

*New York Times Bestselling Authors of Super Brain*

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Joseph P. and Rose F. Kennedy Professor of Neurology, Harvard Medical School



# SUPER GENES

Unlock the Astonishing Power  
of Your DNA for Optimum  
Health and Well-Being

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## PRAISE FOR *SUPER GENES*

“In *Super Genes*, Drs. Deepak Chopra and Rudolph Tanzi illustrate the interplay of nature and nurture using cutting-edge genetic science and argue persuasively that adapting one’s lifestyle can maximize the potential to transcend the inherited susceptibilities handed down to us from our parents.”

—James Gusella, Ph.D., director, Center for Human Genetic Research, Massachusetts General Hospital

“Once thought to be the domain of genes, the control of health and behavior is now dynamically linked to the environment and more important, *our perception of the environment*. *Super Genes*, by Deepak Chopra and Rudy Tanzi, is a paradigm-shattering synthesis of epigenetic science that offers an easy-to-understand explanation of the mechanisms by which consciousness and environment control our genetic activity. Drs. Chopra and Tanzi’s contribution is a valuable resource that empowers us to become the masters of our fate rather than the ‘victims’ of our heredity.”

—Bruce H. Lipton, Ph.D., epigenetic scientist and bestselling author of *The Biology of Belief*, *Spontaneous Evolution*, and *The Holographic Universe*  
*Honeymoon Effect*

“The concept that biology is destiny is one of the most pathological and toxic exaggerations to emerge during the entire scientific era. This hard-core materialistic view has been a kind of psychological enslavement that has pushed many people into nihilism and despair. In *Super Genes*, Drs. Deepak Chopra and Rudolph E. Tanzi discuss new evidence that our genes are not our masters, but they respond in large measure to our choices and behaviors. The resulting view honors not just the body but the mind and spirit as well—a vision that is as bright and hopeful as the old view was morbid and depressing. *Super Genes* is an important book. It will empower anyone who reads it, because it expands our view of what it means to be human.”

—Larry Dossey, M.D., author of *One Mind: How Our Individual Mind Is Part of a Greater Consciousness and Why It Matters*

“*Super Genes* demolishes the myth that our genes determine our fate. Deepak Chopra and Rudy Tanzi explain in breathtaking detail the magic of how our diet, our lifestyle, our thoughts, and even our gut bacteria or microbiome ‘talk’ to our genes, regulating which genes get turned on or off, or turned up or down, influencing every aspect of our health. This is essential reading for anyone interested in turning on their health, weight loss, happiness, and longevity genes!”

—Mark Hyman, M.D., director, Cleveland Clinic Center for Functional Medicine, and author of the #1 *New York Times* bestseller *The Blood Sugar Solution*

“We used to think everything about us was either our genetics or our environment. But in *Super Genes*, Deepak Chopra and Rudy Tanzi adeptly teach us that it’s all about both—how tightly they are intertwined. And what we can do about it.”

—Eric Topol, M.D., author of *The Patient Will See You Now*, and professor of genomics, the Scripps Research Institute

“I have always been far more interested in how we can all optimize our health, as opposed to simply preventing disease. Both are important, no doubt, but teaching people how they can be better—better, faster, stronger, happier—is so much more inspiring. It is what I loved about *Super Brain*, the first book Deepak and Rudolph wrote, and they now have a muscular follow-up with *Super Genes*. In many ways, *Super Genes* is the prequel to *Super Brain*, because it peers down into the very essence of who we are, what comprises us as human beings, and how much of what we experience is preordained destiny vs. being in our own control. The answer to these questions will inspire you.

“We cannot be content to simply blame our genes, but to realize that we can control this blueprint for life and the way our bodies interpret it.

“Flawlessly weaving together the complicated science of genetics with the touching stories of very real people, my friend Deepak and Rudolph have written a book that you won’t put down. You will find yourself scribbling furious notes and sharing your new wisdom with the people you love. First they gave us all the ability to have Super Brains, and now they have done the same with our Super Genes.”

—Sanjay Gupta, M.D., neurosurgeon and author of *Chasing Life*, *Cheating Death*, and *Monday Morning*

“A groundbreaking and eye-opening account of recent discoveries in two new fields—epigenetics and microbiomics—woven with practical insights to optimize our own wellness and longevity. Rudy Tanzi and Deepak Chopra, renowned pioneers in their respective fields, have written one of the most important health books of the year.”

—Murali Doraiswamy, M.D., professor of psychiatry and medicine, Duke University

“*Super Genes* will take you on an exciting journey of discovery about the ways genetic expression can be modified by simple lifestyle changes and even by how you use your mind. The essential message of this important book is that your genes alone do not determine your destiny. You can learn how to influence them to enjoy better health and optimum well-being. I recommend it.”

—Andrew Weil, M.D., author of *Healthy Aging* and *Spontaneous Happiness*

“Our genes are a predisposition, but they are not our fate. The biological mechanisms that affect our health and well-being are often extraordinarily dynamic—for better and for worse. When we eat well, move more, stress less, and love more, our bodies often have a remarkable ability to transform and heal. *Super Genes* is a superb contribution to our growing knowledge that mind, brain, genome, and microbiome can act as a single system. Drs. Chopra and Tanzi continue to make pioneering contributions that are bringing integrative medicine into the mainstream. Highly recommended!”

—Dean Ornish, M.D., founder and president, Preventive Medicine Research Institute, and clinical professor of medicine, University of California, San Francisco

“Chopra and Tanzi have written what will be a life-changing book for many. It will completely change your perspective on how our genes influence us and how we can influence them. Well researched, elegant, and engaging, *Super Genes* furthers our understanding of the potential that lies inside all of us. This is a must-read.”

—Steven R. Steinhubl, M.D., director, Digital Medicine, Scripps Translational Science Institute

“This book brings you the sanest, most effective way to participate positively in the very evolution of our whole human species. Deepak and Rudy don’t just bring you the wonderful news that you are not a victim of your genes, but dive straight into putting you in charge of your own health through easy, simple, inexpensive changes in your lifestyle that will improve your genome as they bring you, and even your unborn descendants, vibrant good health!”

—Elisabet Sahtouris, evolutionary biologist and futurist and author of *Gaia’s Dance: The Story of Earth & Us*

“*Super Genes* is a superb contribution to our growing knowledge that mind, brain, genome, and microbiome are a single system. Congratulations to both Rudy and Deepak.”

—Keith L. Black, M.D., professor and chair, Department of Neurosurgery at Cedars-Sinai Medical Center, and author of *Brain Surgeon: A Doctor’s Inspiring Encounters with Mortality and Miracles*

“Genetics is a two-way street. Drs. Chopra and Tanzi show how the mind can tell the genes to heal the body.”

—Stuart Hameroff, M.D., Banner University Medical Center, the University of Arizona

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Unlock the Astonishing Power of Your  
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&  
RUDOLPH E. TANZI, PH.D.



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TO OUR FAMILIES, WITH WHOM WE SHARE THE LOVE THAT MAKES OUR GENES “SUPER”

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# GOOD GENES, BAD GENES, AND SUPER GENES

If you want a better life, what would you change first? Almost no one would say “my genes.” And with good reason—we’ve been taught that genes are fixed and unchangeable: What you were born with is what you will keep for life. If you happen to be an identical twin, both of you will have settled for identical genes, no matter how good or bad they are. The popular notion of fixed genes is part of our day-to-day language. Why are some people gifted with more beauty and brains than the norm? They have good genes. Why, on the other hand, does a famous Hollywood celebrity undergo a double mastectomy without any sign of disease? It’s the threat of bad genes, the inheritance of a strong predisposition to the cancer that runs in her family. The public is frightened, and yet the media doesn’t really communicate how rare such a threat actually is.

It’s time to explode such rigid notions. Your genes are fluid, dynamic, and responsive to everything you think and do. The news everyone should hear is that gene activity is largely under our control. That’s the breakthrough idea emerging from the new genetics and also the basis for this book.

A café jukebox may stand in the corner and never move, but it still plays hundreds of songs. The music of your genes is similar, constantly producing a vast array of chemicals that are encoded messages. We are just discovering how powerful these messages are. By focusing on your own gene activity through conscious choices, you can

Improve your mood level, staving off anxiety and depression

Resist yearly colds and flu

Return to normal sound sleep

Gain more energy and resist chronic stress

Be rid of persistent aches and pains

Relieve your body of a wide range of discomforts

Slow the aging process and potentially reverse it

Normalize your metabolism—the best way to lose weight and keep it off

Decrease your risk of cancer

It was long suspected that genes could be involved when bodily processes go wrong. We now know that genes are definitely involved in making them go right. The entire mind-body system is regulated by gene activity, often in surprising ways. The genes in your intestines, for example, are sending messages about all kinds of things that would apparently have nothing to do with a function as mundane as digestion. These messages concern your moods, the efficiency of your immune system, and your susceptibility to disorders closely related to digestion (e.g., diabetes and irritable bowel syndrome), but also those very distantly related, such as hypertension, Alzheimer’s disease, and



autoimmune disorders from allergies to chronic inflammation.

Every cell in your body is talking to many other cells via genetic messages, and you need to be part of the conversation. Your lifestyle leads to helpful or harmful genetic activity. In fact, the action of your genes can potentially be altered by any strong experience throughout your life. So identical twins, despite being born with the same genes, show extremely different gene expression as adults. One twin may be obese, the other lean; one may be schizophrenic and the other not; one may die long before the other. All of these differences are regulated by gene activity.

One reason we called this book *Super Genes* is to raise the bar for what you expect your genes do for you. The mind-body connection isn't like a footbridge connecting two banks of a river. It's much more like a telephone line—many telephone lines, in fact—teeming with messages. And each message—as tiny as drinking orange juice in the morning, or eating an apple with the peel on, or lowering the noise level at work, or taking a walk before bedtime—is being received by the entire system. Every cell is eavesdropping on what you think, say, and do.

Optimizing your gene activity would be reason enough to throw away the self-defeating notion of good genes versus bad genes. But in reality, our understanding of the human genome—the sum total of all your genes—has vastly expanded over the last two decades. After almost twenty years of research and development the Human Genome Project ended in 2003 with a complete map of the 3 billion chemical base pairs—the alphabet of the code of life—strung along the double helix of DNA in every cell. Suddenly human existence is headed for totally new destinations. It's as if someone handed us a map of an undiscovered continent. In a world where we think there's little left to explore, the human genome is a new frontier.

Let us impress upon you how expanded the field of genetics really is today: You possess a super genome that extends almost infinitely beyond the old textbook ideas of good and bad genes. The super genome is made up of three components:

1. The roughly 23,000 genes you inherited from your parents, together with the 97 percent of the DNA that is located between those genes on the strands of the double helix.
2. The switching mechanism that resides in every strand of DNA, allowing it to be turned on or off, up or down, the way a dimmer switch turns the lights up and down. This mechanism is controlled principally by your *epigenome*, including the buffer of proteins that encloses DNA like a sleeve. The epigenome is as dynamic and alive as you are, responding to experience in complex and fascinating ways.
3. The genes contained in the microbes (tiny microscopic living organisms like bacteria) that inhabit your intestine, mouth, and skin, but primarily your intestine. These “gut microbes” vastly outnumber your own cells. The best estimate is that we harbor 100 trillion gut microbes, comprising between 500 and 2,000 species of bacteria. They are not foreign invaders. We evolved with these microbes over millions of years, and today you wouldn't be able to healthily digest your food, resist disease, or counter a host of chronic disorders from diabetes to cancer without them.

All three components of the super genome are you. They are your building blocks, sending instructions throughout your body at this very minute. You cannot grasp who you are, in fact, without embracing your super genome. How super genes got together to form the mind-body system constitutes the most exciting exploration in present-day genetics. New findings are emerging in

flood of knowledge that affects all of us. It's changing the way we live, love, and understand our place in the universe.

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The new genetics can be simplified in a single phrase: *we are learning how to make our genes help us*. Instead of allowing your bad genes to hurt you and your good genes to give you a break in life, which used to be the prevailing view, you should think of the super genome as a willing servant who can help you direct the life you want to live. You were born to use your genes, not the other way around. We aren't indulging in wish fulfillment here—far from it. The new genetics is all about how to alter gene activity in a positive direction.

*Super Genes* gathers the most important findings we have today and then expands upon them. We combine decades of experience as one of the world's leading geneticists and one of the world's most acclaimed leaders in mind-body medicine and spirituality. We may come from different worlds, and we spend our working days in divergent ways, Rudy doing cutting-edge research into the cause and potential cure of Alzheimer's disease, Deepak teaching about mind, body, and spirit to hundreds of audiences a year.

However, we're united in a passion for transformation, whether the roots of change are found in the brain or in the gene. Our previous book, *Super Brain*, used the best neuroscience to show how the brain can be healed and renewed, optimizing its daily function to create much better outcomes for people's lives.

Our new book deepens the story—you could call it a prequel to *Super Brain*—because the brain depends on the DNA in every nerve cell to do the amazing things it does every day. We are taking the same message—you are the user of your brain, not the other way around—and extending it to the genome. Lifestyle is the domain where transformation takes place, whether we're talking about super brain or super genes. There is the possibility, through simple lifestyle changes, of ending up as a person who is activating an enormous amount of untapped potential.

The most exciting news of all is that the conversation between body, mind, and genes can be transformed. This transformation goes far beyond prevention, even beyond wellness, to a state we call radical well-being. This book explains every aspect of radical well-being, showing how up-to-date science either totally supports it or strongly suggests what we should be doing if we want the most life-supporting response from our genes.

The terms *good genes* and *bad genes* are misleading because they feed into a big, common misconception: biology as destiny. As we'll explain, there are no good versus bad genes. All genes are good. It is *mutation*—variations in the DNA sequence or structure—that can turn genes bad. Other mutations can also turn genes "good." Disease-associated gene mutations that will actually destine a person to acquire a disease with certainty in the span of a normal life span amount to only 5 percent of all disease-associated mutations. This is a minuscule portion of the three million or so DNA variations in each person's super genome. As long as you keep thinking in terms of good genes and bad genes, you've imprisoned yourself in bad, outmoded beliefs. Biology is being allowed to define who you are. In modern society, where people have more freedom of choice than ever before, it's ironic that genetics became so deterministic. "My genes did it" became the blanket answer to why someone overeats, suffers from depression, breaks the law, has a psychotic break, or even believes in God.

If the new genetics is teaching us anything, it's about nature cooperating with nurture. Your genes can predispose you to obesity or depression or type 2 diabetes, but this is like saying that a piano predisposes you to play wrong notes. The possibility exists, yet far more important is all the good music a piano—and a gene—are capable of.

We offer you this book in the spirit of expanding your well-being, not because there are so many wrong notes to avoid, but because there's so much beautiful music left to be composed. Super geniuses hold the key to personal transformation, which has suddenly become far more attainable—and desirable—than ever before.

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# WHY SUPER GENES?

## An Urgent Answer

**T**he purpose of this book is to raise everyday well-being to the level of radical well-being. Such a goal requires a journey of transformation through an understanding of our own genetics. This fascinating field of inquiry has led to a flood of exciting findings, and more appear every day. Human DNA has many more secrets to reveal. Yet a tipping point has already been reached. It has become blindingly clear that the human body is not what it seems to be.

Imagine you are standing in front of a mirror: what do you see? The obvious answer is a living object, a moving machine of flesh and blood. This object is your home base and protective shelter. It faithfully takes you where you want to go and does what you want to do. Without a physical body, life would have no foundation. But what if everything you assumed about your body were an illusion? What if that *thing* you see in the mirror isn't a thing at all?

In reality, your body is like a river, constantly flowing and changing.

Your body is like a cloud, a swirl of energy that is 99 percent empty space.

Your body is like a brilliant idea in the cosmic mind, an idea that took billions of years of evolution to construct.

These comparisons aren't just images—they are realities pointing to transformation. Right now, the body as a physical thing fits in with everyday experience. To paraphrase Shakespeare, if you cut yourself, do you not bleed? Yes, of course, because the physical side of life is totally necessary. But the physical side comes second. Without those other possibilities—the body as idea, energy cloud, and constant change—your body would fly away, vanishing into a random swirl of atoms.

Once you see past the facade of that image in the mirror, the big story begins. Behind the mirror, so to speak, genetics has been unfolding the story of life in stages, punctuated by the 1953 breakthrough that revealed DNA's double helix, a twisted ladder with billions of chemical rungs. In the past ten years, however, the story has exploded, thanks to the discovery of how active our genes really are. Everywhere in the body, a cell puts the secret of life into practice:

It *knows* what's good for it and seizes upon the good.

It *knows* what's bad for it and avoids the bad.

It sustains its survival from moment to moment with total focus.

It monitors the well-being of every other cell.

It adapts to reality without resistance or judgment.

It draws upon the deepest resources of Nature's intelligence.

Can we, the summation of all those cells, say the same for ourselves? Do we eat too much, overindulge in alcohol, put up with pummeling stress, and rob ourselves of sleep? No healthy cell would make such choices.

So why the disconnect? Nature designed us to be as healthy as our cells. There is no reason not to be. Cells naturally make the right choices at every moment. How can we do the same?

What's so exciting about recent research is that gene activity can be greatly improved, and when this happens a state of radical well-being is possible. What makes it radical is that it goes far beyond conventional prevention. The very foundation of chronic disease is being exposed by the new genetic tools. We are seeing how lifestyle choices made years ago profoundly affect how the body operates today, for both good and ill. Your genes are eavesdropping on every choice you make.

We hold that radical well-being is an urgent need, and we believe wholeheartedly that we can convince you of this. Unknown to the vast majority of people, there's a hole in conventional well-being, a hole big enough that accelerated aging, chronic disease, obesity, depression, and addiction have managed to slip through. All efforts to counter these threats have been only half successful at best. A new model is needed. Here's how one woman experienced this need.

## **RUTH ANN'S STORY**

When Ruth Ann developed pain in both hips, she initially shrugged it off. At fifty-nine, she prided herself on how well she was managing her body. She had superb impulse control, eating the right foods without the snacking and guilty dashes to the fridge for ice cream at midnight that gradually piled on pounds. She didn't smoke and rarely drank. Her cupboard held a stock of vitamins and nutrition supplements. Her exercise routine went beyond the recommended minimum of four or five periods of vigorous activity per week—she spent two hours at the gym every day. As a result, on the eve of turning sixty, Ruth Ann could show off a perfect figure, which had been her main focus all along.

The arrival of pain in her hips two years earlier was annoying, but she didn't let it affect her exercise routine. Gradually the pain became chronic; it spiked whenever she ran on the treadmill. Eventually she needed to lie down for an hour every afternoon to allow the pain to subside. Ruth Ann went to her doctor. X-rays were taken, and the news was bad: She had degenerative osteoarthritis. Sooner or later, the doctor informed her, she was facing a hip replacement.

The cause of arthritis, of which there are many types, is unknown, but Ruth Ann has her own explanation. "I shouldn't have been such an exercise fanatic. I pushed myself too hard, and now I'm paying the price." She felt defeated. In her mind, she had been doing all the right things to postpone "turning into an old lady." This was her biggest fear. Now, as if tiny goblins were coming out of the closet, the symptoms of accelerated aging were upon her. Her figure is that of a thirty-year-old, but appearances deceive. She feels tired for no reason. Her sleep and appetite have turned irregular, with nights of severe insomnia that can go on for several weeks. Small stresses give rise to low-level anxiety. Ruth Ann has never felt helpless before. Whenever she has a mental image of herself as an "old lady," she wishes she could run back to the gym and get on the treadmill again.

The bottom line is that Ruth Ann feels her body has betrayed her. Yet consider how the situation looks from a cell's point of view. A cell doesn't push itself beyond its limits. It heeds the slightest sign of damage and rushes to repair it. A cell obeys the natural cycle of rest and activity. It follows the deep understanding of life embedded in its DNA. By conventional standards, Ruth Ann did all the

right things, yet at a deeper level she was disconnected from her body's intelligence.

We have so much that's positive to tell you that we will state the negative side just once: The two major threats to well-being—illness and aging—are constantly present. Out of sight, without you knowing it, your present good health is being silently undermined. Abnormal processes are taking place in everyone's body at a microscopic level. Anomalies inside a cell that affect only a cluster of molecules or the shape of one enzyme are virtually undetectable. You can't feel them as an ache or pain or even as vague discomfort. Such abnormalities can take years to develop into even minor symptoms. But the day will arrive when our body starts to tell us a story we don't want to hear, just as Ruth Ann's body did.

This book tells you how to avert that day for years, or even decades, to come. The possibility of radical well-being is very real, and the most exciting developments are merely a prelude to a revolution in self-care. Become a pioneer in that revolution. It's the most significant step you can take in shaping the future you desire for body, mind, and spirit. Your genes play a part in all of these areas as we're about to show you.

## FROM GENES TO SUPER GENE

The threats that undermine your well-being are persistent. Even if you consider yourself safe right now, how secure is your future? Genes can help answer that question. They can lead you to make life-supporting choices while correcting the wrong choices made in the past. The first step is to focus on the cell. Your body has approximately 50 trillion to 100 trillion cells (estimates vary widely). There is no process—from thinking a thought to having a baby, from fending off invading bacteria to digesting a ham sandwich—that isn't tied to a specialized activity in your cells. A cell must look to its DNA to keep it perfectly functioning, because DNA, as the "brain" of the cell, is ultimately in charge of every process. In a healthy person, this activity occurs perfectly more than 99.9 percent of the time. It's the tiny exceptions, amounting to the merest fraction of 0.1 percent, that can cause trouble.

The DNA that's neatly tucked inside each cell is something magnificent, a complex combination of chemicals and proteins that holds the entire past, present, and future of all life on our planet. Bacteria are essential to the body, too, with trillions of them lining the gut and the surface of the skin. These form colonies known as the microbiome. It's long been known that bacteria in the intestine make digestion possible. But recently the microbiome has assumed much greater importance. For one thing, there's the sheer number of bacteria involved, which amount to something like 90 percent of the cells in the body. Even more crucial, bacterial DNA became part of human DNA over the course of billions of years. It is estimated that 90 percent of the genetic information inside us is bacterial—our ancestors were microbes, and they are, in many ways, still present in the structure of our cells.

In fact, your body may contain 100 trillion or more bacteria (a very rough estimate). In isolation they would weigh somewhere between three and five pounds in dry weight. If we keep score by the number of different genes you possess, it would be about 23,000 genes inside your cells and 1 million genes for all these various microbes. In a sense we are sophisticated hosts for the micro-organisms that colonize us. The implications for medicine and health are potentially staggering and are just now being explored. One conclusion is inescapable: the human genome, having expanded tenfold, has become a super genome. Because of the microbes now being wrapped into the story, Earth's 2.8-billion-year-old genetic legacy is present inside each of us, here and now. Much of the original stuff, genetically speaking, is still propagating inside the cells of your body.

The fact that DNA stores the entire history of life gives it tremendous responsibility. One slip and an entire species can be wiped out. Realizing this fact, geneticists spent many decades thinking about DNA as a stable chemical, its biggest threat being the instability created when a mistake slipped by the body's defenses. But now we realize that DNA is responsive to everything that happens in our lives. This opens the door to many new possibilities that science is just now beginning to grasp.

## SASKIA'S STORY

Some people find themselves apparently victimized by their genes; others are rescued by them. One woman experienced both. Saskia is in her late forties with advanced breast cancer that has metastasized to other locations in her body, including her bones. In her most recent battle against the disease, Saskia bypassed chemotherapy in favor of immunotherapy, which aims at increasing the body's own immune response. She also decided to spend a week learning how to take care of herself through meditation, yoga, massage, and other complementary therapies. (The program she attended was given at the Chopra Center. We mention this in the spirit of full disclosure, not to take credit for what occurred next.)

Saskia enjoyed the week and came away with a feeling that she could relate to her body in a better way. She appreciated how well she was treated, pointing in particular to the loving attitude of the massage therapists. At the end of the week she reported that her bone pain had gone away, and she went home feeling much better, emotionally and physically. She recently sent a follow-up e-mail describing what happened next.

The day after I got home, I had another PET/CT scan. This one was four months after the last. The following week I met with my oncologist. Though I was expecting the worst, I had decided that no matter how bad my scan looked, I felt a lot better, and that's what counted. But instead of bad news, he told me that he had never seen such a response in such a short time, and especially without the use of chemo drugs....He was very surprised and is much more interested now in what I'm doing!

I told him about what I learned at the Chopra Center (especially meditation, yoga, and massages), the dietary changes I'd made, and how supportive my husband has been in these last few months. I believe that all these things were working together to make healing possible.

Basically all the many metastases to my lymph nodes are gone, as well as the metastases to my liver; more than half of the mets to my bones have disappeared. The remaining bone mets have all diminished greatly in size. There's one new lymph node met on the left side of my neck, but the doctor believes it's insignificant in light of the vast improvements everywhere else. He told me to just keep doing whatever I'm doing.

There are two attitudes to take to this story. One is the standard medical response, which amounts to dismissal.

Faced with Saskia's experience, most oncologists would consider it merely another piece of anecdotal evidence that has little bearing on the overall statistics relating to cancer treatment and survival. Cancer is a numbers game. What happens to thousands of patients tells the tale, not what

happens to one patient. The other attitude to Saskia's experience is to explore how changes in her situation led to such a remarkable result. Let's list all the changes she experienced that might influence gene expression:

- Improved attitude toward her disorder
- Increased optimism
- Decreased bone pain
- Emotional support from her husband
- New knowledge about the mind-body connection
- New lifestyle choices added to her daily routine: meditation, yoga, massage
- Benefits from therapeutic massage and other treatments at the center

The list looks quite diverse, and only one or two items on it would be found under current standard cancer treatments. But there's a common thread to every item. New messages were sent from her brain and her genes. If medicine could decode these messages, we'd get much closer to solving the mystery of healing. It can be hard for any physician who is in the business of curing his patients to admit that the only true healer is the body itself. And how the body pushes atoms and molecules around to achieve healing—or not—remains a deep mystery.

What will happen to Saskia in the coming months and years is unpredictable. We are not promoting miracle cures in any way, shape, or form. We know full well that *miracle* isn't a useful term for understanding how the body operates.

If you could listen in on the stream of messages received at the genetic level over the course of a single day, in all likelihood you'd hear the following:

*Keep doing what you're doing.*

*Reject or ignore change.*

*Keep problems away from me. I don't want to know about them.*

*Make my life pleasant.*

*Avoid difficulties and pain.*

*You take care of it. I don't want to.*

You aren't aware that this is what you are telling your genes, over and over, because you don't put these messages into words like a telegram. But your *intention* is clear, and cells respond to what you want and do, not what you say. Each of us is incredibly fortunate that our bodies can run automatically with almost total perfection for decades at a time. But unless we participate in our own well-being, sending conscious messages to our genes, running on automatic isn't good enough. Radical well-being requires conscious choices. When you make the right choices, your genes will cooperate with whatever you want.

This is the new story we want you to follow, and to turn into your own story. When you use your genes for transformation, they become super genes. To guide you to the goal, the rest of the book is organized into three parts:

*The Science of Transformation:* Here we give you the latest knowledge about the new genetic



and the revolution that is changing biology, evolution, inheritance, and the human body itself.

*Lifestyle Choices for Radical Well-Being:* Here we provide a path for change that's both practical and, as much as possible, effortless.

*Guiding Your Own Evolution:* Here we go to the source of all growth and change, which is consciousness. You cannot change what you aren't aware of, and when you are totally aware, the promise of self-directed transformation comes true.

There's the map. Now we begin the journey. The map has marked out the territory to be covered, but until you enter the territory, it won't become real for you. What makes this journey unique is that every step has the power to change your personal reality. Nothing could be more fascinating or more rewarding.

Almost a thousand years before DNA revealed its first secret, the mystic Persian poet Rumi took the same journey. He looked over his shoulder to tell us where the road leads:

*Motes of dust dancing in the light*

*That's our dance, too.*

*We don't listen inside to hear the music—*

*No matter.*

*The dance of life goes on,*

*And in the joy of the sun*

*Is hiding a God.*

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Part One

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# **THE SCIENCE OF TRANSFORMATION**

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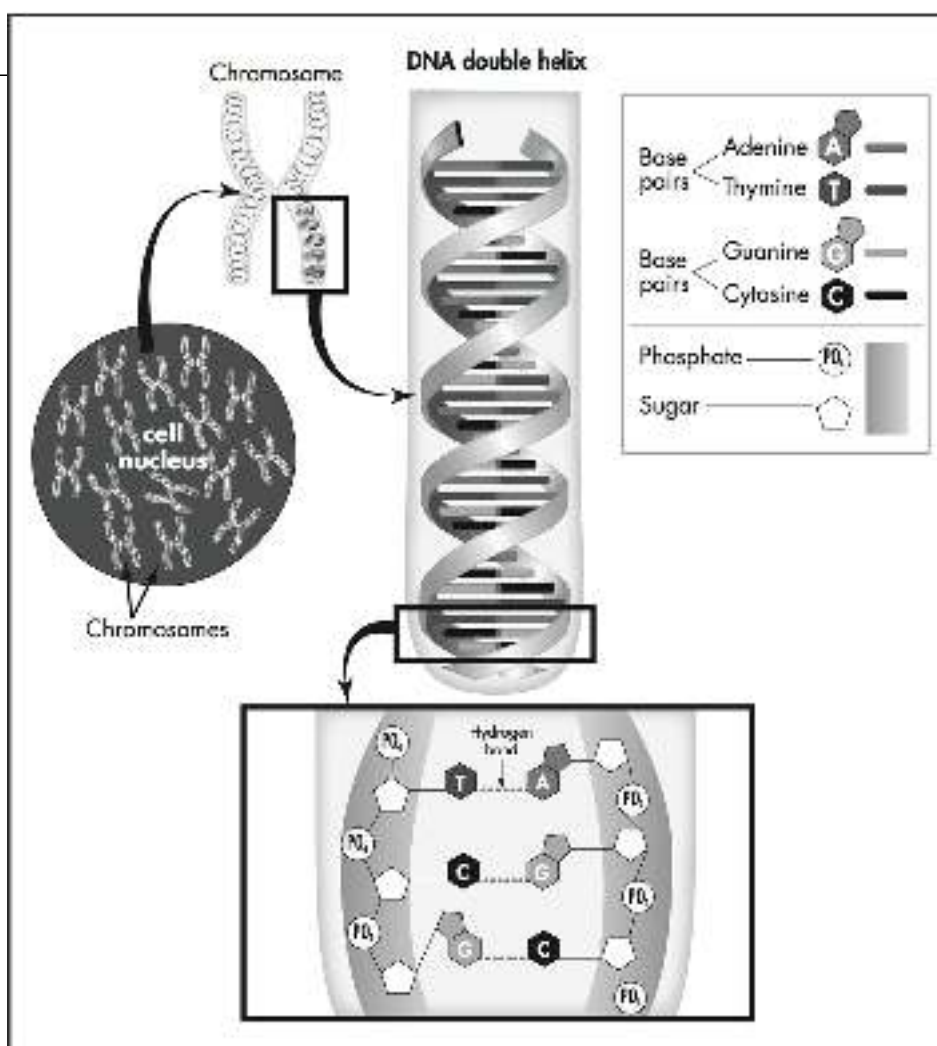
**T**hanks to the genetic revolution happening all around us, a new and powerful ally has appeared to aid human happiness. The notion that DNA contains the code of life isn't new. But it's very new to say that you can *use* your genes. DNA isn't locked up like a frozen bank account you can't draw on. As we mentioned earlier, the old belief that "biology is destiny" no longer has the iron grip it once did. The science of transformation tells a new story, of endless possibilities arising from DNA. But to understand that story, we need to look at DNA in all its fantastic complexity.

The evolution of all planetary life is condensed inside deoxyribose nucleic acid, to use DNA's full name. A single strand of DNA is 3 meters long, yet it fits into a space of only 2 to 3 cubic microns in the cell's nucleus (1 micron = 1 millionth of a meter, or roughly 1 millionth of a yard). Only about 3 percent of your DNA is made up of genes, which provide the blueprints for proteins and ribonucleic acid (RNA), the facsimile of DNA with which proteins are made or gene activity can be regulated. These, together with fat, water, and a huge host of friendly microbes, make up your physical body. To a geneticist, you are a highly complex colony built by DNA, and you are constantly being rebuilt.

The body's superstructure is constantly under revision based on how you live your life. What is known as gene expression—the thousands of chemical products produced by genes—is highly malleable. This goes against what most people know or believe. For instance, how many times have you heard these common phrases: "he's a chip off the old block"; "the apple doesn't fall far from the tree"; "he's just like his old man"? Just how true are the old adages? Are we really just the repetition of biology and continuing personality of our parents, with a few variations thrown in?

The new genetics says no. Like your brain, which responds to every choice you make, your genome is constantly responsive. While the genes your parents passed on to you won't change in the future, new genes—your unique blueprint stays the same throughout your lifetime—gene activity changes fluidly and often very quickly. Genes are susceptible to adverse change that can occur as the result of diet, disease, stress, and other factors. That's why everyday lifestyle choices have repercussions down to the genetic level. It's entirely through gene expression that the body's intelligence acquires its physical form. What's even more astonishing, as we will see, is that how you influence your body today may be felt in the well-being of your children and grandchildren far in the future.

Besides DNA, your genome is made up of special proteins that support and "cushion" the DNA. DNA itself is composed of four chemical bases that pair up to form rungs on the double helix.



These four bases are adenine (abbreviated as A), thymine (T), cytosine (C), and guanine (G). The fact that an alphabet of only four letters is responsible for every life form on Earth never ceases to astonish. Here's how complexity arises from simplicity: A pairs with T, and C pairs with G. Your unique genome carries 3 billion of these bases from each parent. The 3 billion bases are divided up into 23 chromosomes, which are labeled from 1 to 22 plus the sex chromosomes, X and Y. The mother always gives her baby an X chromosome. If the father gives a Y chromosome, the baby's sex will be male; if an X chromosome, the sex will be female. Since each of your parents gave you 23 chromosomes and 3 billion bases of DNA, your cells contain a total of 46 chromosomes and 6 billion bases. It's possible to see already how Nature supplied itself with enough building materials to make a moth, a mouse, or a Mozart out of four letters.

The completion of the epoch-making Human Genome Project in 2003, along with subsequent studies, yielded some surprising, even baffling, results. For example, our genome contains roughly 23,000 genes, which is far fewer than anyone supposed. We consider *Homo sapiens* the most evolved life-form on Earth, but that's not the same as having more genes—the genome of rice, which contains only 12 pairs of chromosomes, has as many as 55,000 genes! How as a species do we get away with fewer genes than a grain of rice? The answer has to do with how efficient our genes have become, and especially how many diverse proteins each of our genes can make. Gene expression is the key.

Compared with the genes in rice, each of our genes can make many different versions of the same protein, each with a slightly different role in the body, whether it's building a cell or regulating it. Thanks to the evolution of human DNA, we get more biological function from fewer genes. Economies of scale, together with redundancy (providing backup so that survival doesn't depend on one gene),

system), is the rule in evolution. Our genes are still evolving to provide more bang for the buck, so speak. Moreover, the genes that are most important for the survival of our species have backup copies just in case some become corrupted with harmful mutations. Talk about efficient and forward thinking!

## BECOMING UNIQUE

From just these basic facts, it becomes clear that your genetic makeup is unique in two ways. First, you are unique in the genes you were born with, which no one else duplicates unless you are an identical twin. Second, you are unique in what your genes are doing right at this moment, because the activity is your story, the book of life that you are the author of. The outcome of ordinary lifestyle choices (*Do I go to the gym or stay home? Do I gossip at work or stay out of other people's business? Do I donate money to charity or fatten my bank account instead?*) depends on a single question: *What am I asking my genes to do?* The back-and-forth between you and your genome is the determining factor in your present and future.

It doesn't take the whole genome to make you unique, however. In the three billion bases of DNA that each parent give you, there is a difference once every thousand bases compared with the vast majority of human DNA on the planet. This means that each of your parents passed on roughly three million bases that are known as DNA variants. A DNA variant can sometimes, but rarely, guarantee a certain disease within a normal life span or simply serve to increase one's risk without guaranteeing the disease. For example, at one of the 3 billion steps of the double helix, you may have the base C while your sibling has a T. This difference may result in your being predisposed to developing a disease like Alzheimer's or a particular form of cancer, whereas your sibling is not.

Contrary to public perception, there is no such thing as a "disease gene." All genes are "good" and provide a normal function needed by the body. It's the variants they harbor that can bring problems. On the positive side, some mutations increase resistance to disease. A few rare family strains, for example, have given almost total immunity to heart disease. No matter how much fatty food is in their diet, the cholesterol isn't converted into blood fats that line the coronary arteries with plaque. Geneticists have sought out these isolated populations to discover which variant might have gifted them with resistance to heart disease. By the same token, there are small, rare populations in which presenile Alzheimer's disease affects almost the entire family line. They, too, must be studied in an attempt to discover if a genetic signature is responsible for such a bad outcome.

Rudy was fortunate to be intimately involved with the earliest pioneering events of the current genetics revolution. When he and his colleague Dr. James Gusella were still in their early twenties carrying out the first mapping of the human genome at Massachusetts General Hospital, they became the first researchers in the world to locate a disease-causing gene by tracking natural DNA variants across the genome. In their landmark study, they were able to show that the gene for Huntington's disease resides on chromosome 4. Huntington's disease is a fatal disorder in which no clues about the cause were previously available.

Some variants are common ones, being present in more than 10 percent of the human population while others are rare, isolated mutations. A genetic variant can predispose you to certain diseases or behaviors, which is why research focuses so intensely on the genetic contribution to Alzheimer's and depression. Other variants do nothing at all, at least not so far in our evolution. Your personal DNA "fingerprint" is based on the set of variants you inherited. These determine both the functioning and

structure of the hundreds of thousands of different types of proteins in your body.

The number of gene variants that give you a fixed characteristic like blue eyes or blond hair are known as fully penetrant gene variants, and they are in the vast minority, as few as 5 percent of the total. But, in the vast majority of cases regarding health and personality, your genetic destiny is not set in stone. Genes are only one component of the almost infinite interplay of DNA, behavior, and the environment.

This fact was underlined by a 2015 study on autism published in the journal *Nature Medicine*. Autism is a baffling disorder because there is no single kind of autism, but rather a wide spectrum of behavior, one that Rudy has worked on extensively over the course of his career. The mass media image of an autistic child portrays a totally withdrawn state in which the child hardly reacts to anything outside stimuli. Totally lost in himself, he may rock back and forth or “twiddle” with repeated, robotic gestures. Emotions are stunted or nonexistent. The parents are desperate to find a way to break through the shell.

But in some families there are two autistic children, and more often than not, the parents say that their behavior is very different. The new study, which looked at the genes of autistic siblings, confirmed this impression. Researchers looked at eighty-five families in which two children had been diagnosed with autism. It’s possible, through techniques known as genome-wide association screening and whole genome sequencing, to look at millions of DNA variants in someone’s genome. The study targeted 100 specific variants that have been genetically associated with a greater risk of being autistic. To everyone’s surprise, only about 30 percent of the autistic siblings shared the same mutation in their DNA, while 70 percent did not. In the shared group, the two autistic children behaved more or less alike. But in the unshared group, the 70 percent, their behavior was as different as any two brothers or sisters. What this suggests is that autism is unique because each person is unique. Even if scientists examined the genome of thousands and thousands of autistic children, it would be extremely challenging to determine the biological basis of the disease.

Unfortunately, not being able to predict autism in advance brings us back to a state of uncertainty. The chances of having two autistic children in a family of four or more is remote, about 1 in 10,000. As reported in the *New York Times*, a Canadian couple who already had one severely autistic child and one child with no developmental problems went to the doctor’s with their wish to have a third child. What was the risk that the new baby would be autistic? Hospitals examine the genome of the oldest affected child to arrive at a prediction. In this case, the couple were told that the chances of having another autistic child were slim, and in any event, if the child were autistic, it wouldn’t necessarily be to a severe degree.

But, in reality, the new baby, which the couple decided to have, did develop severe autism. And the couple report that their two autistic children don’t behave alike. One is outgoing enough to run up to strangers, while the other holds back. One loves to play with computers; the other has no interest. One runs around, while the other prefers to sit in one place.

This is the outcome of diversity. No matter how many genetic samples you take from a family line, the next baby to be born will be largely unpredictable, not just in terms of the risk of autism but in general.

While genes clearly determine some things, like the onset of some rare forms of disease, most of the time the gene variants that we inherit merely confer a *susceptibility* toward a disease. The same can be said about genetic predisposition to certain behavior or personality types. The bottom line is that what we do, what we experience, and how we view the world, along with what we are exposed

in our environment, strongly influence the actual outcome of the genes we inherit. No one can put a precise number on how much influence you can exert on your gene expression. But there's no longer any doubt that your influence is important, because it's in play all the time.

It's now possible to reconstruct the genome of Neanderthals from their remains, but no matter how minutely their genes are examined, the future evolution of humans isn't observable. There is no gene for mathematics or science. If you compared Mozart's genes to an amateur violinist's, you couldn't detect which one was the musical genius. Even the most basic predictions are turning out to be far from simple. A pregnant mother might want to know how tall her baby will grow up to be. There isn't a single gene for height. So far, it seems that more than twenty genes are involved. Even if you could predict how these twenty genes will express themselves, at best you would arrive at 50 percent of the answer. Environmental factors like diet, including both the mother's diet and the baby's, will contribute the other half.

Let's be extremely generous and foresee that genetics, using some sort of super computer, might one day handle all the interlocking physical factors. With all those data, predicting how tall a child will grow up to be would still remain uncertain, because unexpected events always arise. There is a condition known as psychological dwarfism, for example, in which young children raised in an abusive family situation become stunted in their growth. The mind-body connection has turned a psychological factor, heavily weighted with emotional damage, into physical expression. In short, DNA's alphabet has immeasurable "words" to write, and what they will be is unknown.

Sometimes you can witness in action how life experiences alter a person's DNA. At the end of each chromosome is a section of DNA called a *telomere*, which protects the chromosome from unraveling, like the tip of a shoelace. As we age, our telomeres get shorter with every new division of a cell. After dozens of divisions, the protective telomeres become so short that the cell becomes senescent—that is, it stops being able to divide anymore. The death of the cell follows, along with the absence of new cells to replace it.

As it turns out, a person's experiences also affect telomeres. Scientists at Duke University analyzed DNA samples first from five-year-olds and then again when the children were ten. The researchers knew that some of these children experienced physical abuse, bullying, or violent domestic disputes. The ones who experienced the most negative and stressful experiences underwent the most rapid erosion of their telomeres. On the other hand, other research indicates that exercise and meditation have been shown to increase the length of telomeres.

The implications are profound. Longevity is not only influenced by the DNA variants inherited from your parents. What happens to you today will perhaps show up tomorrow in the structure of your chromosomes.

One of the most fascinating journeys in the new genetics revolves around life experiences and our genes. Human existence is infinitely complex, which makes it a bewildering task to understand how genes react to daily life. Somehow they do, and we've made a start in revealing how they do it—that's the subject of our next chapter, which exposes many new possibilities and many mysteries at the same time.

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# HOW TO CHANGE YOUR FUTURE

## The Arrival of Epigenetics

**W**hat enables genes to be just the opposite of fixed—fluid, malleable, and interconnected—falls under a new field called *epigenetics*. The Greek word *epi* means “upon,” so *epigenetics* is the study of what is on top of genetics. Physically, *epi* refers to the sheath of proteins and chemicals that cushion and modify each strand of DNA. The entire amount of epigenetic modification of the DNA in your body is known as the *epigenome*. Research on the epigenome is probably the most exciting part of genetics right now, because it is here that genes get switched on and off (like a light switch) and up and down (like a thermostat). What if we can control these switches voluntarily? The prospect makes any adventurous geneticist dizzy with the possibilities.

In the 1950s, before it was suspected that the epigenome existed, an English biologist named Conrad Waddington first proposed that human development from embryo to senior citizen was not completely hardwired in DNA. It took decades for the notion of genetic “soft wiring” to catch on, for the now familiar reason that genes were thought to be fixed. But eventually it was impossible to ignore certain anomalies. Identical twins are the classical example, because they are born with identical genes. If DNA hardwires them, identical twins should be biologically predestined to live exactly the same all their lives.

But they aren't. Identical twins with virtually the same genomic DNA can be very different based on how they experience the world and how this translates into gene activity. If you know a set of twins, you've no doubt heard them express how different they feel from each other. It takes more than the same genome to create a person. Two identical buildings can be constructed with the same blueprints but be very different places based on the activities inside. Schizophrenia, for example, is known to have a genetic component, yet if one twin is schizophrenic, there is only a 50 percent chance that the other will be. This mystery requires further discussion, but you can see the dilemma posed for “biology as destiny.” Epigenetics was born when geneticists focused on the controls behind gene expression. It turns out that the flexibility of these controls is one of the most precious of life's gifts.

While all the cells in your body have largely identical DNA sequences and genetic blueprints, each of the two hundred or so different cell types possesses different structures and roles. Under a microscope, a neuron looks so different from a heart cell that you would hardly expect them to be operated by the same DNA. Genes are programmed to create a variety of different cells from stem cells, which are the “baby” precursors to mature cells. Stem cells stored in your bone marrow, for example, replace your blood cells as they die, which is every few months. The brain has a lifetime supply of stem cells also, which allows for the generation of new neurons at any stage of life—very good news for an aging population that wants to remain as vital and mentally alert as possible.



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