HUMAN NATURE

DIRECTED BY ADAM BOLT
EXECUTIVE PRODUCED BY ELLIOT KIRSCHNER,
GREG BOUSTEAD AND DAN RATHER

World Premiere - 2019 SXSW Film Festival
Official Selection - 2019 CPH:DOX
Official Selection - 2019 Hot Docs

YEAR 2019 **| RUN TIME** **95** mins | **LANGUAGE** English

www.humannaturefilm.com

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SYNOPSIS

A breakthrough called CRISPR has given us unprecedented control over the basic building blocks of life. It opens the door to curing diseases, reshaping the biosphere, and designing our own children. Human Nature is a provocative exploration of CRISPR's far-reaching implications, through the eyes of the scientists who discovered it, the families it's affecting, and the bioengineers who are testing its limits. How will this new power change our relationship with nature? What will it mean for human evolution? To begin to answer these questions we must look back billions of years and peer into an uncertain future.

HUMAN NATURE
DIRECTED BY ADAM BOLT
FILMMAKER STATEMENT - DIRECTOR Q/A

How did this film come about? How did the idea originate? What inspired you?
I've been in the film industry for more than a decade and I've seen over and over again how the credit for the making of a film often can get wrongly assigned to just one person. Somewhat ironically, in the course of making this film I learned that the same problem exists in science too. Both science and filmmaking are, by their very natures, highly collaborative endeavors and yet that's not necessarily how the public sees them. In the case of film, there's a sense that a film is "by" its director in the same way that a novel is written by its author. In my opinion, unless you shot, edited, scored and acted in your own film, it's not the same at all. It's something I felt when I was working my way up in the industry, and it's something I feel even more strongly now that I've directed my first feature documentary. So let me start by emphasizing that this film was created by many people in additional to myself.

The initial idea actually came from Elliot Kirschner, a longtime friend and colleague of mine who is our producer and executive producer (and also filled every role from grip to craft services during production).

Elliot's an Emmy-winning TV news producer and for years he's been frustrated by how science is covered in the popular media. Elliot's father is a biologist, so Elliot grew up surrounded by science and by scientists. And the cartoon version of science that often appears in TV and movies (including nonfiction), full of dimly lit labs and bolt-from-the-blue discoveries, was unrecognizable to him. For one thing, it turns out it's really important to have the lights on in a science lab, because you have to see what you're doing when you're manipulating things that are thousands of times smaller than a human hair.

But the problems aren't just superficial. Journalists and filmmakers often get the science wrong in ways that have a real impact. This is particularly true in biomedical science, where experimental treatments get oversold as cures, small studies get transformed into sweeping statements about diet and health, a gene that might be associated with aggression gets touted as "the warrior gene." This is bad enough on its own, but what might be even worse is that truly significant science gets lost in the noise.

CRISPR is this revolutionary genetic engineering technology that exploded onto the scene a few years ago. Anyone in the science world has heard of it and considers it to be one of the most exciting, promising, and also potentially worrisome developments in science of the last several decades. It gives humanity these awesome powers and we as a society will have to make big decisions about how to use this technology and, in some circumstances, whether and how we should limit its uses. It's already enabling some amazing new treatments for cancer and there are clinical trials underway for curing some very serious diseases. But it also opens the door to altering the genetics of future generations and making some pretty radical changes to the evolution of other organisms. The field is moving very quickly. And while the scientific community knows this is something people need to be thinking about it, the public at large is only just starting to become

aware. And that's partly because of this breakdown in communication and trust between the public, the media, and scientists.

The problem is multi-faceted. One of the biggest problems, actually, is that people in the media I think drastically underestimate the intelligence of the so-called "general public." I worked for years as an editor, and I've often had to fight with producers or directors to include more nuance and complexity in a story. The attitude is "Well, I understand it, but those other people won't get it." Often there's this idea that you have to deliver everything at a fifth grade level. Well, first of all, it turns out fifth graders are really smart if you actually take the time to explain things to them. But we confuse not knowing something for not being able to understand it. So that's a huge issue.

Also, some journalists and filmmakers simply don't understand the science behind whatever story they're covering because they don't have a background in biology or physics or whatever it is. Then you have the scientists themselves. They obviously have at least some vested interest in drawing attention to their own work. There's also pressure from above, to raise money, to raise the profile of their institution. Frankly, sometimes their university's PR department is just as guilty of hyping something as the mainstream media is. On top of that, some science has big implications for companies or entire industries (the science linking cigarettes and cancer, for example, or the science linking greenhouse gas emissions and global warming) so those interests get involved too and try to muddy the water.

The end result is that people get misled and there's a breakdown of trust on all sides. The scientists don't trust the reporters to get it right, so they give these stiff, cardboard interviews, or maybe they don't trust the public to understand all the nuances of their work, so they dumb things down too much and it ends up being kind of condescending. The reporters are sort of trained not to trust anyone, because that's how our current model of journalism works. But the end result is that the public at large often gets misled about scientific topics. There's this exhausting cycle of hype and disappointment—when a new scientific finding is oversold before it's really corroborated by other scientists and then doesn't pan out— that I think causes some folks to lose faith in science, to distrust scientists, or to just ignore science entirely. That's bad enough on its own, but then…

So Elliot has been thinking about all of this for a long time and trying to figure out what to do about it. Through his dad, Elliot met an amazing scientist named Ron Vale. At the time, Ron was a cell biologist at UCSF and in the scientific community he's as respected as it gets, although most people will never have heard of him, but . If you want to see something really cool, search for "kinesin" on YouTube. You'll find these amazing 3D visualizations that show this microscopic molecule that literally walks along inside our cells, transporting things from one place to another. Ron [or Ron's lab?] was one of the discoverers of this. But you haven't heard of him because his lab does what's often referred to as "basic research" which means they don't specifically set out to cure diseases or discover new sources of energy. Instead, they just try to understand how the world works. And in reality, that's how most so-called "big discoveries" are made: thousands of scientists around the world are chipping away at a problem, bit by bit, and eventually it adds up to something that has profound implications. Science is a relay race, but for some reason we often call the person who crossed the finish line "THE discoverer."

Anyway, Elliot met Ron. And in addition to being an amazing scientist, Ron had also founded an organization called iBiology, which creates videos about important new research and disseminates

them for free online. It's an amazing resource, but it's geared mainly toward people at the undergraduate or graduate level. Elliot and Ron, along with Sarah Goodwin started to think about how they could build on the trust that iBiology had cultivated among scientists and start creating videos and films that were intended for a wider audience of scientists and nonscientists alike. That's what eventually became The Wonder Collaborative, one of our producing partners on this film.

I got involved with The Wonder Collaborative a few years ago, before it even had a name. Elliot and I knew each other from Dan Rather Reports, a weekly TV news magazine where he was the senior producer. I started there as a freelance editor a long time ago and worked there off and on over the years. I liked working there because it was a small team and so you could play a lot of different roles. It was where I took my first steps from editing toward producing and directing. I didn't know Elliot that well, but I knew he was someone who was smart and could think big. One day he called me up and tried to recruit me to work with him on a series of short science themed documentary films with him and Ron.

Initially I resisted, because I didn't think a "science film" was something I was interested in as a filmmaker. I didn't doubt the importance, but I was initially picturing this cliche of narrated TV documentaries that dumb everything down to the point of stupidity.

But Elliot was relentless in trying to recruit me. It's what makes him an amazing producer! He offered me virtually unlimited freedom to make whatever I wanted and that was what initially attracted me. At the time, I was working as an editor and consulting on other people's films. I've been wanting to direct for a long time, and the opportunity to do it with such freedom, even if I wasn't initially drawn to science, per se, was ultimately impossible to turn down.

But the more we started talking about this idea of innovative science filmmaking, the more I got excited about it. I was a huge science nerd as a kid. In middle school and high school, I read voraciously about things like artificial intelligence, evolution, and cosmology. I remember totally devouring a college biology textbook that my mom and I found at a used bookstore. I loved learning about all this amazing and intricate stuff that goes on inside our cells, at a microscopic level. Before I went into film, I thought I would end up as a scientist, actually.

But now as a filmmaker, when I looked at mainstream science documentaries, it seemed to me like they were following basically the same format as what I watched on PBS as a kid. Filmmaking has evolved a lot since then, documentary especially, and yet science documentaries were somewhat stagnant. The more I thought about it, the more this seemed like an area ripe for innovation, which was exciting. This was what Elliot was trying to convince me of from the beginning, but it took me a while to see it, to be honest.

So we ended up worked together on these shorts, and that went really well, and then we decided to try something more ambitious. That was the beginning of 2015, and CRISPR was just starting to bubble up. Elliot was working on another project called Conversations in Science with Dan Rather. Because of Elliot's connections in the scientific community, he knew about CRISPR before most people, and he put together an interview between Dan and Jennifer Doudna, one of the co-inventors of CRISPR technology. And some of the early threads of this documentary emerged from that interview.

One striking thing about CRIPSR is that it was discovered more than it was invented. CRISPR is actually a natural process that humans learned to harness. But initially, the scientists who were studying CIRSPR had no intention of creating a revolutionary new tool for genetic engineering. It came out of basic research in a relatively obscure field called microbiology, which is the study of microorganisms. Of course people have spent a lot of time studying that bacteria that cause disease, but the vast majority of microorganisms have nothing to do with humans. Some of them live in very unusual or extreme environments and it's not obvious in any way what the practical purpose of studying them would be. That's the kind of research CRISPR came out of. The story begins when a few different scientists noticed these peculiar patterns in the DNA of these microorganisms. Eventually, they figured out that these patterns were part of a previously unknown immune system in bacteria that help protect from infection by viruses. When the flu virus infects a cell, it actually injects its DNA into the cell and the viral DNA takes over and hijacks the cell's own machinery in order to turn it into a little virus factory. Unfortunately in the process the cell is destroyed. The same thing can happen to bacterial cells, but it turns out bacteria had evolved this defense system that could chop up the viral DNA before it took over. And then Jennifer Doudna and several other scientists had the realization around the same time that this defense system could be harnessed to cut up not just viral DNA but any DNA, including human DNA. And it turns out that being able to cut up human DNA in a precise way is incredibly important to genetic engineering. And actually the genetic engineering folks were looking for a way to do just that, to cut DNA in a precise way, and the existing methods were extremely difficult and time consuming. And it turns out that CRISPR, this system that had evolved naturally, was way way better than what we humans could do on our own.

So that is an amazing science story. This breakthrough that comes out of this obscure area of research studying these microorganisms that nobody cares about. Among biologists and geneticist, CRISPR became a household word in late 2012 and early 2013, after a series of papers showed that it could be used to precisely edit the DNA of humans, crops, animals, insects, you name it. It turned out to be this universal tool for gene editing. And then things started moving very quickly. Within a year, someone had used CRISPR to edit monkey embryos, and it was clear that it would soon be possible to do that in humans as well. And that has really profound implications.

Why did you make this film?
Scientists tend to be a cautious bunch. They're suspicious of hype and not known for making outlandish claims. So it was really striking when I kept hearing leading researchers say these extraordinary things about CRISPR. They spoke about it as a technology that could change the future in huge and unknowable ways, on par with the internal combustion engine, the transistor, or the Internet. What's more, CRISPR seemed to explode out of nowhere, so suddenly things that everyone thought would be decades away are literally happening now. Right there you have the makings of a great story.

I was also struck by how much debate was going on within the scientific community about how to deal with CRISPR. For example, many scientists are genuinely unsettled by the idea that we could design our own children and think that altering future generations is a line we should never cross. But others don't see as much of a difference between CRISPR and other technologies (space travel, modern medicine, and even agriculture) that have in some sense "changed what it means to

be human." This is realm where there are no easy answers, even to those who understand the science best.

Did the film change from your original idea for the film as you were filming or in post?
My background is as an editor and every documentary I've ever worked on has taken shape in the edit room. On cinematic documentaries like this one, the editing process is when the film gets written, so to speak. Before that, you have ideas and outlines, but you don't really know what the structure is until you start watching the footage and actually stringing things together. That's why Regina Sobel, my editor, shares a writing credit with me on the film, even though we weren't literally writing words on a page. She and I were really in the trenches together figuring out how to tell such a big and complex story in a compelling way. We didn't want it to feel like an educational film, but we didn't want to force the story into a cliche plot either. Eventually we settled on the chapter structure we have now, but this was only after months of experimenting.

I started editing the film with Steve Tyler in April 2017, when we had just a few interviews in the bag. At that stage, we were just trying to figure out if our approach would work. I didn't want to use narration to tell this story. I wanted it to be told through the voices of people who were closest to the story, starting with the scientists who discovered CRISPR. Our first six months of production was very heavy on interviews with scientists, and Steve and I worked together to figure out if we could explain CRISPR and the larger history of genetic engineering and gene therapy just by interweaving their interviews. It was a real challenge not being able to go in and write a line of narration to clarify something, and the early edits we did helped me refine my interview process to make sure I was getting what we needed from each person.

Regina Sobel came onto the project in September 2017, and that's when we really started trying to figure out how to structure the film and what else we need to shoot to make it work. Regina was very influential in making those decisions, especially our choice to focus on sickle cell disease as an example where CRISPR could potentially make a big impact. Our producer Meredith got in touch with several labs that were working on a cure for sickle cell, and through Matt Porteus's lab at Stanford, we found David Sanchez, a teenager with the disease who was donating his cells to Porteus's lab for research. David and Matt both ended up becoming central pillars of the film.

The whole time we were editing, we were constantly experimenting with different ways to structure the film. In fact, the beginning and end of the film changed completely just a few weeks before we were supposed to finish editing. We had actually already submitted the film to SXSW at that point, and we had an opening that a lot of people liked, including me, which used the Vladimir Putin scene that now appears later in the film. I loved that footage, which I had come across almost by accident on the website of the [HAVE TO TRACK THIS DOWN]. In it, Putin speaks to a group of science students about genetic engineering and the possible implications for humanity. There is automatically something electric about Putin saying, for example, that this could be used to create super soldiers. But what was interesting to me was that he seemed really troubled by the idea and his points were surprisingly nuanced. I thought it was a very engaging way to start the film, but I also worried that it set the film off on the wrong foot. For one thing, we wanted people to be thinking about the implications of CRISPR not just in the immediate future, but also for the future of humanity in the long term. When we talk about the possibility of altering the course of human evolution, that's something that will take centuries to play out. Putin is obviously in the headlines a lot these days, and I worried that starting with him could set people up for a film that was much

more investigative and polemical than our film actually is. I showed that version of the film to several editor friends, and got an almost unanimous consensus that it setting the film off on the wrong foot. This is a film that isn't just about the recent past and future, but that asks people to think about human history going back to the origins of agriculture 10,000 years ago and evolutionary history on the scale of billions of years, which is how long CRISPR has existed in microorganisms, lying in wait for us to come along and discover it and harness it. And Putin just didn't set you up for that journey.

The problem was that we didn't have any other ideas to start the film, which was kind of terrifying with so little time left. I remember very clearly that Regina and I were in the edit room on a Saturday and decided to just focus on the beginning for the entire day. We started playing with ideas in Avid and we pulled up an archival clip that we both loved but that we hadn't been able to find a place for. It was of a 1966 speech by Robert Sinsheimer, a prominent biologist of that time, called "Where is Biology Taking Us?", where he tried to imagine the future of genetics from his standpoint just over a decade after the discovery of DNA. We loved this clip we had and Harry Jackson, our amazing associate editor and associate producer, had tracked down the full speech. When he had watched it months before, he was like "You've got to see this." But Regina and I had never actually watched it. It was about 45 minutes, which seemed like a lot of time to sit and watch something that might not even pan out. But we decided to at least start it and see if it pulled us in. And within the first few sentences, he was talking about the epic scope of evolutionary history and human history and basically asking people to think on that level. It was perfect and we both got really excited.

We loved the idea of someone from the not-to-distant past trying to peer into a future that is just starting to arrive now. He imagines an era when humans have the power to specifically and consciously alter their own genes. "This will be a new event in the universe," he says. Well, that's exactly the era that CRISPR has ushered in. And yet, on the scale of hundreds or thousands of years, we are in the pretty much the smae position that SInsheimer was, trying to imagine where this all is going to take us±because CRISPR is really just the beginning.

Before we even watched the rest of the speech, it was obvious to both of us that this was how we had to start the film. Within a few hours, Regina and I had edited together a version of the beginning that is pretty similar to what we have now (although it took a lot of experimenting with music and imagery and pacing to get it right). We shared it with the rest of the team. I don't think anyone was expecting us to change the beginning of the film that late in the game, so it was a scary thing to do in a way. But everyone quickly agreed that it was the right approach and we actually ended up adding a few weeks to the edit in order to give ourselves time to really get it right, which also included doing some last minute shooting to bring his speech to life.

What were the challenges in making this film?
One thing we knew from the beginning was that we wanted to push the envelope in terms of delving into the science behind CRISPR. When you understand how CRIPSR actually works—first of all, it's awe-inspiring. But I also think it impacts how you feel about the technology. The tendency is to call genetic engineering "unnatural." But if you know that CRISPR is something that evolved naturally over billions of years, it calls that into question a little. In reality, there's nothing special about manipulating DNA. It's happening all the time in nature. That doesn't make manipulating DNA for a particular purpose good or bad, but we wanted to blur this line between natural and

unnatural. And so explaining how CRISPR works in nature, and how humans learned to harness it, was really important.

The challenge was figuring out how to do that in a way that was compelling. And also finding the right balance, explaining enough that people actually understood it in a meaningful way, without having it feel like an educational film.

In the popular media, CRISPR is often described as “molecular scissors” that can be used to cut and paste DNA. But how is that possible? How do you cut and paste something that is 40,000 times smaller than a human hair? Well remember that every living cell has DNA inside of it, and it turns out a cell needs to manipulate DNA constantly—for example, it has to make copies of its own DNA when the cell divides (which is how DNA is passed from one generation of cells to the next) and it has to repair DNA when it gets damaged by things like x-rays. So over billions of years, cells have evolved mechanisms to manipulate DNA in a variety of ways, powered by tiny molecular machines called proteins.

For decades now, scientist have known about proteins that can cut DNA. That’s what powered the first wave of genetic engineering that started in the 1970s. But the real challenge is figuring out how to cut the DNA in a specific place. Take something like sickle cell disease, which is caused by a single mutation in a single gene—where one chemical “letter” of DNA is substituted for another. If you want to cure sickle cell disease, you have to find this one letter out of the more than 3 billion letters in human DNA and make a cut at exactly the right spot. Then you have to repair it with the correct letter. Until very, very recently, this was so difficult to do that it might as well have been impossible. Which is why, even though the idea of “gene therapy” to cure diseases like sickle cell has been around for decades, it hasn’t really worked that well in the past.

But It turns out that certain microorganisms have evolved a system, known as CRISPR, that can cut DNA in a very precise manner. They use it as a defense mechanism. These microorganisms get attacked by viruses, just like our cells do, and the viruses actually inject their own DNA into the cell when they infect it. So the microorganisms have molecular machinery called CRISPR that recognizes viral DNA and cuts it, which effectively disables the virus. A key component of CRISPR is a molecule called cas9. One of the scientists we interviewed called it molecular law enforcement. Cas9 literally carries around a short snippet of genetic code that comes from the virus and functions as a sort of most wanted poster. Cas9 floats up to any DNA it encounters and checks to see if that DNA matches the most wanted poster it’s carrying. You don’t want to be cutting up your own DNA by mistake, so this most wanted poster is an ingenious way of finding only those pieces of DNA that come from your enemies.

So here you have something that has evolved over billions of years to find a unique DNA sequence and cut it. And then scientists figured out that they could easily swap out the most wanted poster for something else. So instead of having cas9 hunt for viral DNA, you could have it find the DNA that codes for the sickle cell mutation, or any other gene, and cut it.

Once you cut the DNA, the cell tries to repair it. And you can sort of get in the middle of that process and change the DNA at that point. But the key is being able to cut the DNA at a precise place. And that’s what CRISPR does.

It's a lot to explain and since we weren't using narration, we had to get the scientists themselves to explain all of this on camera, in a way that wasn't boring or confusing. I also knew we needed lots of options in the edit room, because we didn't know in advance what the best way to tell this story would be. So we conducted fairly long interviews, some of them five or six hours, and I tried to make sure we had real conversations. I knew if I just said "explain CRISPR," the light would leave their eyes and they would just sort of go into lecture mode. Instead, I asked them to tell me stories, about the first time they heard about CRISPR, about how they figured it all out, about the moment they realized the implications of what they had discovered. People come to life when they're telling a story, and I thought we could explain what CRISPR was and how it worked through the story of how it was discovered, which is an amazing story.

From the beginning, we also knew that graphics would be critical to bringing CRISPR and gene editing to life. Scientists like to joke that all biology labs look the same: just a bunch of people siphoning clear liquids from one test tube to another. This is largely true, and doesn't make for very interesting visuals, nor does it help you understand what's happening in those test tubes. The really cool stuff is happening at the molecular level, which obviously we couldn't film.

Ned Piyadarakorn created all the graphics that bring this molecular world to life, and his designs were so influential on the look and feel of the overall film—and the graphics themselves are so beautiful—that we decided "Art Direction" was the best label for what he did. Usually graphics are created toward the end of a project, but we brought Ned onto the project way earlier, so we could start figuring out the graphic language as we edited and allow that to inform our editing decisions and vice versa.

I'm personally not a fan of graphics that feel oversimplified. We definitely weren't going to have cas9 look like a tiny pair of scissors or anything like that. I wanted the graphics to be based in reality, but also evocative. Thanks to a technique called x-ray crystallography, scientists actually know a lot about what cas9 looks like at the molecular level and Ned used real scientific data to build 3D models of cas9 and DNA. All the DNA sequences we show in the film are real and Ned came up with a way of representing genes that is based on how DNA sequencing data actually looks. A lot of these molecular processes are based on how different molecules fit together, sort of the way a key fits into a lock, and Ned's graphics capture that beautifully. We wanted the graphics to be easy to follow, without losing the sense that there is a lot of intricacy and complexity to what's going on.

What do you want audiences to take away from this film?
When I would tell someone I was directing a film about genetic engineering, the most common response was some variation of "Wow, that must be scary, huh?" I think in part that's because many of us have a certain visceral reaction to the idea of tinkering with life—and especially with human life—that's very different from how we react to other kinds of technology. But I think the reaction also has to do with certain assumptions or cliches about what a documentary is supposed to do when it takes on a "big issue" like genetic engineering: that it is supposed to scare us or make us angry. And then tell us who to direct that anger at. But the true story about CRISPR is nuanced and complex. There is plenty to be afraid of, but there is just as much to be hopeful about. There are millions of people whose lives could be saved by this technology. And it could also potentially help with some very serious problems that our planet is facing. In our film, we certainly don't shy away from the aspects of CRISPR that make people say "wow, scary," but we also

wanted to capture the part of it that is just plain “wow.” We now have the ability to manipulate DNA, something that is 40,000 times smaller than a human hair. And we can do it in this incredibly precise and relatively easy way. The story of how humans figured this out is incredible. And if humans are capable of that, maybe we’re also capable of figuring out how to navigate all the difficult existential questions that genetic engineering raises. But that’s only a maybe, and I hope this film inspires audiences to embrace the ethical and philosophical inquiry that comes from this new horizon of knowledge.

HUMAN NATURE really asks people to think about what it means to be human—and what we want it to mean, now that we have the power to change ourselves in this fundamental way. I hope people walk out of the theater and immediately start discussing and debating that with each other. We definitely don’t give a definitive answer in the film (nor would I pretend to have one). Instead, we wanted to take people on a journey through the brave new world of CRISPR and hopefully leave them feeling a little uncertain about how they feel. In a world where technology is changing so quickly, I think some collective uncertainty is a good thing. CRISPR and gene editing have tremendous potential for good. But I think we have to be continuously grappling with how technology is affecting society. And that’s what I love about film—it brings people together in a dark room to have a shared experience, and then when the lights come up we can start talking about it with each other.

ADAM BOLT
DIRECTOR - “HUMAN NATURE”

HUMAN NATURE
DIRECTED BY ADAM BOLT
FILMMAKING TEAM BIOS

ADAM BOLT
Director
Adam Bolt edited and co-wrote the Oscar-winning documentary Inside Job, for which he received the Writer's Guild Award for Best Documentary Screenplay and was nominated for an American Cinema Editors award for Best Edited Documentary in 2011. He won an Emmy in 2014 for his work on the Showtime documentary series Years of Living Dangerously, where he served as senior producer, writer, and editor. His other credits include director Alex Gibney's Park Avenue: Money, Power & The American Dream, which premiered on PBS's Independent Lens and went on to win a Peabody Award in 2013; Page One: Inside the New York Times, which was nominated for two Emmys (including Best Editing) in 2012; and the HBO documentary The Recruiter, which won a Columbia duPont award for excellence in broadcast journalism in 2010.

ELLIOT KIRSCHNER
Executive Producer
Elliot Kirschner is the Executive Producer of the Wonder Collaborative, a New York Times best-selling author, and Emmy-award winning news and documentary producer. He got his start at CBS News, producing for such programs as 60 Minutes, Sunday Morning and the Evening News. In 2007, Kirschner joined legendary news icon Dan Rather to help manage a cable news and documentary program where he commissioned and oversaw numerous science reports. He joined iBiology in 2015 and is currently leading the group's efforts to create content for the general public. His 2017 book What Unites Us: Reflections on Patriotism, written with Dan Rather, was a bestseller.

REGINA SOBEL
Editor/Co-Writer
Regina Sobel is a Brooklyn-based film editor and producer. She was the editor and co-writer of Fail State (Starz), a feature documentary about inequality in higher education which premiered at DOC NYC in 2017. She also served as editor and producer on Old Dog, a verite documentary about sheep dog training in New Zealand, and associate editor on Alex Ross Perry's Queen of Earth (IFC Films), starring Elisabeth Moss. Previously, she produced and directed graphics for film and TV, including PBS's Park Avenue: Money, Power & the American Dream, Showtime's "Years of Living Dangerously," and HBO's "Game of Thrones."

MEREDITH DESALAZAR
Producer
Meredith DeSalazar is an award-winning news producer with over 16 years experience. She started at ABC News covering the presidential election, then researching and producing for World News Tonight. She joined news legend Dan Rather 13 years ago producing investigative stories, often with a science focus such as: the environmental impact of stormwater runoff, the dark underworld of shark finning and the invasion of lionfish into foreign waters. She was the first television reporter to raise red flags about the danger of concussions and the NFL's efforts to sweep the issue under the rug.

SARAH GOODWIN
Producer
Sarah Goodwin is the leading science advisor on the film. She is the Executive Director of the Wonder Collaborative and the Director of iBiology, a non-profit that produces videos by the world's leading biologists. Before joining iBiology, she got her Ph.D. in Cell Biology from the University of California, San Francisco. Under her leadership, iBiology has grown in staff and scope, and has produced hundreds of videos with millions of yearly views. Sarah has worked with a wide variety of scientists on communicating their research and stories, and has ensured the science content in this film is accurate in depicting the state of knowledge and the spirit of discovery.

DEREK REICH
Cinematographer
Derek Reich is an Emmy Award winning cinematographer who has traveled to datelines around the globe to capture the images needed for visual storytelling. After getting his start covering the American West for CBS News, Derek expanded into documentary filmmaking with an emphasis on cinematically arresting narratives. He will regale you with stories of bears and dogs.

STEVE TYLER
Editor
Steve Tyler is an Emmy Award winning documentary film editor and long-time collaborator with Human Nature executive producers Dan Rather and Elliot Kirschner. Before taking up editing, Steve could be found on Broadway or in theaters around the country as an accomplished music director for shows like The Producers, Jane Eyre and The Sound of Music.

GREG BOUSTEAD
Executive Producer
Greg Boustead is the Program Director at Science Sandbox, an initiative of the Simons Foundation that he helped launch in 2015 to inspire a deeper interest in science, especially among those who don't think of themselves as science fans. With a background in neuroscience, film, and journalism, Greg has dedicated his career to bringing sophisticated science content to general audiences, across many platforms. Other credits include executive producer of the feature-length documentary The Most Unknown, co-produced with VICE Media/Motherboard and released by Netflix in 2018.

DAN RATHER
Executive Producer
Dan Rather is one of the world's best-known journalists for much of the last half century. He has interviewed every president since Eisenhower and personally covered almost every important dateline of the last 60 years. Rather joined CBS News in 1962 and in 1981 assumed the position of anchor and managing editor of the CBS Evening News—a post he held for 24 years. His reporting across the network helped to turn 60 Minutes into an institution, launched 48 Hours as an innovative news magazine program, and shaped countless specials and documentaries. Upon leaving CBS, Rather returned to the in-depth reporting he always loved, creating the Emmy Award winning, Dan Rather Reports on HDNet. Now, he is president and CEO of News and Guts, an independent production company he founded that specializes in high-quality non- fiction content. He has a special interest in telling the stories of science.

HUMAN NATURE
DIRECTED BY ADAM BOLT
FEATURED VOICES

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Revive and Restore

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Stanford University

ANTONIO REGALADO
MIT Technology Review

DAVID SANCHEZ
Sickle cell patient

SYNTHEGO
RNA synthesis company

FYODOR URNOV
Altius and IGI

ETHAN WEISS
Ruthie's father

PALMER WEISS
Ruthie's mother

RUTHIE WEISS
5th grader

LUHAN YANG
e-Genesis

FENG ZHANG
Broad Institute

SANDBOX FILMS

Sandbox Films is a mission-driven documentary studio that champions excellence in science storytelling. We seek to tell stories that inspire viewers and reveal an authentic portrait of the actual process of science. By emphasizing the pursuit of discovery, in all its beauty and sometimes messiness, these stories humanize science in relatable ways for diverse points of view. Sandbox Films, LLC is a registered affiliate of the Simons Foundation. More info at: sandboxfilms.org

THE WONDER COLLABORATIVE

The Wonder Collaborative is dedicated to bringing together scientists and storytellers in a spirit of collaboration and experimentation to revolutionize science filmmaking. A division of the non-profit science communication organization iBiology, The Wonder Collaborative develops, produces, and shares powerful stories for the general public about the wonder, awe, and diversity of science. The film, **HUMAN NATURE**, about the genome editing revolution knowns as CRISPR, is their inaugural effort. More info at: https://wondercollaborative.org/

NEWS AND GUTS FILMS

News and Guts Films was founded by news icon Dan Rather to combine the immediacy and artistry of independent documentary film with the highest of journalistic standards to tell compelling and important stories to a global audience. A partnership with Rather's long-time collaborator Elliot Kirschner, they focus on projects that are engaging and nuanced, provocative and thoughtful. They have a particular interest in world affairs, science, history, and the arts.

HUMAN NATURE
DIRECTED BY ADAM BOLT
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DIRECTED AND PRODUCED BY
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ART DIRECTION
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IN MEMORY OF
Shakir Cannon
a tireless advocate for victims of sickle-cell disease
1983 - 2017

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WE GRATEFULLY ACKNOWLEDGE THE COOPERATION OF
Australian Institute of Marine Science
Barrangou Lab, NC State University
BRAS DEL PORT Saltworks (Santa Pola, Spain)
Çatalhöyük Research Project
Church Lab, Harvard Medical School
Doudna Lab, UC Berkeley

eGenesis
Genomic Prediction
Gottschalk Cranberry
Innovative Genomics Institute
Lake Wheeler Dairy Farm
Lucile Packard Children's Hospital Stanford
Marraffini Lab, Rockefeller University
Minority Coalition for Precision Medicine
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Statz Bros, Inc.
Syngenta
Synthego
Zhang Lab, The Broad Institute

Science is a collective effort.
We would like to acknowledge the hundreds of other researchers around the world who have contributed to the understanding of gene editing and CRISPR.

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The filmmakers are grateful to Ron Vale for his support and vision in launching this effort.

VERY SPECIAL THANKS
Donna Bolt
Lee Bolt
Delancey DeSalazar
Joe DeSalazar
Rachel Fletcher
Valerie Gelber
Lee Goodwin
Julia Huang
Eva Kirschner
Helena Kirschner
Marc Kirschner
Phyllis Kirschner
Alan Oxman
Heather Reich
Yoni Sauerbrun
Linda Schwartzstein
Malia Simonds
Cooper “Fuzzman” Sobel
The Edit Center
The Staff of iBiology

SPECIAL THANKS

Line Bay
Paul Berg
Elizabeth Christopherson
Phillip Cleves
Janet Coffey
Ted Cohen
Michael Friend
Maria Jasin
Martin Jinek
Dan Kevler
Robert Kirshner
Eugene Koonin
Doug Koshland
Janet Mertz
Michael Rodgers
Alexandra Shor
Virginijus Šikšnys
Marilyn Simons
Jim Simons

THANKS

Bruce Alberts
Judy Aley
Uri Alon
Brittany Anderton
Ark Church of Baltimore
Madison August
Bethany Babbitt
Becky Bach
Alejandro Chávez Badiola
Harriet Bailey
Brett Baillie
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Nadine Sobel
Renan Sper
John Spiro
Brett Staahl
Wesley Statz
Eric Steen
Stochastic Labs
Airdri Stoddart
Nico Stuurman
Edna Sun
Jongmin Sung
Kyanna Sutton
Suzanne Symonds
Emma Taddeo
Annie Tchu
Laurent Christian Asker Melchior Tellier
Michael Terns
Etosha Terryll
Allegra Thomas
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Trevor Thompson
Charis Thompson
Sergio Tobar
John Tracey
Nathan Treff
Connor Tsuchida
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Pablo Valenzuela
John van der Oost
Hannah Vanderlan
Kellie Vaughan
Mike Veech
Rosa Veguilla
Tao Wang
Rebecca Ward
Gabriel Caleb Washington
Will Watkins
Nancy Wexler
Blake Wiedenheft
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The Kremlin
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ADDITIONAL MUSIC
“Piano Concerto No. 3 in D minor, Op. 30: III. Finale: Alla breve”
Performed by Lang Lang (Conductor), Sergei Rachmaninoff (Orchestra), Alexander Scriabin (Performer), Yuri Termirkanov, (Performer), St. Petersburg Philharmonic (Performer)

Courtesy of Telarc, a division of Concord Music
Record Company: Telarc

"Night on Bald Mountain"
Performed by Eduardo Mata (Conductor), The Dallas Symphony Orchestra (Performer)
Courtesy of Sony Music
Record Company: RCA - Sony Classical

This film was made possible with support from Science Sandbox, a Simons Foundation initiative.

This film is funded in part by the Gordon and Betty Moore Foundation.

The filmmakers also thank the BESI Fund at the San Francisco Foundation, Stonesthrow Fund, Rita Allen Foundation, and iBiology for their support of this film.

Distribution advisory services provided by ro*co films.