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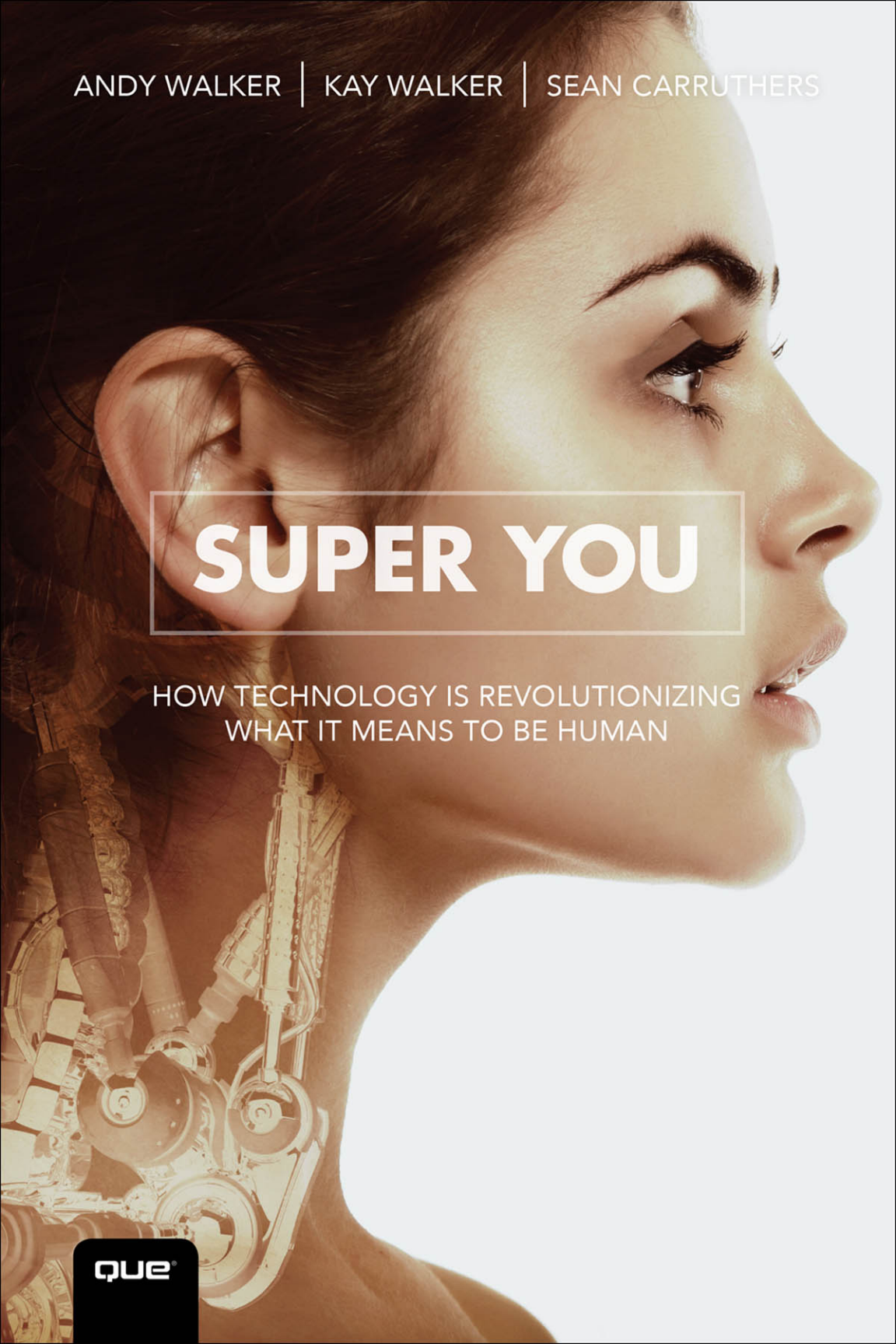

SUPER YOU

HOW TECHNOLOGY IS REVOLUTIONIZING WHAT IT MEANS TO BE HUMAN

que®

SUPER YOU

How Technology Is Revolutionizing What It Means to Be Human

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Super You

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Foreword

Let's face it, the world is moving quickly into a future full of uncertainty. One where for the first time in history, human beings may no longer be classified as a mammal. One where technology will naturally be a part of man's evolutionary footprint.

There are many people today that have done the research. They understand the future we are inevitably walking into. Technology is growing faster than it ever has before. There will come a day where man will build machines that match and then supersede his intelligence.

These groups use different words to describe the new era: Transhumanist, posthuman, techno-optimism, cyborgism, humanity+, immortalist, machine intelligence, robotopia, life extension, or Singularity.

While there is overlap, each name represents a unique camp of thought, strategy, and possible historical outcome for the people promoting their vision of the future. Collectively, they all believe in the same experience of life, something the authors have captured so expertly in this book. We are walking into the "Age of Super You."

This book is a guide to that future. It explores some of the major themes we face in this new era. How will science and technology impact our humanity? What will we look like? What will our children look like and become? Will we be healthy? Will we live for hundreds of years? Can death be cured? Who will be in the way of all this? Can our leaders, government, and clerics keep up with it all?

As this book goes to press, I am in the final months of running for President of the United States. I'm running as the leader of the Transhumanist Party, a political organization I founded seeking to use science and technology to radically improve the human being and the society we live in.

In addition to upholding American values, prosperity, and security, many of these issues are on my mind.

The three primary goals of my political agenda are as follows:

1. Attempt to do everything possible to make it so this country's amazing scientists and technologists have resources to overcome human death and aging within 15 to 20 years—a goal an increasing number of leading scientists think is reachable.
2. Create a cultural mindset in America that will embrace and produce a radical technology and science that is in the best interest of our nation and species.
3. Create national and global safeguards and programs that protect people against abusive technology and other possible planetary perils we might face as we transition into the transhumanist era.

There is a burgeoning movement in the United States, and as well as many other countries, that we need to prepare for a robust technology-enhanced future. The authors have crisply defined the trend in their book and have cleverly looked back to see how it happened and look forward to see where it is going. Even though it wasn't intended to be a guide to the future and how we got there, in many ways it is.

The book examines how humans are transforming themselves through science and technology to become better versions of themselves, to live healthier and more fulfilling lives, and to hyperextend their human capabilities, including their longevity.

There's increasing evidence everyday from the frontiers of science—and already in the warehouses of ecommerce companies—that much of what this book examines and predicts is, or soon will be, a near-term reality.

In 1969, as man first walked on the moon, we lived in a largely analog society. There was no sign of the digital economy that was about to sweep the world in the next three to four decades, and yet, life has since radically changed. First, with the personal computer in the 1980s and the birth of the consumer Internet revolution in the 1990s and the mobile revolution in the 2000s and 2010s. Information that was once limited to black and white television screens on the evening news and in newsprint each morning now flows freely and ubiquitously on-demand, and with no regard for your location.

All that was around the corner back then, but only a few could see it. The Jetson future was about the raw power of rockets, a push-button work week, and flying cars, rather than the simplicity and elegance of the Internet, the transformational nature of a digital economy, and the radical hybridization of machine and human that's about to arrive.

The future is hard to predict with any accuracy. Still, here in 2016, we know a major shift is about to happen again. We can see the macro-trends of the technology Singularity coming, and fast. It will be tectonic in how it shifts society.

You'd think every politician in the twenty first century would be publicly and passionately pursuing and preparing for the future. But they're not. They're more interested in landing your votes, making you slave away at low-paying jobs, keeping you addicted to shopping, forcing you to accept bandage medicine and its death culture, and getting you to pay as much tax as possible to fund far-off wars. There's no regard for the future.

And if transhumanists—a growing group consisting of futurists, life extensionists, biohackers, technologists, singularitarians, cryonicists, techno-optimists, a few authors, and many other scientific-minded people—are serious about the pending future, then it's time to get involved. If it's new territory for you, start by reading this book.

Zoltan Istvan
Presidential candidate and founder of The Transhumanist Party
April 2016

About the Authors

Andy Walker has had a long career as one of North America's top technology journalists. In the last two decades, he has written about consumer technology for dozens of national newspapers, magazines, and websites. His personal technology advice column was syndicated across Canada and today his body of work is published at technologytips.com where more than 50 million unique visitors have read the advice over the last decade.

Andy was also a cohost on the internationally syndicated TV show *Call for Help* with Leo Laporte on G4TechTV as well as writer and host of several spinoff shows.

Super You is his fifth book (he has written four with Pearson Education).

He has also worked with some of the top luminaries in technology publishing. Between 2002 and 2004, Andy was the executive editor of Berkeley-based *Dig_iT* magazine, a publication focused on the digital lifestyle. It was founded by David Bunnell and Fred Davis, the publishing pioneers behind *PC* magazine, *PC World*, *MacUser*, and *MacWorld*.

Walker has a passion for technology literacy. He created the Canadian charity Little Geeks, which gives computers to children and families in need. He is also a recipient of the Queen Elizabeth II's Diamond Jubilee Medal for his work in technology literacy and digital publishing.

Andy was a pioneer in video podcasting with the hit Internet show *Lab Rats*, which he cocreated with *Super You* coauthor Sean Carruthers, and can also be seen and heard regularly across the dial on national radio and television commenting on emerging technology trends.

He has had consulting roles on content and business development projects for Microsoft, Yahoo!, and Canadian Press Enterprises.

Andy was born in the UK, educated and raised in Canada, and now lives in Tampa, Florida, with Kay, his wife and coauthor, and Carter, their first child.

They also run Cyberwalker Digital (Cyberwalker.com), an online marketing agency.

You can reach Andy, and learn more about him and his coauthors at readsuperyou.com.

Kay Walker is a life hacker. She teaches people noninvasive tools—neuroplasticity exercises, emotional IQ skills, and personal development tactics—they can use to access their full potential and overcome their biological limitations that hold them back from living a life they love. She's the creator of AwesomeLifeClub.com, an exclusive club for individuals who want to learn tangible tools they can use to become super performers in all areas of life.

Walker is well known for her advocacy work in the mental health field. She runs a resource site Depression Zone (http://depression.zone) where she provides online support, books, courses, and private coaching services for people suffering from depression.

She's also married to coauthor Andy Walker. It's not the first project the two have collaborated on. They run a digital marketing agency, Cyberwalker Digital (based in Tampa, Florida) where they teach businesses and entrepreneurs how to strategically market their businesses on the Internet.

Though she's well-versed in digital marketing, Kay is the least "techie" of the three authors. She helped refine *Super You* into a book for a mainstream audience. She also brings a female perspective to some of the more gender-specific topics covered in the book, such as designer babies and cosmetic surgery.

Sean Carruthers has been writing, podcasting, and broadcasting about technology for nearly two decades. Sean was a content producer on the G4TechTV programs *The Lab with Leo Laporte*, *Gadgets and Gizmos*, *Torrent*, and *Call For Help*. He was also one of the early pioneers in the world of video podcasting, where he cocreated, cohosted, and edited the long-running technology program *Lab Rats* with coauthor Andy Walker.

He served as the Test Lab Editor for *The Computer Paper* and *HUB: Digital Living* magazine, where he was always up to his eyebrows in the hottest new technology. His writing has been featured in *The Globe and Mail*, the *Village Voice*, allmusic.com, *ITWorld Canada*, and various other technology and music publications. He has also produced audio and video content for various outlets, including CBC Radio's program *Spark*.

Currently, Sean is the manager of the custom video department of The Canadian Press Enterprises Pagemasters North America subsidiary, where he has overseen the production of nearly ten thousand videos.

Dedication

The authors dedicate this book to Carter Devon Walker, the son of authors Andy and Kay, who was birthed, learned to walk, talk, and work a touch screen, in the time it took to write this book. His parents and "Uncle Sean" believe his generation will be the greatest yet.

Acknowledgments

The authors would like to acknowledge the amazing contributions of the following people, without whom this book would not have been possible.

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This book was also a true family affair:

Cornelia Svela: Cornelia is Kay's mom, an amazing artist and illustrator who agreed to provide the amazing illustrations you see in this book. That, plus undying love, support, and enthusiasm. Thanks Cornelia, we love you!

Kris Svela: Kay's talented and hardworking journalist father provided indispensable research for several chapters in this book. He was a champion of the project all the way through. We love you, Kris!

Ian Svela: Ian is Kay's talented brother. He not only provided volumes of research, but is a talented writer, who has an incredible future as as an author himself. He was an irreplaceable resource, who threw himself into weeks of research for this book and helped us through some of the most intensive chapters, even in the lead up to the birth of his second son. Thank you, Ian. You are incredible!

Then there are our publishing mentors:

Rick Kughen: This book came about when our Executive Editor Rick was watching a documentary on body hackers, who put magnets under the flesh of their finger tips. He has an innate ability to spot a great idea and make it into something awesome. He is funny, supportive, and inspired, and we are lucky to count him as both a friend and colleague. Thank you for your hard work, dedication, and inspiration Rick! You made this book what it is, and it wouldn't have been possible without you.

Sam Hiyate: Our literary agent Sam is an extraordinary champion of great writing, great authors, and great books. He is a fierce advocate for book publishing and perhaps the most generous person around with his time in developing young talent. We love and admire you Sam. Thanks for everything you do.

We would be remiss, if we didn't acknowledge the awesome team at Pearson Education including Laura Norman, Lori Lyons, and Ellora Sengupta. They are a talented bunch we are extremely fortunate to have behind us. Our names may be on the front of this book, but there would be no book without their commitment and dedication. Thank you so much team.

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The authors would also like to thank each other for being so awesome. And to you the reader for getting this far down the page. Without you, we're not much use at all.

We Want to Hear from You!

As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

We welcome your comments. You can email or write to let us know what you did or didn't like about this book—as well as what we can do to make our books better.

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8

Hyper Longevity: How to Make Death Obsolete

If you came to this chapter expecting to read the magic 10-step certified Super You process that will help you live a very, very long time, then here it is; although, notice that it's only three steps.

1. Don't get sick.
2. Avoid accidents.
3. Wait.

Easier said than done, right? Don't get sick? That's not a step. But you need to invest effort into avoiding it at all costs because unless something bad happens, such as a Whole Foods truck taking you out as you cross the road to buy a Twinkie, then you can pretty much be sure some nasty disease will end your life at some point. Don't get sick. We'll show you what we know about not getting sick in more detail later in this chapter. We'll then show you how technology (and its accelerating improvement) is going to help you stay healthy. Or cure what ails you.

Step 2 is less controllable. Still, here is the advice, avoid the following: Falling down, guns, cars, poison, suffocation, and water (drowning). Avoid people because they statistically kill the most people, by accident or on purpose. People also kill themselves. It's hard to avoid yourself. But be vigilant with your mental health.

Depressed? Please Read This

If you are depressed and you want to get undepressed, author Kay Walker has built a self-help website to aid people who suffer from severe depression. She uses the latest research and techniques to help people through this devastating and sometimes fatal condition. For more information, visit http://Depression.Zone.

If you are successful with Steps 1 and 2, and most people are because even though people do die of accidents and disease, the average human life span worldwide is 71 (based on 2013 World Health Organization (WHO) data). By the time you read this, it will be pushing toward 75 and in the next decade on its way to 80. Australians live to 83. Canadians live on average longer than Americans. Their life span is on average 82.5 years. The Japanese are the longevity champs at 84.6 years. Average American life expectancy in 2014 was a rather sad 79.59.

Step 3 is "wait." This is deceivingly simple. But we really mean it: Let time go by and stay alive as best you can. Waiting is important because as time goes by, the acceleration of technological improvement will bring new therapies to stave off and eventually mitigate death. We will talk more about this in detail a bit later.

When these handy steps help you live a very long time, you can send us a nice thank you card when you turn 100 or 200 … you'll see.

Table 8.1 shows the top ten things that kill people in the United States.

Table 8.1 Leading Causes of Death in the United States

Rank	Cause
1	Heart disease
2	Cancer
3	Lower respiratory (lung) disease
4	Stroke
5	Unintentional injuries (accidents)
6	Alzheimer's
7	Diabetes
8	Kidney disease
9	Flu and pneumonia
10	Suicide

Source: National Vital Statistics System, United States, 2010.

The History of Aging

Here's the best news of all: Life expectancy rates—the median age of death for most people in a given population—has been consistently increasing since early man dropped out of the trees and moved into subdivisions.

Technology helps increase life span so it is no surprise that the trend in technology is similar to the graph of life expectancy rates.

Let's start as close to the beginning as possible. Research efforts to plot the growth of human life span in early human development have been somewhat daunting.

The passage of time has erased remains of early humans from the prehistoric era. With access to only the fragments of skeletal remains from archaeological digs, scientists are limited by the resources at their disposal to conduct their research.

"Life expectancy rates have been consistently increasing since early man dropped out of the trees and moved into subdivisions."

Until recently, this impeded scientists' ability to uncover the average life expectancy rates of the earliest humans. However, in 2004, anthropology professors Rachel Caspari of Central Michigan University and Sang-Hee Lee of the University of California-Riverside established a revolutionary method of fossil analysis. This allowed them to track the first significant life span shift in the history of mankind.

They use what is called the OY ratio (old to young ratio), which uses bone analysis to measure relative age—instead of the exact age of a person—at the time of death. Using this method, they were able to group bone fragments for the fossilized remains of 768 humans in four regions of the world into categories of "young" and "old."

When the researchers measured the proportion of young to old in each population, they discovered life span rates increased marginally across most of the time periods except one. Humans living 30,000 years ago had an OY ratio five times greater than earlier populations. For the first time, three generations of the same family coexisted, and humans lived long enough to become grandparents. Naturally, this discovery is called the "evolution of grandparents." And the 5 P.M. early bird dinner special was not long behind. (This last bit is speculation, don't write that in your thesis.)

This sudden increase in life span appears to be related to knowledge transferred from earlier generations. Over time, the oldest people transferred the tools they had for survival to the youngest people. Then the youngest people used existing knowledge to improve upon those tools. Eventually, family members could survive long enough so three generations were living at once.

Caspari and Lee identified the impact of knowledge transference on longevity in another study they published in 2006. They reviewed the OY ratios of Upper Paleolithic Europeans to understand whether life span increases in the population were a result of their biology or their culture. They found that life span increased when modern humans arrived in Europe, bringing new knowledge with them.

The earliest information available that verifies the exact ages of humans at death comes from epitaphs of those who died during the Roman Empire. These show an average life span for Romans was 20 to 35 years old. Infectious diseases or infected wounds from accidents or conflicts were the major causes of death. Child mortality was high as well. However, if Romans survived birth, didn't contract a deadly disease, or get skewered with a spear, they could live into their 60s and 70s.

Major killers included cholera, tuberculosis, and smallpox. Plagues such as the bubonic plague in the fourteenth century—also known as the Black Death in Europe—wiped out as many as one-third of Europe's entire population.

Between 1500 and 1800, life expectancy rates rose to between 30 and 40 years. By the 1800s, life expectancy rates had doubled thanks to the Industrial Revolution. Major innovations in manufacturing sparked improved health care, sanitation, access to clean water, and better nutrition. Inventions in transportation, such as the steam engine, also increased the dissemination of knowledge across continents.

Life expectancy rates have improved gradually in the last couple of hundred years or so between 1800 and 2012. There was a small dip from 1918 to 1919, when the influenza outbreak (disease) and World War I (other people) killed large numbers of the population before age could get them. As we said, it's illness that greatly shortens most people's longevity. However, technological innovation in science and medicine is the great tool against illness. For those of you that were around in the 1970s or 1980s, you'll recall (or if you don't, ask someone who does) how people related to cancer and AIDS in those decades. These diseases were once pretty much death sentences if you became ill with them. After a diagnosis, you cleaned up your affairs, told the people around you that you love them, and then sooner or later you succumbed to the disease. There was little medical science could do for you, except perhaps help you to suffer less at the end.

In the nineteenth and early twentieth centuries, there were a series of major health innovations that helped prevent and manage acute and chronic disease. Among them were antibiotics, vaccines, pharmaceuticals, and various medical instruments that advanced treatment capabilities.

At the turn of the twenty-first century, the average global life span was 75. That number is still improving, as has been the long-term trend. As we said earlier, the average American life expectancy in 2014 was 79.59.

And guess what's going to happen to the trend as nanotechnology, stem cell research, robotics, and genetics all continue to progress? Humans will live longer, especially those in developed nations with access to wealth, and of course the technology to spend that wealth on.

The Methuselah Award Goes to…

If you are going to live a very long disease-free life, then it's probably helpful to understand who has done the best job at it. And it would be logical to copy that person's habits, even if that logic is flawed.

Here's a little story. Once upon a time there lived three very different people who lived on three different continents and led three very different lives. They all were named in the Guinness World Records as record holders for longevity.

- **Jeanne Calment**—Let's start with Jeanne Calment, a French woman who lived to 122. Upon her death in 1997, she was referred by the newspaper *Le Monde* this way: "Elle était un peu notre grand-mère à tous," which means, "she was a little bit grandmother to us all." Calment holds the Guinness World Record as the oldest person ever to live. She was born in the south of France and spent her entire life there. She witnessed the building of the Eiffel Tower and met Dutch artist Vincent Van Gogh. Each week, she purportedly ate 2.2 pounds of chocolate paired with a daily glass of port wine. The rest of her diet was rich in olive oil, which she also slathered on her skin in an effort to fight wrinkles.
- **Jiroemon Kimura**—While Calment ate chocolate and drank port, Jiroemon Kimura, from Japan, was restricting his diet. Kimura is the oldest man that ever lived. He died at age 116. Kimura believed in eating small food portions every couple hours. During his life, he witnessed the reign of four emperors and saw 61 Japanese prime ministers hold office.
- **Sarah Knauss**—Then there was American Sarah Knauss. She lived three years more than Kimura, dying at the age of 119 in Pennsylvania. The Ford Model T was introduced while she was growing up. She also lived at the time when the *Titanic* sank in 1912. She was a homemaker and her hobbies included needlepoint and watching golf. Her favorite snacks were milk chocolate truffles, cashews, and potato chips.

So what do all three have in common? They were supercentenarians—people who live to the age of 110 or more.

But besides that, they seemingly have few lifestyle commonalities. For scientists that have studied these long livers, the conclusion is mostly a collective shrug. Nothing about these supercentenarians outwardly suggests any set of strategies that can be copied to produce a longer life in another person.

That said, there has been some significant research in longevity that has produced some interesting results, and this work does suggest actions anyone can take to extend their natural life span.

What We Know About Super Agers

According to the New England Centenarian Study, as of 2014, one person for every 5 million people on the planet will live to 110 or more.

People who live to the age of 100 are called centenarians and their ranks are much more common than they used to be. In 2014, the incidence of centenarians was one for every 5,000 people and that number is steadily growing.

In 1999, data compiled by the United States Census Bureau shows that during the 1990s, the number of American centenarians nearly doubled: 37,000 at the beginning of the decade and 70,000 by the end.

Then there are the predictions.

A 2010 edition of *TIME* magazine reported that by 2050 more than 800,000 Americans will live into their second century of life. Remember, at the start of this chapter, we pointed to a long life strategy called: "Step 3." It was "wait." If you can hang on for another 30 years or so, you might be in luck. Compare 800,000 centenarians to data from 2010 when there were only 80,000 centenarians in America. That's a forecasted tenfold improvement.

In 2013, *National Geographic* launched a longevity issue with a baby on the cover and a headline that read "This baby will live to be 120." If that proves to be true, there will be at least 4 million supercentenarians in the United States by 2133.

A more aggressive prediction comes from controversial gerontologist Aubrey de Grey, a world-renowned longevity expert. He is also the chief science officer of the Mountain View, California-based SENS Foundation, a research-focused outreach organization that educates policymakers and the public about how humans can live longer through the "damage-repair" approach to treating age-related disease.

"We are looking at a divide and conquer approach. Dissecting the problem of aging, accumulating (the) damage of old age into sub-problems and addressing those sub-problems individually," de Grey said. "The problem with aging is that so many things go wrong that we can't control and fix them all."

De Grey predicts by 2030 there will be 3 million centenarians worldwide. Based on accelerating technological improvements, he is likely to be right in his forecast, although not everyone agrees with him. A lot of that longevity progress will depend on breakthroughs in heart disease, cancer, and other life-ending diseases. Stem cell and genetic therapies, organ regeneration, and nanotechnologies will drive the trend.

Longevity Research Is Still Young

Humans only began living to the age of 100 in the twentieth century, so the longevity research field is a relatively youthful one. Most of the work has been done in the last two decades. Aubrey de Grey said, "It's only been about the last 10 or 15 years that we have been able to start talk about actual theory of concrete plans for delivering medicine that postpones aging."

The majority of the knowledge about longevity today has been obtained by studying super-agers like Calment, Kimura, and Knauss (see "The Methuselah Award Goes to …" earlier in this chapter). The intention is to find out what these people do that the rest of us don't do that makes them live exceptionally long lives. Researchers study their daily habits to isolate common lifestyle choices.

What they have discovered is that gobbling chocolate and slurping port, taking olive oil baths, or eating potato chips while watching golf isn't the fountain of youth. (But it sounds fun though, doesn't it?) What we do know is that what you eat and how you live your life is certainly a major factor. However, your genetics play a big role in how long you live as well.

Research from the world's largest centenarian study, the New England Centenarian Study, shows the ability for an individual to live a long time is 20 percent to 30 percent attributable to their genetic makeup. The remaining 70 percent to 80 percent relates to what you do regularly to stay healthy.

One of the core fields of study in longevity science is genetics. If scientists can master genetic engineering and bring everyday genetic therapies to the masses—especially to those that have short genetic fuses and have a family history of short livers—then we are starting to unlock the puzzle on a key factor that can extend longevity.

The Kay Walkers of the world don't have to worry much on this genetic front because she has two grandmothers that are still alive at 87 and 90. That suggests Kay has good longevity genes.

The Andy Walkers have it a little tougher. His paternal grandfather died young, in his 20s (as a result of war), and his maternal grandfather is unknown. That said, Andy's father and eldest paternal uncle are mostly healthy in their mid 70s.

In Sean Carruthers' case, it's a wild card situation. His father died of a heart attack/stroke at 60, after fighting hypertension most of his life. His mom on the other hand is a hardy 71 and her mom is 95. Sean's other three grandparents made it to their late 70s or 80s.

Like us, if you want an indicator of your own longevity genetics, look at your grandparents and parents and uncles/aunts and you'll get a sense of what programming is likely nestled in your genes.

One study shows your life span can somewhat correlate to your parents's life span. It has a minimal impact though, and is not a guaranteed indicator of your longevity. It should be factored in with your lifestyle. Disease in your immediate family might be more of an indicator that your longevity fuse is shorter thanks to your genes. But again, no one factor will predict your life span. Twin studies, however, suggest genetics only account for approximately 20 percent to 30 percent of your predictable life span.

You can play against a bad hand dealt to you with two strategies:

- Wait for genetic therapies to adjust for your genetic deficiencies, and
- Adjust your lifestyle to buy time until longevity-extending technologies arrive.

Lifestyle Secrets: Live Long and Prosper

If genes are 20 percent to 30 percent of the longevity equation, then what accounts for the other 70 percent to 80 percent?

Simple. How you live your everyday life.

Your lifestyle significantly affects how long you live. There are some very specific choices you can make that will give you a better shot at a long life than if you are more cavalier about it. It's supposed to be quite simple: eat nutritious food and engage in regular physical activity. These are the basic health rules most medical professionals advise today (and most of us ignore). To a certain extent these ring true from the research that has been done, though drinking diet "anything" and getting your exercise from video games, doesn't appear to be the solution to a hyper-long life. Jane Fonda aerobics and fruit smoothies aren't either, at least not according to the longevity doctors.

Most of the common sense rules (that are backed up by longevity science) we list here are generally intuitive, although you might find a few surprising:

- Eat less of everything
- Eat nutritiously and consume less animal protein and more beans
- Avoid obesity
- Live with purpose
- Live in a supportive community
- Stay married
- Drink wine in moderation
- Stay active
- Manage your stress
- Don't smoke or abuse drugs, including alcohol
- Buy lots of books by Kay Walker, Sean Carruthers, and Andy Walker

Although this is by no means a complete and definitive list, it is a general snapshot of what scientists know about lifestyle choices that extend longevity. All except

buying our books. That one will just keep you entertained, and it helps us pay for our fleet of yachts.

Longevity scientists have gleaned a lot from their research in the last couple of decades, which extensively includes the study of centenarians. Following is a look at some of the more significant research done on Super Agers.

Centenarian Studies

Longevity research that has studied centenarians and supercentenarians has led to some major findings that support our list of tips for longevity (see the previous section). In the next section, we've summarized some of the most prominent research that has been done to date.

The Blue Zones

It could all start with where you live. In 2004, one of the most extensive longevity studies was conducted by American explorer Dan Buettner in partnership with *National Geographic* and a team of the world's top longevity experts. The premise of the study was to map out areas of the world where the highest concentration of people are living abnormally long and healthy lives, and then, to explore those regions to isolate potential longevity factors. The project identified the following five regions, which Buettner calls the Blue Zones:

- **Icaria, Greece**—This Greek island is home to approximately 8,500 people that enjoy an isolated culture built on tradition. They value family and spend time with the people in the community. They drink wine together, play games, and socialize daily.
- **Loma Linda, California**—A city in Southern California with a big slice of the population that are members of a Protestant sect known as the Seventh-Day Adventists. The religion focuses on principles of healthy living, exercise, vegetarianism, and avoidance of tobacco, alcohol, and illegal drug use. The focus on the California community comes from the concentration of Seventh-Day Adventists, however the lifestyle the religion promotes extends the Blue Zone merits outside that geographic area to include any Seventh-Day Adventist congregation.
- **Sardinia, Italy**—Inhabitants of the highlands of this Mediterranean island hunt, fish, and cultivate most of their own food. While they live a very healthy life, their superior longevity could be related to a genetic marker, M26, that might be a factor linked to long life spans.

- **Okinawa, Japan**—Okinawa has long been a focus of longevity research. It's where the world's longest-living women live. However, men live longer there, too. The Okinawans value community. They work hard with a sense of purpose and eat healthy diets. They exemplify the Power 9, which are longevity-promoting lifestyle choices that Buettner recommends (see the following section entitled "Power 9: The Nine Lifestyle Choices that Promote Longer Life Spans").
- **Nicoya, Costa Rica**—An 80-mile peninsula south of the Nicaraguan border. People who live there have access to water rich in calcium and magnesium. It strengthens their bones and protects them from heart disease.

Why Blue?

When Dan Buettner was asked during a *TED Talk* why he called his famous longevity study the "Blue Zones," he answered it this way: "I wish I had a wonderfully exotic and scientific answer for that but the reality is, was when we were honing in on it in Sardinia, our team of demographers were drawing concentric circles with blue ink on a map and we just started referring to the area inside the smallest circle as the Blue Zone. And the name stuck."

Power 9: The Nine Lifestyle Choices that Promote Longer Life Spans

People in the Blue Zone regions are ten times more likely than the average American to reach the age of 100. When they did a cross-comparison of the five zones, Buettner and his team identified nine reasons for higher rates in life span. Buettner calls them the Power 9. The following nine factors are suggested as essential for a longer than average life:

1. **Move naturally**—A super-ager fitness regime involves daily physical activity that occurs spontaneously. The exercise is incorporated into activities that have to get done.

   Sardinians are a sheep-herding culture. Many of them get their physical activity from their work. Many Okinawans work in agriculture. Their day involves gardening and tending to fields.

2. **Live purposefully**—The French refer to it as "raison d'etre." The Nicoyans call it "plan de vida." In English, it's the "reason for being." People who live long believe there is a reason for their life. They believe they are meant to achieve something. Waking up with this mindset encourages them to take action. It gives them a reason to want to live.

"People who live long believe there is a reason for their life. They believe they are meant to achieve something."

   World-renowned Austrian psychiatrist Viktor Frankl would probably agree. He was a Holocaust survivor who studied the mental health of fellow prisoners in the concentration camps where he was imprisoned during World War II. In 1959, he published a book that established a revolutionary new therapy called logotherapy. It was built on the fundamental principle that people with a life's purpose deal better with difficult life circumstances. He found that religious Holocaust prisoners were more apt to live through difficult times than commit suicide. He asserted it was because they believed they were there for a reason.

3. **De-stress regularly**—The world's longest living people have routines that help them de-stress regularly. This makes sense if you consider what the American Medical Association (AMA) says about stress. It's the number one proxy killer in America and is linked to 60 percent of all human illness and major disease. Stress produces chronic inflammation in the body, which can lead to chronic illness and early death.

   To de-stress, Dr. Mihaly Csikszentmihalyi, Distinguished Professor of Psychology and Management at Claremont Graduate University in California, suggests that people should engage in activities that encourage what he calls "flow." Experiencing flow involves engaging in an activity that encourages a total involvement with life in the moment.

   Here's an example of flow. When a musician learns to play a song, the musician must concentrate on the notes he or she plays. However, once the song is learned, he or she can play without thinking. In a sense, the musician becomes one with the music. This experience of becoming completely entrenched in an activity so thoughts are concentrated on that very activity is "flow."

4. **Don't over-eat**—Blue Zoners stop eating when they are 80 percent full. The Okinawan people have a name for it: "hara hachi bu." Roughly, translated it means "eat until you are eight parts (out of ten) full." Resist the temptation to yell out "HARA HACHI BU!!!!" at the pimply McDonald's cashier the next time you are asked to super-size it.

5. **Eat more beans**—Inhabitants of the Blue Zones eat a lot of beans and plant-based foods. Buettner says that Super Agers only eat meat about five times per month and it is usually pork. And no, that's not a free pass to an all-bacon diet.

   Buettner's diet suggestion is consistent with a 2014 study by Dr. Valter Longo, Professor of Gerontology at the University of Southern Carolina. He suggests that eating too much protein before age 65 can lead to an early death.

   The research study analyzed the diets of 6,831 middle-aged and older adults who responded to a national dietary survey. The findings indicated that people who ate high levels of protein before age 65 died sooner than those who didn't.

   Longo suggests that an unhealthy growth hormone, 1GF-1, is activated in the body when a person eats large amounts of protein.

   However, adults older than 65 with little body fat are encouraged to eat protein to gain weight during a time when their body needs excess fat.

6. **Drink wine**—We didn't make this one up. And yes, we agree, it's a good idea. People living in the Blue Zones provide solid evidence that moderate wine drinking increases life span. It turns out moderate drinkers outlive nondrinkers, especially when they enjoy their drinks with friends.

7. **A sense of belonging**—Attendance at religious gatherings are falling but there might be a reason to start going to church, synagogue, or a mosque again. People who attend religious gatherings (no matter what their denomination) at least four times per month, are more likely to live longer than noncongregants. In fact, Buettner says they might live up to 14 years longer.

   A 2013 study by the Pew Research Center reported that only 37 percent of Americans attend church on a weekly basis. In 2014, 16 percent of the population said that they had no religious affiliation.

   In an interview about his documentary "The Happy Movie," director Roko Belic said that during a visit to Okinawa, he learned the Okinawans see all members of their community as part of their family. They have a strong sense of belonging. He believes this is "one of the cultural traits that relates to why Okinawans are so happy."

   It suggested this sense of incredible community has members with a strong sense of belonging always feel supported and able to take on tragedy easily with the support of others.

8. **Put loved ones first**—Centenarians believe in building a close-knit community. They marry, live close to grandparents and relatives, and bear children. Remember that the next time you plan a convenient business trip on the same week your spouse's parents are coming to town. Drinks with the in-laws equals a longer life.
9. **Get lucky**—Becoming a super ager is ten percent luck. People born into a society that cares about health usually live longer. Their environment teaches them how to be healthy. Good news if you live in Monaco, Macau, or Japan. According to the CIA, those countries are top three for life expectancy rates.

   In 2009, Buettner partnered with the American Association of Retired Persons (AARP) and the United Health Foundation in a pilot project to test the Power 9 on a community: the city of Albert Lea, Minnesota.

   The project involved the enrollment of 20 percent of the city's members, 50 percent of the top 20 employers, and 25 percent of the city's restaurants, schools, and grocery stores. The Power 9 principles were incorporated into day-to-day life. The focus was on building sustainable health initiatives and making it easy for members of the community to make healthy choices.

   After just 1 year, participants added an estimated 2.9 years to their life span and health care claims for city workers dropped 49 percent. Efforts to implement the Power 9 into communities continue. There's more about this at BlueZones.com.

BadAss Centenarians versus the Early-Grave Sprout Eaters

You have heard of healthy people who die young and really old people who eat fried food and chain smoke. Dan Buettner, in his *TED Talk*, had an explanation for these genetic outliers: "To clarify … there's a small percentage of people who could eat bean sprouts and walk every single day and be completely engaged and die of cancer at 50. And there is another end of the spectrum of people who can smoke two packs of cigarettes, drink a fifth of whiskey and live to a 100. They (give) centenarians a bad name. Most of us, 80% of us, are in the middle."

The New England Centenarian Study

The New England Centenarian Study is the oldest, largest, and most prestigious centenarian study in the world. The study was established by the Boston University School of Medicine in 1995.

The premise of the original study was to understand the incidence of Alzheimer's in centenarians living in eight towns in the Boston area. However, initial findings showed that centenarians with Alzheimer's are rare. So, the study's main focus shifted to isolating potential lifestyle and genetic factors that allow a person to live to the age of 100 or more.

When the study began in 1995, the prevalence of centenarians in industrialized regions was 1 per 10,000 people. In the United States specifically, that number has changed to 1 in 6,000, making centenarians the fastest growing segment of the population.

The original group studied consisted of 46 people. Today, the study group has grown to 1,600 centenarians, 500 children of centenarians aged 70 to 80, and 300 younger people. Participants no longer include only people in the Boston area. The expanded group lives around the world. It also includes 107 supercentenarians.

The most current findings from the New England Centenarian Study suggest that there are three lifestyle factors that contribute to longevity.

Centenarians have the following things in common:

1. They are not obese.
2. They don't smoke.
3. They've learned to deal with stress better than most people.

The study also uncovered some genetic findings:

1. Fifty percent of centenarians have more Super Agers in their families.
2. Centenarians have extroverted personalities (results based on personality tests).
3. Centenarian women have had babies after the age of 35 years old.

This study shows that longevity is 70 percent to 80 percent lifestyle and 20 percent to 30 percent genetics. These statistics were gathered from studying twins separated at birth. They compared twins who were brought up in different environments to see how it affected their life spans.

The study also suggests that it is physically possible for all Americans to live to the age of 88 or 89. Researchers discovered this biological capacity by closely examining the Seventh Day Adventists in Loma Linda, California. Members of this group have an average life expectancy rate of 88 (see the Blue Zones section earlier in this chapter if you missed it).

In January 2014, the study published the results of their latest genetic findings. To date, they have isolated a total of 281 genetic markers. These markers are

61 percent accurate in predicting who will live to 100 years old, 73 percent accurate in predicting who will live to 102 years old or older, and 85 percent accurate in predicting who will live to 105 years old or older.

These same genetic markers play roles in many of the genes involved in old age diseases such as Alzheimer's, diabetes, heart disease, cancer, and high blood pressure. They also play a role in the biological mechanisms that create aging in the body.

WHY MEN WHO MARRY YOUNGER WOMEN LIVE LONGER

If you are a man and you want to live longer the answer, it seems, is simple. A study produced by the Max Planck Institute for Demographic Research (Rostock, Germany) claims that men who marry younger women live longer.

Researchers looked at the deaths of the entire population of Denmark between 1990 and 2005. The study showed that Danish men who married women who were 15 to 17 years younger than them lived longer than men with wives who were closer to their age.

There are three hypotheses for the findings:

Natural selection—It is possible that younger women choose healthier, better-maintained older men as their husbands. These men naturally take care of their health so they typically live longer.

Financial wealth—Men with considerably younger wives are often rich. Because of their financial means, these men enjoy a more comfortable lifestyle. Factors such as the ability to afford a healthy lifestyle are possible contributors for a longer life span.

Emotional support—A younger woman will care for a man better than spouses who are older, so he lives longer. A younger spouse might also have a beneficial psychological effect on the older partner. (And, we assert, his libido, too.)

This proves that Groucho Marx was right: "A man's only as old as the woman he feels."

The Longevity Genes Project

The Longevity Genes Project was launched in 1998 by the Albert Einstein College of Medicine (AECM) at Yeshiva University in New York City. The project, led by Dr. Nir Barzilai, Director of AECM's age-related diseases. The project has looked at more than 600 centenarians and their offspring. All the people in the study are

Ashkenazi Jews, a group originally from Eastern Europe, who have been identified as being able to live extraordinarily long and healthy lives. Barzilai also needed a population with the same genetic background to better isolate specific genes.

In 2013, CBS News interviewed Irving Kahn, one of Barzilai's study participants. At the time, Kahn was 107 years old. His brother was 105. His sister lived to 109. And, his son was 69. (Kahn died in 2015 at the age of 109.)

When asked what he saw when he walked past Central Park in New York on his way to school as a young boy, Kahn told CBS News he would see "things you would never see (today) … cows, sheep on the lawn."

The study has revealed that lifestyle has nothing to do with the family's exceptional longevity. (Kahn said his favorite food is "A rare hamburger … and a good cheese.")

Phase 1 of the study produced significant gene-related findings. The analysis of the blood samples of the Ashkenazi centenarians and their children showed high amounts of good cholesterol called HDL. The average amount found in their blood was 80 mg/dL to 250 mg/dL. The normal range for HDL is 35 mg/dL to 65 mg/dL for men and 35 mg/dL to 80 mg/dL for women.

They also discovered three genes that centenarians have that protect their bodies against age-related diseases such as diabetes, cardiovascular disease, and inflammation.

The research produced by the study is going into the development of drugs that will help people deal with age-related diseases. Barzilai says the future lies in developing drugs that could give everyone the same advantage that Super Agers have.

Strategies for a Longer Life

There are other strategies that can affect how long you live. An obvious behavior is watching your calorie intake. Another strategy that has been touted all over the Internet is drinking red wine—in moderation, of course.

Calorie Restriction

One actionable strategy that appears to extend human life is perhaps not that appealing for cultures that like to eat a lot. It's certainly not compatible with the Super-Size Me America we live in today. The technique is to eat 30 percent less than you might normally eat. Calorie restriction (CR) as a strategy to live longer has been around for more than 500 years.

Luigi Cornaro, a fifteenth century Venetian nobleman, is the first person who increased his life span by eating fewer calories. He ate 350 calories and drank

414 milliliters (about half a bottle) of wine per day, and he lived to 102. Before he died, he published a book about calorie-restrictive eating called *Discourses on the Temperate Life*. There was not much evidence to back his theory until the twentieth century when studies with mice popularized the idea of eating less to live longer.

In 1934, Clive McCay and Mary Crowell, two nutritionists from Cornell University, published a breakthrough study that found mice fed a calorie-restrictive diet almost doubled the typical life span for their species. The same findings were reproduced in similar studies in the 1980s by two notable longevity researchers, Richard Weindruch and Roy Walford.

Walford used the results of the study to formulate a calorie-restrictive diet that he sold to humans (because mice can't read). He called it "The 120 Year Diet." And he outlined the process in a book by the same name, which he published in 1986.

A calorie-restrictive diet is simple. It suggests eating about 30 percent less calories than nutritionally advised. That would mean if the recommended daily minimum for an adult male is 2,500, Walford's diet would have him eat 1,800 to 2,000 calories per day.

In 2000, Walford's follow-up book did better than his first as it contained tangible evidence related to humans that backed his theory. He was involved in a research study, called Biosphere 2, that required eight bioscientists, Walford included, to eat calorie-restrictive diets.

From 1991 to 1993, the participants lived in a three-acre, self-contained greenhouse in the Arizona desert. The intention was to test the survivability of a small group of people in a man-made colony for a long period of time. The group was forced to live on only what they could grow, and naturally, their diets were limited to approximately 1,500 calories a day.

When they left the biosphere, lab tests showed dramatic health improvements. Their glucose and insulin levels were down, their body fat was reduced, and the process of cell loss had slowed. This gave Walford credibility.

Unfortunately, he died in 2004 at the age of 79. (And, let's face it, it's hard to be a credible longevity doctor if you don't live a long time.) In all fairness he had suffered from the brain disease ALS (amyotrophic lateral sclerosis, also known as Lou Gehrig's disease) and it's likely that this caused his premature death. A later ALS research study that used mice found that calorie-restrictive eating might provoke an early death in ALS patients. The irony.

Many people still eat calorie-restrictive diets today. This way of eating involves calculating calories before consuming food. Calorie-restrictive eaters also avoid using extreme heat cooking methods. No frying, grilling, roasting, barbecuing, or smoking food. (We can't imagine there are many CR diet proponents in the

Southeast.) Heating food introduces harmful compounds into the food, called advanced glycation end products (AGEs). This occurs when carbohydrates and proteins combine without any enzymes. When glucose in carbohydrates combines with protein, cells go stiff. It's been suggested this process leads to cellular damage and premature aging. Eating raw and unprocessed foods helps calorie-restrictive eaters avoid AGEs.

TheCalorist.com is a site dedicated to teaching people today how to live the CR way. In 2012, its founder, Joe Cordell, was featured on *The Oprah Winfrey Show* when he was 51. He was described by medical professionals at the time to have the body of a 20-year-old athlete.

Cordell told Oprah the whole idea of calorie restrictive eating is "about getting the most nutrients per calorie." For breakfast he'd eat the peel of an apple, for its nutrients, mixed with berries and walnuts that he weighed. Lunch was a giant family-sized bowl of salad, and dinner was something similar.

A Day in the Life of a Calorie Restriction Eater

Breakfast—A glass of freshly squeezed juice with a bowl of homemade cereal topped with a banana.

Mid-morning snack—A protein shake and a handful of dried fruit

Lunch—Steamed vegetables

Dinner—A vegetarian dish, such as steamed fish with homemade tomato sauce

Cordell's site shares references to positive research studies and quotes from qualified experts that reinforce the benefits of calorie-restrictive eating. However, recent findings conclude that it is doubtful that calorie-restrictive diets are an effective life-extending strategy.

In 2012, *TIME* magazine published an article with this headline: "Want to Live longer? Don't Try Calorie Restriction." The article referenced two calorie-restriction studies with conflicting results done on the rhesus macaque, a small monkey.

The Wisconsin National Primate Research Centre (WNPRC) in Madison published the results of a 20-year study in 2009. It reported that monkeys fed calorie-restrictive diets had lower rates of diabetes, cancer, heart disease and brain disease. It also found that a lower number of monkeys on calorie-restrictive diets died from nonage-related causes. It found 13 percent of the CR diet monkeys died from age-related causes compared to 37 percent of monkeys in a control group that were not fed a restricted diet.

This all sounded pretty good, until the National Institute of Aging (NIA) published its conflicting results three years later. That research involved a 25-year study that followed a very similar format to the WNPRC. However, the NIA concluded that genetics and dietary composition matters more than calorie restriction for prolonging life.

When both studies were examined more closely, the qualifying difference was the quality of food both groups of monkeys were fed. The WNPRC monkeys were fed an unhealthy diet, high in sucrose (table sugar). And their calorie-restricted monkeys ate less of the bad food.

The NIA fed their monkeys food composed of fish oils and antioxidants. Monkeys in the NIA control group were also fed fixed amounts of food versus the WNPRC monkeys in the control group who ate what they wanted when they wanted.

NIA's research produced no connection between calorie restriction and health. They suggest that genetics could be more important than diet.

The debate continued and in 2014 a further examination produced different results. Because the WNPRC monkeys were allowed to eat all the food they wanted, they naturally had a higher body weight than the NIA monkeys who lived longer. Monkeys that ate what they wanted had a three-fold higher risk of death. This means that calorie restriction can still make a difference in increasing life span.

A heaping bowl of lactalbumin, please

The difference in the two conflicting CR research studies was as follows: The NIA diet contained protein and fat from natural ingredients including wheat, corn, soybean, and fish. The WNPRC study used a purified diet with a single protein source (lactalbumin) and fat derived mainly from corn oil. The WNPRC food also contained much more sugar.

The NIA and WNPRC might collaborate in a further study in an effort to fully understand why such different results were generated and to get closer to accurate, measurable results. Until then, calorie restriction might be a strategy to consider. The lesson: Eat less, but ensure it is a high-quality diet. So put that chocolate bar down and go eat half a kale sandwich.

Red Wine and Resveratrol

If you are unwilling to restrict your diet (or are dubious that it will work), you might want to simply drink more wine. Well, kind of. You'd have to drink a lot of red wine to reap its longevity benefits. Hooray!

"If you are unwilling to restrict your diet (or are dubious that it will work), you might want to simply drink more wine."

The health benefits of red wine come from a compound called resveratrol, which is found in grape skin. It is as you might guess a key component of red wine. Sorry white wine and liquor drinkers, your beverages don't contain resveratrol. But take heart, resveratrol is also found in peanuts (and peanut butter), dark chocolate, and blueberries, as well as, you guessed it, red skinned grapes.

Red wine contains at most 12.59 milligrams of resveratrol per liter, so to get 500 milligrams daily, you'd need to drink almost 40 liters daily (that's about 53 bottles).

It was first isolated by Japanese researcher Michio Takaoka in 1939. Newer contemporary research confirms the theory that resveratrol can promote longer cell life by stimulating the cellular proteins known as sirtuins.

Dr. David Sinclair of Harvard Medical School originally discovered resveratrol's effect on sirtuins in 2003. (Sirtuins are proteins that regulate biological processes linked to aging.) He and his team recently discovered that resveratrol appears to help increase the activity of mitochondria, which produces energy within cells, which extend the cell's lives.

In scientific circles, resveratrol is what's known as a synthetic Sirtuin-activating compound (STAC). This means that it can be removed from its originating source (grapes, peanuts, or berries) and made into pills. When it's ingested, resveratrol activates a specific gene linked to longevity called SIRT1.

In a 2013 *TED Talk* for *TEDMED*, Sinclair recalled the initial study. "I thought the mice would die. Resveratrol wasn't known to be safe in those days. But, what happened was really surprising. The mice fed resveratrol stayed healthy and had the physiology of a lean mouse."

Sinclair discovered that mice put on regular fatty diets and fed resveratrol were as healthy as mice that were fed a lean diet.

A follow up study, conducted in Switzerland, fed resveratrol to mice who became unusually healthy. The resveratrol-fed mice could run faster and for a longer time than a control group and became a breed of high achievers.

"Resveratrol could be a modern day fountain of youth."

Some suggest resveratrol could be a modern day fountain of youth. In 2008, pharmaceutical company GlaxoSmith paid $720 million to acquire Sirtris, a research company co-owned by Sinclair. The company intended to use his research to develop new drugs that act on sirtuins. In 2013, initial drug trials were successful so they moved the entire operation to Philadelphia. Research continues today.

Sinclair is still studying the sirtuin genes. When we asked him what he does to stay young, he told us, "I take resveratrol."

We Want to Live Forever, Too

After interviewing David Sinclair, Super You authors Kay Walker and Andy Walker started taking daily resveratrol supplements in capsule form every day. They take a daily dose in pill form of 1,000 milligrams. Just to be sure, Kay also supplements her resveratrol intake with plenty of red wine.

Current Bodies of Research in Longevity

Longevity is a complicated field of scientific study because there is no single cause of aging. Sinclair said, "Our body functions better when we are young and better when we exercise and diet. Conversely, when we get old and more sedentary these genetic pathways are turned down and their ability to protect the body diminishes."

He went on to explain there are four major areas of genetics currently being researched linked to longevity. They are:

1. Sirtuin genes
2. The mTor pathway
3. The AMPK pathway
4. Insulin signaling

The following is a brief discussion of each of the four major areas of genetics, as well as the latest research pointing to a link in extending longevity. None of the genetic research has been applied to humans yet. All are still at an early stage of testing, which is why you'll notice the studies only involve laboratory mice.

Sirtuin Studies

Sirtuins are proteins that regulate biological processes linked to aging. There are seven sirtuin genes and they're found in different parts of the cells in the human body. Their functions include regulation of cell death as well as repair, insulin secretion, metabolic processes, and gene expression. Sinclair called sirtuins "protectors of cell health."

The term Sir2 genes is used interchangeably with sirtuin. The name "Sir2" comes from the initial discovery of this group of genes. In the mid-1990s, the Sir2 gene was discovered by Dr. Leonard P. Guarente, a biology professor at MIT. His team (which included Dr. Sinclair, a graduate student at the time) was studying yeast cells to isolate potential longevity genes.

Guarente's group split a group of the yeast cells up and removed the Sir2 gene from one of the groups. Both groups were fed a calorie-restricted diet. This stressed the cells and triggered the Sir2 gene. That gene expression halted the production of waste material in the cell, which allowed the cell to work more efficiently and for longer. The yeast cells lived longer than they should have.

Mammals, such as humans, don't have Sir2 or (SIR2), but they do have SIRT1, which works in the same way, protecting cells by suppressing specific genes that when activated produce a malfunction in the cell. It's suggested that this error could lead to Alzheimer's, diabetes, and other genetic conditions.

SIRT1 is the sirtuin we know most about at this point. And as you read earlier, resveratrol targets SIRT1. It is the one substance we know that can activate it. Although, calorie restriction might also activate SIRT1.

The most recent findings with the SIRT1 gene provided breakthrough insights into how it is linked to aging. The research garnered Sinclair a spot on *Time* magazine's list of the top 100 most influential people of the year in 2014.

Sinclair's SIRT1 Breakthrough

For a long time, it was assumed that SIRT1 protected the function of the mitochondria. The mitochondria, as mentioned in Chapter 2, "Baby Science: How to Conceive a Tennis Star and Other Procreative Miracles," is the cell's energy turbine. When they aren't functioning optimally the body's motor functions slow down. This is why seniors move more slowly than 20-year-olds.

Why mitochondria break down over time is still unknown. If you think of the human body as a car, the process of natural wear and tear overtime is quite similar. Parts wear out. Humans happen to have the ability to regenerate themselves to a point (some cells die and are replaced) until aging catches up to them.

However, Sinclair's team discovered that the SIRT1 breakdown does not directly cause mitochondrial breakdown. The process involves a chain of chemical events. SIRT1's role is intermediary.

They discovered that SIRT1 is affected by a chemical called nicotinamide adenine dinucleotide (NAD) that determines whether SIRT1 functions at normal levels.

You Don't Know NAD

NAD is short for nicotinamide adenine dinucleotide. Because your authors are simple minded, we will simply refer to it as NAD henceforth. There will, however, be a test later in this book, and you will be expected to know what NAD means, and be able to spell it correctly.

When SIRT1 is at normal levels it protects the cell from harmful intruders, like a chemical called hypoxia inducible transcription factor (HIF) that destroy the mitochondria. When HIF gets into the cell it causes disruption—much like a drunk at a party.

Think of it like this, SIRT1 is like a bouncer at the door of the nightclub. The SIRT1 bouncer keeps HIF-1 out of the club and protects the mitochondria inside. Think of NAD like a fitness coach in that the fitness coach (NAD) is the determining factor whether SIRT1 will be in shape enough to keep the HIF-1 out of the club.

Normal levels of NAD = Normal levels of SIRT1

When NAD malfunctions, SIRT1 can't do its job to keep HIF-1 out and the intruder attacks the mitochondria, or at least barfs on his new shirt.

Sinclair's team made this connection when they removed the SIRT1 gene from a group of mice, expecting the mice would show signs of aging and mitochondrial dysfunction. However, the researchers found the mitochondrial proteins remained at normal levels. When the research team investigated this further they discovered NAD. Research efforts are now focused on creating NAD-producing compounds that might one day help slow the aging process.

During preliminary trials, a NAD-producing compound was given to a group of mice for one week. When the research team examined the test rodents, their bodies had reverted back to a younger state. In human years, Sinclair said, "This would be like a 60-year-old converting to a 20-year-old in specific areas of the body."

SIRT3 Breakthrough

In 2013, another sirtuin breakthrough was made, this time by a team at the University of California at Berkeley. The research dealt with the SIRT3 gene. It was led by Danica Chen, UC Berkeley Assistant Professor of Nutritional Science and Toxicology.

At the time of the announcement, Chen said, "We already know that sirtuins regulate aging, but our study is the first one demonstrating that sirtuins can reverse aging-associated degeneration." Chen's lab reversed the aging process in a group of mice by manipulating the SIRT3 gene in a two-part process. The SIRT3 gene produces protein that helps blood cells cope with damage that automatically occurs when a cell produces energy.

SIRT6: Helpful, But Not

A team at the University of Chicago is actively researching the SIRT6 gene. Their most current research studies have provided insights into the role of its anti-aging properties and exciting prospects on treating cancer.

One study with transgenic mice showed that by overexpressing the SIRT6 gene in male mice, the mice lived 15 percent longer than normal.

In 2014, a second study with SIRT6 pointed to the gene as a cancer-causing agent. A research team at the university found a higher level of SIRT6 protein in sun-damaged skin cells compared to healthy skin.

To better understand the connection, they removed the SIRT6 from the skin cells of cancer-infected mice. Tumor production in those mice decreased.

Amazing mTOR

Another focus of research in longevity science is the mTOR protein, or mechanistic target of rapamycin. Say that ten times fast!

The protein regulates cell growth in mammals. At the most basic level, the mTOR receives information from a number of growth-related biological processes. Then it makes a decision whether to start or stop the body's growth response.

If this process malfunctions then diseases such as diabetes, obesity, depression, and various cancers might develop. Longevity research suggests that aging processes occur via similar cellular malfunctions. And those malfunctions occur when specific mTOR chemical pathways in the body become hyperactive.

Scientists first learned about mTOR while studying a molecule called rapamycin, back in the 1970s. It is a bacterial component that was first discovered in soil samples on Easter Island (a Polynesian Island in the southeastern Pacific Ocean. It's the site of all those huge stone heads.)

A Molecule-Sized Easter Egg

The indigenous name for Easter Island is Rapa Nui, hence "rapamycin."

The molecule has since been engineered into an FDA-approved drug. Rapamycin is an immunosuppressant, a drug that reduces activity in the immune system. It's been used to treat cancer and prevent transplant rejection. It affects the mTOR protein specifically by binding to it and stop it from performing normal cell-regulation processes. Kind of like how an octopus on your face would stop you from driving.

Methuselah Mice and New MTOR Research

In 2013, Dr. Toren Finkel, Chief of Molecular Medicine from the National Heart, Lung, and Blood Institute, made a breakthrough discovery with the mTOR pathway. Finkel's team bioengineered a group of mice that lived 20 percent longer than

normal. Finkel's mice lived to 28 to 31 months-old. Their average mice counterparts only lived 22 to 26 months.

The difference between Finkel's "Methuselah Mice" and normal mice was a scaled-back mTOR gene. Finkel's mice had a mTOR gene that had been cranked back to a quarter of its normal operating level using rapamycin.

Finkel's mice had better balance and memory and also had improved organ function. However, they also had a greater loss of bone mass and more infection. It took them longer to age, but they weren't healthy. This is due to an aging process that is not uniform. Aging occurs at various speeds in different parts of the body. When the study was published in 2013, Finkel told the *Scientist* magazine that he's interested in learning how mTOR reduction affects aging cells. "Perhaps cells get rid of cellular garbage at a faster rate. That's our best guess. But it's a complete guess," he said.

Insulin Signaling (Long Live the Worms)

When a species of worms lived to double their normal life span it piqued the interest of Tom Johnson and David Friedman, two scientists at the University of California at Irvine, who made a breakthrough discovery in 1988. The team identified two gene mutations (daf-2 and age-1) that contributed to the worm's longevity.

More importantly, later research connected these genes to a pathway in both worms and humans called the insulin signaling pathway. Scientists are actively studying this pathway as a potential major player in longevity in humans.

The insulin signaling pathway is triggered by the hormone insulin when it's released from the pancreas in the normal process of sugar metabolization that occurs in a healthy human. The release of insulin causes a number of chemical processes to be sent into motion that affect the body's metabolism.

Insulin regulates the body's ability to absorb sugar (glucose) that enters the bloodstream through food. During the process of digestion, insulin facilitates the body's ability to absorb sugar. It allows sugar from the blood to be distributed to the skeletal muscles and fat tissue. That sugar is used for energy.

Restricting food intake by means such as calorie restriction affected the insulin signaling pathway of the worms that Johnson and Friedman were studying. When food was abundant the worms developed normally. When food was unavailable or the worms were overcrowded, they entered a long-lived larval state called dauer in which the aging process slowed down. Worms with this muted gene are also resistant to oxidative stress, along with environmental and bacterial pathogens.

The Curious Case of Laron's Syndrome

An unusual group of people with a rare disease called Laron's syndrome also connect the insulin signaling pathway to longevity. The disease impairs an important growth hormone affecting their ability to grow to normal adult height. Individuals with Laron's syndrome are easily identified by their characteristic dwarfish appearance. However, their short stature is a bit of a trade-off if you consider the mutation they all have blocks life-threatening diseases such as diabetes and cancer.

Dr. Jaime Guevara-Aguirre, an Ecuadorean physician, has been studying Laron's syndrome patients since the mid 1980s. He found the incidence of Laron's syndrome was most common in remote villages in southern Ecuador, which were populated by descendants of conversos (Sephardic Jews from Spain and Portugal). In 1994, he learned that people with Laron's syndrome were curiously immune to cancer and diabetes.

Dr. Valter D. Longo, of the University of Southern California, discovered that IGF-1, a hormone that makes normal children grow, was not present in Laron's syndrome patients. He also learned that the process of IGF-1 creation in the body is directly associated to the GH receptor gene. To test his theory, he gave doses of IGF-1 to prepubescent Laron's patients and found they grew to almost normal height.

Longo took a look at a laboratory roundworm that like humans, has what is known as the IGF-1 pathway. He found that knocking out a receptor known as DAF-2 (which basically makes IGF-1 work) allowed the worms to live longer.

And, like the DAF-2-less worms, Laron's patients lack a normally functioning IGF-1 pathway. This is another possible reason for why they live longer.

In 2011, Longo and Guevara-Aguirre put their heads together. They took a genetically compounded serum from Laron's patients and added it to human cells in a petri dish.

There were two key findings:

- The cells were protected from genetic damage when the serum was added.
- Any cells that were already damaged were destroyed. This mechanism is used by the body to stop the spread of cancerous cells.

When IGF-1 was added to the petri dish both the effects noted above were reversed. The scientists suggest that lowering the level of IGF-1 could be beneficial. A drug that does this could prolong life span.

AMPK, the Cellular Housekeeper

Let's talk a bit about the adenosine monophosphate-activated protein kinase pathway. But, er, best we call it AMPK because otherwise this book is going to be much longer than it needs to be.

The AMPK pathway, similar to the mTOR pathway, is a regulator. It's a master switch that handles metabolic change and protects cells by blocking unhealthy intruders.

Humans have the AMPK gene but in most people it's turned off. However, it can be activated with drugs, diet, and exercise. When it gets turned on, it regulates the release of a molecule that allows cells to transfer energy. Simply put, it's really good at cellular housekeeping and helps cells survive stress.

The good news is there is a drug on the market called Metformin that turns the AMPK pathway on. Metformin was invented in 1922 and has been in use since the 1950s to treat type 2 diabetes. The drug got some flak for a long list of side effects. But multiple studies proved it could decrease the incidence of cancer, heart disease, and even better, it can reverse aging.

Andy's Off-Label Experiment

Inspired by news of Metformin's magical properties, author Andy started taking it daily for its off-label longevity-enhancing properties. He got his doctor to approve its use and discovered with a prescription in hand the drug was easily accessible from his local pharmacy for free. It's true that it can have some unpleasant side effects, including diarrhea and occasional dizziness, but you can eliminate them by managing doses and the time when you take the pill. We offer a free step-by-step guide to buyers of this book at http://ReadSuperYou.com/metformin

Long Live the Fruit Flies

In 2014, UCLA announced a successful study using AMPK to increase the life span of fruit flies. A team of UCLA biologists took a group of 10,000 fruit flies and fed them Metformin to activate AMPK. The flies with the AMPK gene lived eight weeks. Flies in the control group lived the usual six weeks. The AMPK flies were also healthier for a longer time.

Living Forever: The Research of Dr. Aubrey de Grey

One of the people who is all for the therapies being developed in the previous pages by scientists such as David Sinclair is longevity researcher Aubrey de Grey. He is a theoretician of gerontology and chief officer of the SENS Foundation which was

founded in 2009. It actively studies how to preventing age-related physical and cognitive decline.

"The work that David is doing and the approach we are doing at the SENS Foundation should be pursued full-tilt," he said.

The two approaches are complementary. On one hand the "simple" therapies will keep you alive long enough to benefit from the more-complicated approaches studied by the SENS Foundation.

The two work hand in hand. "David (Sinclair) is looking at magic bullets, single interventions that have global impacts on the whole of aging. The SENS Foundation is looking at a divide and conquer approach to solving the problem of aging," said de Grey.

The aging process is a series of degradations, so solving one issue won't solve the entire problem. de Grey said, "The SENS approach is the sweet spot between stopping damage that occurs in the first place versus fixing the diseases and disabilities that result from old age."

"There are seven problems targeted by the SENS Foundation research," said de Grey. Here are the causes of aging and their proposed solutions:

1. **Cell atrophy**—Cell death that occurs naturally in the heart and the brain as the body ages. Suggested solution: Stem cells can be added to the body to replenish parts of the system.
2. **Unwanted cells**—The body contains unwanted cells, like fat cells that "poison" the body overtime. Suggested solution: A procedure called "suicide gene therapy" could be tried. Suicide gene therapy involves the injection of a viral or bacterial gene into the body causing unwanted cells to destroy themselves.
3. **Protein cross links**—The loss of elasticity that occurs when protein links—components that hold together cells—are overproduced. Suggested solution: Drugs that counteract this process could be created.
4. **Internal cellular garbage**—Cells are in a constant state of action, breaking down proteins and molecules that do not serve the body. Molecules that can't be digested become "junk" inside the cells. Suggested solution: Enzymes that break down this "junk" could be developed.
5. **External cellular garbage**—"Junk" accumulates on the outside of cells. Suggested solution: Development of enzymes to break down this "junk."
6. **Mitochondrial damage**—Damage over time to the power supplier in cells slows energy production. Suggested solution: Gene therapies could repair and prevent this damage.

7. **Chromosomal mutations**—Mutations to DNA components cause diseases like cancer. Suggested solution: The regular replenishment of cells via stem cell therapy could help.

The Secret to Longevity

So what does Aubrey de Grey do to extend his own life? "I don't accept invitations to speak at seminars in dangerous countries," he said. "I am well built, I eat, drink what I like and nothing happens. Every few years I have a check up and I always end up doing really well in terms of my biological age: that is, younger that I am. I am lucky that way. The only real generalization is to pay attention to your body, to just understand everyone is different, and what you need to do is work with what your body is telling you it needs."

De Grey proposes that in 25 to 30 years we will have the technology to solve aging. "However," he cautioned, "one big unknown in terms of time prediction is not just science, but feedback from the public." The process to approve new therapies involves the development of the technology and then the social, legal, or political policy to allow the technology to be used.

The second issue that could slow progress is the lack of funding. De Grey said, "The world's best people working on these projects are hot to trot but they are working much more slowly than they could due to limitations on funds. As far as I am concerned, if we had the money, we would be done. When I say 'the money' I am talking a ridiculously small amount of money. At the moment the key work that needs to be prioritized the most is the work at the earliest stage of development. That is, at the stage of cell culture and experiments with mice as opposed to clinical trials. That means, much cheaper."

"Right now SENS has a budget of about $4 to $5 million per year," said De Grey, adding that there is another $10 million being spent by other similar organizations studying the same things.

"That is unbelievably tiny. We probably only have to multiply that by ten and we would pretty much be able to do all we wanted to do in the short term," he said.

"In the longer term, 8–10 years from now, we will want to be doing more clinical trials, which will be more expensive. But, that kind of doesn't bother me because it seems to me that the achievement of specific results in the lab with mice to motivate clinical trials from a scientific perspective was going to be ample to also motivate the funding of those trials," he concluded.

Once this is demonstrated, he believes that acquiring the funding will be trivial because the work and results will garner the interest and enthusiasm of the public and policy makers.

Incidentally, de Grey believes he will live forever, but just in case he doesn't, as a precaution, he has personally invested in a specific type of cryonic preservation known as neuropreservation. During this procedure the head is removed from a deceased person and frozen to protect the face and brain. When the specimen is revived years later it is attached to a new body.

Cryonics: Freeze Me When I Die So I Can Live Forever

In the 1992 film, *Forever Young*, Mel Gibson plays a pilot who dies in 1939, is cryonically frozen by his best friend, and wakes up in 1992. And it's not just a Hollywood invention—cryonics is real. People can choose to become life-sized popsicles when they die with the promise of being brought back to life when mankind figures out how to revive them and nano-repair their disease or damaged bodies and then—ZAP!—bring them back to life.

Actually, we shouldn't use the word "frozen." The correct term is vitrified, which is to be cooled to a glassine state at a temperature of −140°C (−220°F). To set it all up, you join a cryonics non-profit (there are four in the world) and pay an annual membership while you are alive. You provide a cash allocation that can be funded by a life insurance policy, before you die, which goes to the cryopreservation company.

On your death, the cryo company sends in a team to cool you, package you, and ship you to a facility where you are cryopreserved in liquid nitrogen until the technology is available to bring you back in 100 or so years. (Or maybe sooner.)

We are going to oversimplify this here, but it helps to understand the process by thinking of the food in your freezer. Consider a bunch of peppers that are on the verge of the compost bin. Chop the veggies up, throw them in a freezer bag, and weeks later they will still make a pretty good pizza topping.

Unlike freezing vegetables, the cryopreservation process is used to freeze a recently deceased person into a glassine state. The key here is to first remove all water from their body and then freeze them in liquid nitrogen. The problem with freezing someone in water is that ice crystals pierce the cell walls. A defrosted frozen pepper is never as vibrant and crunchy as its prefrozen self.

This is why the cryonics process is carefully done slowly and without water to preserve the structure of your cells, and actually most importantly the structure of your brain cells. If you die and are preserved, it means the structure of all that is

you is still there. The cryonics process halts physical decay and preserves you as you were at the moment of legal death.

Robert Ettinger founded the Cryonics Institute in 1976 in Clinton Township, Michigan. They house 150 patients in cryostasis. A monthly membership fee (usually financed from an annuity) pays to house them in cryostasis.

The other well-known cryonics facility is Alcor in Scottsdale, Arizona. As of July 2015, it has another 150 patients in-house who have been cryopreserved. Also, there are facilities in Russia and Switzerland that have a handful of patients. Another facility is being built in Australia and should be opened by 2017.

There are an estimated 300 people in cryostasis in facilities across the United States. Not all have their whole bodies vitrified. Some have opted for preservation of just their heads. This is called *neuropreservation*. The theory is all that is you is encoded in your brain tissue, and in the future you will be able to grow a new body to replace the one that isn't frozen.

One of the most notable patients at Alcor is baseball great Ted Williams, whose head was cryopreserved by his children.

The Costs of Cryo

Costs to be cryopreserved upon your death vary wildly. However, there are three components: 1) An annual membership to the non-profit for between $150 and $700. 2) An allocation to the company of $28,000 for the Cryonics Institute or $200,000 for Alcor. 3) Cost to transport your body to the facility, although Alcor includes transportation in its $200,000 fee. Costs to cryopreserve just your head is $80,000, and is only available at Alcor.

Cryo-Pets, Anyone?

For those of you that haven't been able to get over the loss of a furry family member, there's good news. You can opt to freeze Spot or Fluffy for a future reunion, as well. In the various facilities around the world there are more than 50 pets that have been cryopreserved by their owners.

Get Frosty

Do you find all this cryonics info super interesting? Learn more details in this great blog post: http://superyou.link/getvitrified and http://waitbutwhy.com/2016/03/cryonics.html

Reports of Your Death Are Greatly Exaggerated

So what does Ray Kurzweil say about all this? In a 2013 interview with the *Wall Street Journal*, he said his baby boomer status puts him in the last generation that might have to worry about natural death.

"I'm right on the cusp," he told the newspaper. "I think some of us will make it through." The "us" are the baby-boomer generation that includes Kurzweil. He was born in 1948, making him 65 at the time of the interview. Practical immortality, he believes, might be possible for boomers that can hang on for another 15 years to about age 80.

"By then," the article continues, "Mr. Kurzweil expects medical technology to be adding a year of life expectancy each year. At that point we will be able to outrun our own deaths."

When we spoke to Kurzweil, he pointed to two of his books, which he wrote with Dr. Terry Grossman: *Transcend: Nine Steps to Living Well Forever* (2010) and *Fantastic Voyage: Live Long Enough to Live Forever* (2005).

"We talk about three bridges to radical life extension," he told us.

Transcend spells it out like this:

- **Bridge One**—Bridge One represents the strategies you can use right now to slow down, and in many cases stop, the processes that lead to disease and aging.
- **Bridge Two**—Bridge Two is access to the coming biotechnology revolution. By 2030, "we will have means," say the authors, "to perfect our own biology by fully reprogramming its information processes." Kurzweil said recent developments (in 2014) in technology had launched us into an early Bridge Two phase.
- **Bridge Three**—Bridge Three is the endgame in the longevity strategy, and by end, we don't mean death. Bridge Two adds decades to our lives so that we can blow past traditional life expectancy to access the coming nanotechnology revolution "where we can go beyond the limitations of biology and live indefinitely," says Ray and Terry in their book. That's Bridge Three. And that's when the fun begins.

The rest of the book is a guide to how to set yourself up to live forever and take advantage of Bridge One and Bridge Two technologies.

Extendgame, Not the Endgame

Now you might get the sense that the avant garde thinking among the people we studied and spoke to for this chapter is that death is generally curable. And aging is not only stoppable but reversible. You'd be right.

However, the cynics out there don't believe any of it. Some say it will be hundreds of years before any of this is feasible. Some even say it will never be possible and that Mother Nature will find a way to do in the oldest of us with some virus or other biological process that clears the way for future generations.

If you are onboard with the cynics, go book your casket this weekend and pick out your funeral flowers. If you're not that cynical, here's what there is to do: Stay alive for 15 more years. American life spans on average, as we said earlier, are just shy of 80 years. And that is increasing every year.

"If you are onboard with the cynics, go book your casket this weekend and pick out your funeral flowers."

If you are a baby boomer or younger that should be relatively simple to do. Then by 2030, there should be technologies around to hyper-extend your life long enough for you to be around when nanomedicine and nano-engineering technologies are commercialized such that we can fix all this old person business and become young again.

We'll give the last word here to Kurzweil, who said in his 2006 book *The Singularity is Near*, the following: "We have the means right now to live long enough to live forever. Existing knowledge can be aggressively applied to dramatically slow down aging processes so we can still be in vital health when the more radical life extending therapies from biotechnology and nanotechnology become available. But most baby boomers won't make it because they are unaware of the accelerating aging process in their bodies and the opportunity to intervene."

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