, or in some very high salty springs. And she was noticing, as others had, that these bacteria have repeated sequences in their DNA. And nobody could quite figure out why would they have these repeated sequences in their DNA. And they were clustered together in regular interspaced sequences. And they got known as clustered regularly interspaced sequences, or soon they were called crispers. And crispers, had been discovered just a few years earlier, I think around, you know, 2000, round the year 2000 or so by a Spanish graduate student, a wonderful guy named Francesco mohaka, who, in alteon, de Spain, saw for the first time as he was sequencing the DNA of these bacteria and other organisms he was looking at that they had these repeated sequences. So he's trying to figure out, what do they do? Why would nature repeat certain sequences, and he finally discovers that what these repeated sequences do, is that they contain sandwiched in between them different snippets of DNA, that are genetic material that come from viruses that had attacked

those bacteria. Now, you think we got a problem with viruses for 3 billion years, bacteria, the war between bacteria, and the viruses that attack them, has been the longest running most deadly battle on this planet, trillions per second, are involved in this fight. And so part of the defense system that bacteria developed was this notion of being able to take a mug shot two viruses that attack them, and remember them so that they could cut them up, the next time the viruses attacked. In other words, it was an immune system for viruses that would attack that would adapt to each new wave of virus, which by the way, is just what we humans could use. In this age in which we're being attacked by wave after wave of viruses and viral pandemics. A lot of people studied them, including a couple of great scientists who were at the danesco, which is a yogurt making company, because the biggest problem yogurt makers have is when viruses destroy the bacteria in the starter cultures. And so they were figuring out exactly how this system can can cut a virus, genetic material, or cut any genetic material. And that's when Jillian Banfield said, it looks like RNA is the key ingredient here. And she meets with Jennifer Doudna, the hero of my book, and one of those cafes, if you've ever been to Berkeley, there's a Free Speech Movement cafe, right next to the right at the entrance to the library. And those of you are old enough, remember that the Free Speech Movement was something in the 60s at Berkeley, the beginning of the anti war and the protest movement. So they needed the Free Speech Movement cafe. And Jennifer goes on a quest to figure out how does crispo work? How does it target a piece of DNA? And then how does it chop it up. And she figures out by in the year 2012, just nine years ago, how the system works. And very simple is a piece of RNA. That's a guy that has the code of what they're trying to target. If you're trying to target a gene, if you're trying to target a virus, whatever. He'll say, here's a snippet of the code we're trying to target. And it takes that guide RNA and attaches it to a scissors. Definitely an enzyme, but an enzyme is just a protein that can cut things up. So it's a guide RNA attached to a scissors that can be directed to cut DNA at any place. It wants to at any target and decides to attack and when Jennifer Doudna and her Tea with a manual sharpened J. A French born researcher who becomes a manual sharpened j and Jennifer Doudna become research partners, when the two of them figure that out in 2012, how it works. it dawns on Jennifer, almost like a eureka moment that, Oh, this is how it works. And we can reprogram it just by changing that guide RNA so that it will attack and cut DNA at any target we want. If we don't like a particular gene, we can target it. If we want to change a gene, a gene that would play if we change it make us taller, or change our hair color, or make sure we don't have sickle cell anemia, we can target the gene and put in a new one. And so it becomes clear that this basic science that they were pursuing the basic science of how do bacteria fight these viruses? How does CRISPR work? That that basic science would lead to something that was applied science, it's one of the great things about scientific research is curiosity driven, basic research eventually often leads to practical inventions and tools and technologies we never would have thought of, at the beginning of our curiosity driven research, just like Einstein's curiosity driven research of

how electrons dance on the surface of semiconducting material, eventually it leads to the transistor in the microchip won this case, this notion of how does a system called CRISPR... ...target and then chop up a piece of DNA at a particular spot that can become a technology, a tool for editing our genes. And then there's a great race in the book because all science including the double helix by James Watson, is a competitive endeavor. And so Jennifer Doudna and her team are competing with a team at MIT and Harvard led by Fong Zhang, who is a china born but IO raised corn fed biochemist wonderful guy, and they're competing with each other to say, Alright, we've discovered how this CRISPR thinking, target and edit a gene. Let's show how it can work in a human cell, you still got to tweak it some to make it work in a human cell. Well, Fung Jang actually beats Jennifer by two weeks and figuring it out and publishing how you can use it as a gene editing tool. This is in January 2013. And they're still in broiled in the patent battle over who gets the intellectual property rights to various aspects of human gene editing by CRISPR. But you know, that's part of science, too, is being able to commercialize it, and sometimes even fighting over the patents. Shortly after Jennifer did that, shortly after, she worked on figuring out the principles of CRISPR. And how it edits genes. She had a nightmare. She dreamed or era nightmare. She was told that there was somebody who wanted to meet her to talk about this wondrous new gene editing technology she had come up with. And she goes into the room to meet the person and the person looks up and is Adolf Hitler. She said she had trouble She told me she had trouble sleeping after that for a long time. And she realizes that this gene editing tool that she has helped create, that she in a manual shop and j created for which they win the Nobel Prize this past October, that this technology could be used for good or could be used for bad. And so she starts gathering near 2014 international meetings and summits of scientists and policymakers to say how are we going to use this tool? What should be the rules of the road for cutting up our DNA for changing our genes for editing our genes for getting better genes for our children, if we want? And it's a very, very difficult question. Because there's certain things that are just absolutely miraculous that we're going to want to do with CRISPR and gene editing. For example, in Nashville, Tennessee, four months ago, a Mississippi woman named Victoria gray, who has lived her life with sickle cell anemia. He becomes the first person ever cured of sickle cell anemia. Because the stem cells in our blood were extracted. And CRISPR was used to edit them, so that they no longer had the mutation that causes sickle cell anemia. And those are really great things we're going to be able to do with CRISPR. It's going to be especially easy enough in the next five to 10 years to do things that are really really dangerous, horrible diseases, but usually involve only single gene or simple mutations. That includes Huntington's disease, cystic fibrosis, multiple sclerosis, sickle cell anemia, and so editing in a living patient, genetic defects, so that we can help kill them, especially if things like blood disease, or blindness, or congenital blindness, you can edit the cells in the human eye, so that you can fix these horrible diseases that we've lived with, for our entire existence. But then, there's another step you can take. And that's not just editing

one single patient by extracting some of their cells, editing them and returning them to the body. You can, in theory, and also now in practice, edit early stage embryos, or reproductive cells. So that you can create designer babies, you can edit the embryo before it is become a fetus, so that every cell in that body will carry the edit you've made, or you can do it with an egg, so sperms and make genetic edits in theory, so that we can create what's called inheritable genetic edits, so that not only are you making it so that the patient doesn't have sickle cell anemia. But you could take all people with Tay Sachs or sickle cell or Huntington's, and they want to have kids, you can edit it out. And soon it'll be edited out of the species, because not only will their children but all of their descendants will have the fix to they won't have the mutation that causes Tay Sachs or sickle cell, or Huntington's. And we'll say, well, that's going across a different line, which is to make inheritable edits that are going to change the nature of the human species. And you think Well, okay, that science fiction? Well, like any good science fiction, it's already happened in some places, and in some ways, at the end of 2018, a rogue scientist in China was sort of a rogue. He was a doctor, young scientist, who had been to Jennifer Doudna, his seminars on how to use CRISPR, went back to China and edited the embryos, what became twin, baby girls, I edit them when they were early stage embryos, and they become the first CRISPR babies, the first designer babies, the first babies to have their genes altered before they were born. So that for them their whole lives and all the cells in their body, and that of all their children and all their descendants will carry the attic. What edit did he make, he made an edit, so that they would not have the receptor that makes you susceptible to the virus that causes a nail in November 2018. When this is announced, Jennifer Doudna is part of a meeting where he announces that she shocked there's a whole bit of all but then they're shocked people horrified that this has happened. But we now see this notion of making the human species less susceptible to receptors that can cause us to be infected with viruses that may seem a little bit more possible, a little bit more useful, and a little bit less horrifying. Now that we've gone through this pandemic. Now he did it way too soon. It was early on. He did it before the technology had been perfected. And so it was a little bit sloppy, and people said it was dangerous. And there's also unintended consequences like well, maybe they added that gene and will also be more susceptible to malaria or something. Even so, he proved it. Wouldn't be done. Until now we have to figure out when are we going to allow this inheritable type of gene editing? Well, we get to decide what genetic traits we want in our kids. Now, let's think about this as Jennifer Doudna. And others have died, because it's up to us, up to you and me, not just the scientists and the politicians. So it's useful to figure out this technology. And to be able to think it through the way we didn't quite think through things like social networks, and, you know, Facebook, when are we going to use it? How are we going to use it? Well, as for me, if I were having kids and this were now available, I'd say, yeah, make sure that they don't have dreadful diseases like Tay Sachs, or sickle cell or cystic fibrosis or Huntington's. Like we'd all say, if you can do it really safely, we're available to

all people, let's make sure that these things as long as they're no unintended consequences, we can add it. But let's go a little bit further. Let's say that, you know, genetically, a child may have a propensity to be very short or very obese. Well, those genes can be edited as well, a little bit more complicated, but in a decade or two, that'll be easy to, to do. And of course, if you can do that, you can not only fix problems, you can enhance the kids, you can make taller children, you can make children with better muscle mass and less propensity to fat, with faster muscle twitches or with blue eyes, blonde, and whatever, you might pick dark hair, whatever you want, the kid to have. And that becomes Of course, a little bit more problematic. Especially when you get into editing even more complex things like memory, we've already been able to do that in mice, you can do certain things genetically, to make mice have better memories. And what about mental processing power, or reactions? You know that to until eventually you might be able to do that very nebulous thing we call intelligence or IQ. Do we want to be able to edit our children to be smarter? Now, we go through this in the book and it's, you know, step by step in the book, don't answer right away, I hope you'll read the book and say, Alright, I get why we take this step. But will we take the next step? It's a slippery slope. So let's do it step by step, let's do it, where we can try to get secure footing. A person like George George, who was a Harvard professor is a great researcher and gene editing, says I don't see anything wrong with editing our kids to be taller, or even editing them to be smarter. What's wrong with that? And Jennifer Doudna, ends up thinking, well, maybe that's a problem. But it would actually be immoral not to fix bad problems they may have. And then we get into what will that do with the diversity of our species, we may not want our kids to be psychologically depressed, or blind, or various things for now, sex or sexual orientation, or height or whatever it may be. We may say, Okay, I choose this preference for my children. But as I stand on that balcony, baffling me on Royal Street in New Orleans, and see the diversity of people going by, I think one of the cool things about the human species is that in our you know, 3 billion letters of our DNA, nature has programmed in a lot of diversity. We don't want to edit that out. We want people of all shapes and sizes and dispositions to be there. And secondly, do we want to let the rich buy better genes for their children, we already have a society with a lot of inequality. But this would kick it up into a new quantum orbit, meaning it wouldn't just be a lot more inequality, but it would be encoded into our own species, that some people would be created differently, as opposed to equal to others. Though, you know, we could create a subspecies, like in brave new world or Gatica, where people are able if they can afford it to Hance genetically, their children. So those are some of the moral and ethical issues that Jennifer Doudna wrestles with. And I do think it's important for us not to be intimidated by this technology. This is gonna be great to be able to get rid of all sorts of congenital disabilities and diseases and horrors. But it also means we should go step by step, preferably hand in hand and figure out which ones should we do, which ones should we allow? And how do we make sure that people have equal access to it? And how do we

make sure we don't create a society that loses its flavor, like our genetically altered tomatoes do or loses its diversity. After doing all this exactly a year ago, in late February of last year, Jennifer Doudna starts hearing about the spread of Coronavirus. So does Fang j and their two rival groups, one at MIT and Harvard, the other at Berkeley, take their team and start using the technologies they've developed to create ways to fight COVID. Once again, RNA is the molecule of the year it's a miracle molecule, you can program it to make genetic cut. You can also program it to be a messenger to make proteins and ourselves as I said, that's how the new vaccines are working. And it's how Jennifer Doudna and farm jack have created new detection technologies new easy tests to see which viruses may be in our system. One of the problems has led to this pandemic is that we didn't have great testing you couldn't do like you can pour pregnancy testing, go into a CVS or Walgreens, buy a kit and in 15 minutes, do it. And a woman can find out if she's pregnant. It's hard. It was hard early on. And it's still hard to get really instant fast, cheap tests that you could do every day or every few days at home in order to see if you have Coronavirus or for that matter have the flu or any other virus or bacterial infection or cancer. But what they're now doing, Jennifer Doudna Fung Jang and the pioneers in this book, are creating at home testing kits that we'll be able to use CRISPR technology, I think bacteria have been using for 3 billion years to spot viruses to spot viruses in our system to tell you it's this type of Coronavirus. You can program it to detect bacteria in your system. You can do it to detect influenza, you can even do it to detect certain types of cancerous cells, all you have to do is program the RNA. Just as if you're a digital program, you use those four letters of RNA and program it to say, here's what I want you to hunt. And here's what I want you to seek, I want you to seek that. And so that will bring biology into our home, the way personal computers brought digital technology into our home. And that's going to be the big transformation, we'll be able to fight off viruses, we'll be able to stop pandemics, we'll be able to make sure our kids are healthier and stronger, we'll be able to treat molecules as new microchips and tell them to do things we want them to do, we'll be able to fight cancers and tailor the cancer to the very specific genetic code of the tumors that you happen to have. And we'll be able to bring it into our homes, so that we will have a feel for molecules will have a feel for our bodies. Just like we now even if we don't understand microchip have a feel for what they do. Because we bring them home every day in our iPhone, and they're not personal computers. To me, this book is about a journey of discovery, and about questions we're gonna have to ask in the future. But the most important thing of all is like when Jennifer Doudna read the double helix. There's a joy that comes from understanding things. It makes it less intimidating. It makes the vaccines less intimidating, makes gene editing less intimidating. There's a real joy that comes from understanding, especially when that thing is ourselves. And that's what this book is about.

T Tricia Johnson 44:29

Walter Isaacson is a professor of history at Tulane University. He was chairman of CNN and editor of Time Magazine. He also served as CEO of the Aspen Institute until 2018. His latest book is "The Codebreaker: Jennifer Doudna, Gene Editing and the Future of the Human Race." This conversation was held for members of the Society of Fellows. The Society of Fellows is a national community of leaders who sustain and support the Aspen Institute and have unparalleled access to institute programs to view a video of the original conversation, hear more like it and learn about SOF. Go to Aspeninstitute.org/SOF. Make sure to subscribe to Aspen Ideas to go wherever you listen to podcasts. Follow Aspen Ideas year round on social media at Aspen Ideas. Today's show was produced by Marci Krivonen and me. Our music is by Wonderly. I'm Tricia Johnson. Thanks for joining me.

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