The Science and Technology of Growing Young

What's in it for me? Learn how to live to 200.

Imagine being able to live for two centuries. Or – perhaps even better – being able to turn back the clock, so that your body works like it's 25 again. That might all sound far-fetched, like the story of Benjamin Button. But it's scientifically credible, especially if you consider how much science and technology have advanced over the last few decades. The Longevity Revolution has already begun, and it will affect all of us. So, the more you know about it the better. In these blinks, you'll learn all about the technological innovations fuelling this healthcare revolution. And if that's not enough, you'll also find out how to take your health into your own hands right now, so you can live the longest possible life. In these blinks, you'll learn

how AI will help us prevent disease and create tailor-made treatments; why it's so important to follow a Mediterranean diet; and how genetic engineering can cure cancer.

We're on the cusp of a Longevity Revolution.

Picture this: you wake up, feeling refreshed. You've had a good night's sleep – and you're looking forward to the party. Today's your 200th birthday. You've spent the night in a temperature-controlled bedroom, with the ventilation controlled by AI. And that means your body has received just the right amount of oxygen. Your bed monitored your sleeping patterns; and while you slept, microscopic robots toiled away inside your body, doing little repairs. Diagnostic devices both inside and outside your body did a whole scan of your vital signs, and fed the data into a computer for analysis. You get up and go to the bathroom. Your toilet scans your urine and fecal matter and analyzes the health of your microbiome. You look in the mirror appreciatively. Even though you've lived for two centuries, you don't look a day over 25! And all of that, because you've actively reversed your physical age. The key message here is: We're on the cusp of a Longevity Revolution. In the premodern world, people could expect to live until the age of 30 – if they were lucky. Over the last few decades, that number has increased to around 75. Why the big jump? Well, progress in agriculture has improved what, and how, we eat. And inventions like antibiotics have saved billions of lives. Health-care in general has become much better, especially for mothers and babies. Living an extra 45 years is nothing to sneeze at, but it's just the beginning. In the near future, people are going to be able to live for 115, 150 or even 200 years. If your brain is telling you that's not possible, just think about how quickly science is evolving. It took 200 years to develop the first smallpox vaccine. When polio broke out in 1895, scientists took 50 years to develop a jab against it. But when COVID-19 spread like wildfire in 2020, it took only one year to create effective vaccines which have already saved millions of lives. In the years to come, developments like the Human Genome Project, artificial intelligence, and quantum computing will fuel inventions that we could never have believed possible. People will live longer, chronologically – and they'll also become younger, biologically. So put your skepticism aside and learn all about the Longevity Revolution. One thing's for sure: it's going to change your life.

Developments in how we diagnose illness will save lives.

Today, we're living with a diagnostic crisis. Health systems across the world are overburdened, and even the most competent doctors have little time to spend with their patients. In many parts of the world, people in rural or under-resourced areas have no access to doctors at all. That's why, globally, over 100 million people have undiagnosed thyroid conditions, and 232 million people live with undiscovered diabetes. Medicine is more reactive than proactive. Doctors run around putting out fires when their patients are already sick, rather than making sure that people remain healthy in the first place. But advances in diagnostic technology mean that it's about to change. In fact, it already has. The key message here is: Developments in how we diagnose illness will save lives. Did you use a Fitbit to check how many steps you took today? Or, perhaps, an Apple smartwatch tracks your heart rate? Then you're already benefiting from the revolution in diagnostic technology. A host of technological startups have been racing to create diagnostic devices that are cheap, portable, and easy to use. For example, the Cerebrotech Visor – that you wear like a cap – uses radio waves to detect strokes. Its accuracy is an astounding 93%. A British startup, Owlstone, has created a diagnostic mask that analyzes your breath in real time. And implantable glucose monitors have already changed the lives of millions of diabetic patients. All that data can be fed into an enormous database – a kind of Internet of Bodies. Using machine-learning algorithms, computers will compare your data to information they'd gathered from millions of other people from across the globe. Part of this database is already there. Thanks to companies like 23andMe, it's become easy and affordable to access your genetic information, creating a fuller picture of your health needs. Machines will then consider the latest scientific findings, as well your family history, microbiome, and lifestyle choices. The result? An accurate diagnosis that will allow you to nip diseases in the bud. But diagnosis is just the beginning. Most importantly, these algorithms will be able to pinpoint a course of treatment uniquely suited to your situation. As we'll learn about in the next blink, this is called precision medicine, and it might just save your life.

Using AI, precision medicine finds solutions tailored to the individual.

Teresa McKeown was preparing for her death. She was only in her early fifties, but she had stage three breast cancer. It metastasized and spread to her bowels. Grueling chemotherapy failed to treat it. Teresa was emaciated, in unbearable pain, and seemingly out of options. But then her doctor referred her to an experimental program at the Moores Cancer Center. This was her last resort. Doctors at the Moores Center used AI to sequence and analyze the DNA in her cancer cells. With that information, they searched the database of all available cancer drugs and pinpointed the one that would be most effective. The AI recommended an experimental immunotherapy drug, Opdivo. It seemed like a strange choice, because the drug is usually only used to treat skin, kidney, and lung cancers. But, after only four months, McKeown's cancer was in total remission. The key message here is: Using AI, precision medicine finds solutions tailored to the individual. Until now, treatment for illnesses like cancer has been one-size-fits-all. But every patient has a unique medical history, lifestyle, and genetic makeup. To really be effective, medical treatment needs to be tailored. Luckily,

advances in AI are making that possible. At the moment, patients are wholly reliant on the skills and expertise of their doctors. But those skills vary considerably, and even the best doctors are only human – so they make mistakes and have inevitable off days. What's more, even the best of doctors will struggle to follow all the medical science. One million new peer-reviewed studies appear every year. And new drugs come on the market with dizzying speed. So what's the solution? Well, a form of AI called Natural Language Processing has made it possible for computers to scan hundreds of millions of documents and compare that information to a patient's health diagnostics and genome sequence. The result is an accurate, individual diagnosis and treatment. This approach has already been used to tailor-make drugs for specific patients. But it can also have a preventive function. It will be able to pinpoint hereditary disorders or vulnerabilities and suggest preventative lifestyle changes or medications. Of course, computers won't replace doctors. But they will allow our medics to do their job better, and to tailor treatment to each and every one of us.

Genetic engineering can eliminate diseases.

Imagine you could change and reprogram your genes, just like upgrading the software on your computer. Imagine you could engineer our diseases like cancer or viruses like HIV. That might sound very far-fetched, but the truth is that scientists and doctors already have the technologies to alter our DNA, controlling or eliminating illnesses that we once thought were incurable. Take the example of sickle cell anemia. People who have this disease produce abnormal red blood cells, which can't carry enough oxygen around the body. Patients suffer from chronic pain and fatigue, and have a life expectancy of only 54 years. But doctors are now able to alter the genes that cause this condition. The key message here is: Genetic engineering can eliminate diseases. So, how did genetic engineering help to cure sickle cell anemia? By deploying a very special protein. Our bodies are full of bacteria that are very good at fighting off viruses. When they detect an intruder, a protein is deployed – called Cas9 – that targets the virus and "snips" it out of the cells it had infected. Nobel prize-winning doctors Jennifer Doudna and Emmanuelle Charpentier have shown that this protein – Cas9 – can be "programmed" to target any virus. Thanks to this scientific breakthrough, doctors have been able to combat sickle cell anemia, some forms of muscular dystrophy and heart disease, and even snip the HIV virus out of affected cells. Another promising form of gene therapy involves inserting new, healthy cells into the body, rather than snipping the virus out of unhealthy ones. This has been effective in treating babies with Severe Combined Immune Deficiency – or SCID – a condition that means bodies do not produce the T-cells we need to fight infections. A related gene therapy called CAR T-cell therapy has even had impressive results in curing cancer. It modifies the T-cells to make them better at hunting down and eliminating cancer cells. This therapy has proven effective in curing pediatric leukemia and non-Hodgkin's lymphoma, even in patients who were considered on their deathbeds. Today, gene therapies are prohibitively expensive – the price tag for curing SCID can be close to a million dollars. But as the technology develops and these treatments become more widely used, those prices will drop. It is very likely that diseases like cancer will be completely eliminated in our lifetimes. But can gene therapy improve our longevity, as well as fight disease? We'll find out in the next blink.

We will all become bionic, upgrading our bodies with artificial parts.

Science fiction novels and movies often predict technological innovations. But they also put their finger on the pulse of our cultural anxieties. Think of Frankenstein, for example, the story in which a man was created in a laboratory and turned into a monster. Or all the movies about robots taking over the earth. Well, the truth is that these scenarios are not that far-fetched. In fact, science has progressed to a stage where we can now create body parts in laboratories. And we already rely on prosthetic parts for operations like knee and hip replacements. In the future, the line between the natural and the artificial in our bodies will be eroded even further. The key message here is: We will all become bionic, upgrading our bodies with artificial parts. Take organ replacement, for example. In the United States, over 113 thousand people are on the waiting list for an organ transplant. But the number of donors is far smaller. And not all transplants work: organ donation is hampered by a myriad of factors, like blood type compatibility, for instance. What's more, the logistics of successfully harvesting and transporting organs is incredibly complex. Organs often get damaged in transit, leading to worse outcomes for the patient. And, even if the transplant is successful, most people have to take immunosuppressant drugs for the rest of their lives, so that their bodies don't reject it. Luckily, bold developments in the field of organ transplantation may soon make all this unnecessary. In the future, you won't have to wait for an organ to become available. You'll just make your own. One company, LyGenesis, has developed the technology to grow – essentially – mini livers inside your body. They are all attached to your lymph nodes and can take over from your original liver if it no longer works properly. And another company, Stratagraft, has made new skin in a lab. This product has helped burn victims whose skin is too damaged to regenerate itself. And what if you're having trouble with your sight? Well, in the future, you may be able to use a 3D-printed cornea. A team of engineers at Newcastle University created one using bio ink that contains stem cells and proteins. It works just like the original. And a U.S company called Second Sight has even figured out a way to restore some sight to those with total loss of vision, by creating an electronic connection between the retina and the brain. In the near future, we will all become bionic. What was science fiction looks set to become part of our everyday lives.

Futuristic technologies might allow us to live forever.

In a viral YouTube video, a young girl is shown playing cheerfully in a park. She runs up to her mother and tells her that she's missed her. Then the two of them sit down to light the candles on a birthday cake: the girl is turning seven. Tears stream down her mother's face, but the girl tells her not to cry. After all, she's not sick anymore. This touching video is not what it seems. Although the child in the video appears real, she's actually a mirage of a real girl, who died at the age of seven from a terminal illness. The mirage was created while she was still alive, with the help of a 3D scanner that captured her physical likeness, and interviews that captured her voice, personality, and mannerisms. A company called Vive Studios then created this virtual reality version of the girl, so her mother can interact with the hologram when she's missing her daughter. The key message here is: Futuristic technologies might allow us to live forever.

Technological inventions like these trouble the line between the real and the fake. If the avatar of a seven-year-old girl looks, sounds, and moves just the real child; and if the program spontaneously says the kinds of things the girl herself would say, could she be considered an extension of her person? Most of us would say no. After all, this mirage is just a representation of a person, rather than the person herself. But what makes you, you? And what if even your consciousness could be digitized and stored in some kind of cloud? A researcher at the Oxford Future of Humanity Institute, Anders Sandberg, is attempting just such a feat. He thinks that "whole brain emulation" is possible. This technique would use AI to identify the impulses in your brain, and emulate the patterns. The copy of your brain would think, act, and feel just like the real you. This digital brain could be implanted in the avatar of your choice, and upgraded every few years, much as you'd upgrade your car. The avatar could be an exact physical clone of you, like an identical twin. This futuristic scenario brings up troubling moral questions, like "Are you responsible for the crimes your avatar commits?", and "Can your avatar fall in love, or have children?" There are no easy answers, and these questions will only become more pressing in the years to come.

Immortality doesn't have to be an environmental catastrophe or present an ethical problem.

It's possible to extend human lives. But is that really a good idea? After all, the planet is buckling under the strain of just supporting the current population. Now imagine if everyone lived a hundred years longer! Not everyone is a fan of the idea of extending human life. People raise environmental concerns or worry about morals: What if some humans used their immortal powers to enslave or terrorize their mortal fellow citizens? These concerns are valid, of course. But we can't extrapolate from the present to judge what the future will look like. The key message here is: Immortality doesn't have to be an environmental catastrophe or present an ethical problem. Way back in 1798, economist Thomas Robert Malthus raised very similar fears about overpopulation. He predicted widespread famine, because he thought that farmers would never keep up with the growing population. Malthus's model was based on the assumption that farmers would continue using steam-powered tools and manual labor. But they didn't. Instead, inventions like automated farm machinery, refrigerated transport, and genetic engineering completely transformed agriculture. Malthus didn't have a clue about the future. And neither do we. Who knows what the earth will look like by the time people are able to live to 200. Inventions like lab-grown meat will make it possible to eliminate animal farming and all the environmental devastation that goes with it. And that's just the beginning: other, more exciting, innovations may also be in store. Now let's look at the other concern: the fear that immortality might be based on immorality. It stems from questions about how humans will use new medical technology. Some fear that current disparities in wealth and power will only become greater. Imagine if dictators could extend their lives – and their grip on power – indefinitely? Or if only the wealthy could afford to enhance their bodies and extend their lives, creating two classes of humans? These worries are firmly grounded in reality. But, again, we can't assume that the problems we experience today will be there tomorrow. After all, technologies like DIY diagnostics and AI doctors will actually make healthcare more democratic. Millions of people lack access to hospitals or clinics, and those same people will benefit from lifesaving care delivered via simple smartphones. The future is uncertain, but we can

start shaping it now. Not by cutting innovation in the bud, but by making sure that its benefits will be shared by all.

Do everything in your power to stay alive.

If you're in your twenties or even middle-aged, you can be sure that you'll be able to benefit from the Longevity Revolution within your lifetime. Many of the innovations it promises are already there. But some are still in the early phase, or need time to refine. So, to reap their enormous benefits, you'll need to make sure that you stay healthy for as long as possible. You shouldn't just wait for robot surgeons to save you; your health is in your hands right now, and there's a lot you can do to preserve it. The key message here is: Do everything in your power to stay alive. First of all, make sure that you get regular check-ups. Many forms of cancer are entirely treatable if found early. Not so, if they've already developed. If you're a man over 40, you should get screenings for pancreatic cancer, and if you're a woman, regular checks for breast and cervical cancer are essential. Get your blood work done, and also arrange for a thyroid health check. And don't forget to use the DIY diagnostic tools on your smartphone or Fitbit! You should also watch what you put into your body. Eating a Mediterranean diet that's high in vegetables, good fats, and whole grains, has been proven to boost overall health. It will also dramatically reduce your chance of developing cancer or diabetes, or dying from a heart attack. Consuming too much red meat, animal products, sugar or processed foods, on the other hand, does the exact opposite. A recent Spanish study surveyed 20,000 people and found that those with poor diets had an 18% greater risk of death. And, of course, you should avoid common vices like cigarettes and alcohol. They are the biggest killers around. Tobacco alone accounts for half a million deaths every year in the United States. The other lifestyle change you can make to support your health is exercising regularly. In fact, studies have shown that moderate exercise for just 15-20 minutes a day reduces your risk of dying by around 35%! Even just one brisk walk every day will have enormous benefits. Looking after your mental health is just as important. Good sleep, meditation, and time with people you care about will boost your health as much as any medical intervention.

Final summary

The key message in these blinks is that: The Longevity Revolution is around the corner, and it's entirely possible that humans will live to 200 years, or, perhaps even longer. Cutting-edge technology like human genome sequencing and AI diagnostics have already started to make that possible. In order to benefit from this revolution, we need to look after our health now so that we can stay alive for as long as possible. And here's some more actionable advice: Get enough sleep. One of the best ways to optimize your health is very simple: get enough sleep. Sleeping for at least seven hours a night has been shown to decrease the risks of developing heart disease, diabetes, and cancer. It can also greatly improve your mental health. Make sure you go to bed an hour early so you give yourself enough time to unwind and fall asleep on time. You'll wake up refreshed and ready to tackle another day.